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A Review of Research on Dementia-Friendly Environment for Older Adults

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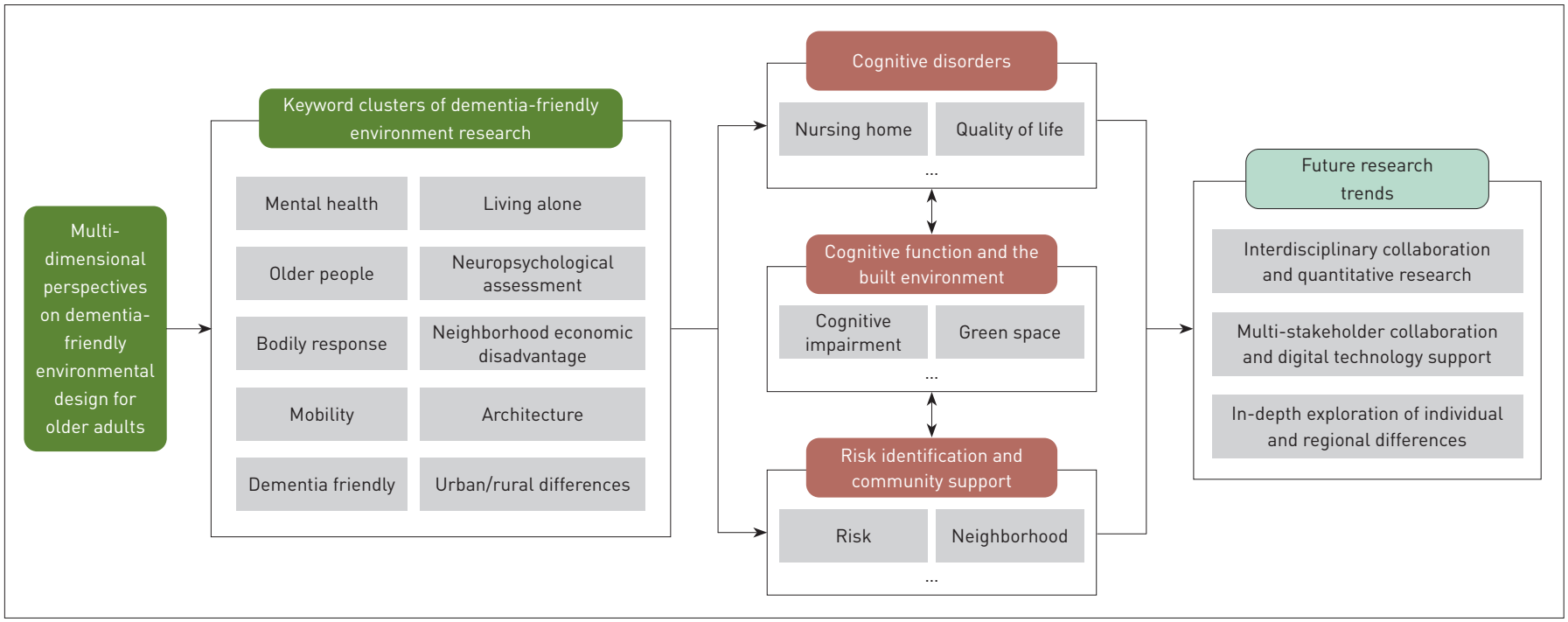
GRAPHICAL ABSTRACT



ABSTRACT

With the global number of people with cognitive impairment continuing to rise, there is an urgent need to create supportive environments that can both improve quality of life and slow the progression of symptoms, as cognitive disorders pose major challenges to public health and care systems. To systematically sort out the research trends and hotspots of dementia-friendly environments, this study combines a systematic literature review with CiteSpace-based knowledge mapping. It systematically retrieved Chinese- and English-language literature published between 2009 and 2024 and finally included 80 articles. The keyword cluster analysis in this field identified ten major hotspots: mental health, living alone, older people, neuropsychological assessment, bodily response, neighborhood economic disadvantage, mobility, architecture, dementia friendly, and urban/rural differences. Over three stages of development, the scholarly focus has shifted from disease and quality of life to the interaction mechanisms between cognitive function and the built environment, and more recently to application-oriented research emphasizing risk identification, accessible design, and community support. On this basis, the paper proposes three key directions for future research:

1) advancing interdisciplinary integration and in-depth application of quantitative research; 2) building intelligent, responsive dementia-friendly environments supported by multi-stakeholder collaboration and digital technologies; and 3) paying closer attention to individual and regional differences to enhance the adaptability and cultural sensitivity of dementia-friendly environmental design. The findings of this systematic review provide theoretical references and practical insights for creating more adaptive, sustainable, and culturally-sensitive dementia-friendly environments.

KEYWORDS

Dementia-Friendly Environment; Environmental Design; Community Support; Digital Intervention; Older Adults; CiteSpace; Interdisciplinary Integration

HIGHLIGHTS

- Employs the CiteSpace knowledge-mapping to trace the development of research on dementia-friendly environments
- Cluster analysis reveals ten key dimensions in the interdisciplinary construction of dementia-friendly environment
- Shows a shift from disease-centered care to function–environment interaction and risk prevention and control
- Dementia-friendly environments evolve from closed, institutionalized care to community-embedded inclusiveness
- Digitalization and multi-stakeholder collaboration as new trend in dementia-friendly environment design

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1 Research Background

Diseases associated with cognitive impairment—particularly Alzheimer's disease—have become a major challenge facing global public health and social care systems[1–4]. As of 2021, approximately 57 million people worldwide were living with cognitive impairment, with more than 60% residing in low- and middle-income countries[5]. Dementia has become one of the leading causes of disability, loss of independence, and reliance on caregiving among older adults worldwide. According to the World Health Organization (WHO), the number of people living with dementia is projected to increase from around 55 million in 2019 to approximately 139 million by 2050[6]. The etiology of dementia is complex and its treatment is difficult; however, incidence may be reduced by addressing modifiable risk factors. For instance, research noted associations between built environments and cognitive function in older adults[7]. Consequently, creating dementia-friendly environments carries significant implications for public health systems as well as for patients and their families.

The concept of "dementia-friendly" refers to environments and initiatives designed to support the daily living, participation, and social inclusion of older adults with cognitive impairment[8–10]. It encompasses not only the accessibility and legibility of physical spaces but also improvements in social awareness, service systems, and community support networks, thereby enhancing the elderly' sense of security, independence, and quality of life[11–12]. Older adults suffering from dementia experience significant cognitive decline, including memory impairment, disorientation, decreased attention, and executive dysfunction. This necessitates more refined and targeted design for dementia-friendly environments, shifting away from deficit-oriented narratives that emphasize burden on families and society, toward one that emphasizes inclusivity[13].

At present, international research has explored environmental design guidelines and the integration of emerging digital technologies[14–15]. However, most existing studies focus on the intervention effects of a single dimension—such as spatial design, care technologies, and social interaction mechanisms. Systematic research that employs a multidimensional framework to analyze pathways and mechanisms of dementia-friendly environmental design remains scarce. To address this gap, this study employs visual knowledge-mapping methods to review the literature on dementia-friendly environmental design, identify research trends and hotspots, and propose a multidimensional analytical framework that may inform more integrated and actionable design interventions in the future.

2 Research Methods

This study conducted a systematic review to comprehensively examine and analyze literature related to dementia-friendly environmental design. Five major databases were selected—Web of Science, Scopus, PubMed, ScienceDirect, and CNKI (China National Knowledge Infrastructure). Literature retrieval was conducted

across keyword categories including “cognitive impairment and dementia,” “care and facilities,” “community and environment,” “space and design,” “design guidelines and concepts,” “emotion and health,” and “landscape and natural environment” (Table 1). Document types were limited to articles, reviews, and dissertations. The search timeframe spanned January 1, 2009 to December 31, 2024. To ensure the quality of selected literature and its relevance to spatial design, the following inclusion criteria were applied: 1) the literature must be in Chinese or English to ensure accurate comprehension and analysis by the research team; 2) the literature must explicitly focus on older adults with dementia or cognitive impairment①, ensuring representativeness; and 3) the literature must involve the effects of spatial environments, design factors, or community environments on the quality of life, cognitive function, or emotional well-being of people with dementia. After screening, a total of 80 publications[13,16–94] were included in the review—27 in Chinese and 53 in English.

3 Cluster Analysis of Research on Dementia-Friendly Environments

3.1 Results of Cluster Analysis

Cluster analysis of the reviewed literature helps reveal common themes and underlying connections among research subjects, enabling inferences about research hotspots and trends in the field (Fig. 1). Using CiteSpace for automatic clustering, 219 nodes

① Whether examining dementia populations as a whole or specifically Alzheimer’s patients, older adults indeed constitute the overwhelming majority. Sporadic cases in other age groups are excluded in this study.

Table 1: Overview of keywords for literature retrieval

Category	Language	Keywords
Cognitive impairment and dementia	Chinese	认知障碍；认知症；失智；阿尔茨海默病（症）；轻度认知障碍；认知功能衰退
	English	Cognitive impairment; dementia; Alzheimer’s disease; mild cognitive impairment; cognitive decline
Care and facilities	Chinese	照料设施；照料中心；养老机构；长期照料设施；社区居家养老；认知症照护设施
	English	Care facility; care center; nursing home; long-term care; residential aged care; dementia support facility
Community and environment	Chinese	认知友好社区；失智包容；住区公共空间；邻里环境
	English	Dementia-friendly community; dementia-inclusive; community public space; neighborhood environment
Space and design	Chinese	空间环境；环境设计；生活空间设计；疗愈景观；寻路；康复花园；街区感营造；空间记忆；视觉障碍
	English	Built environment; environmental design; living space design; healing landscape; wayfinding; healing garden; neighborhood place-making; spatial memory; visual barrier
Design guidelines and concepts	Chinese	设计导则；设计策略；循证设计；以人为中心的照护；友好化设计；设计人类学
	English	Design guideline; design strategy; evidence-based design; person-centered care; user-centered design; design anthropology
Emotion and health	Chinese	情绪效益；情绪健康；生活质量；非药物干预；感官疗法；健康；认知改善
	English	Emotional benefit; emotional well-being; quality of life; non-pharmacological intervention; sensory therapy; well-being; cognitive improvement
Landscape and natural environment	Chinese	景观环境；绿色空间；户外环境；康复花园；公共公园
	English	Landscape; green space; outdoor environment; healing garden; public park

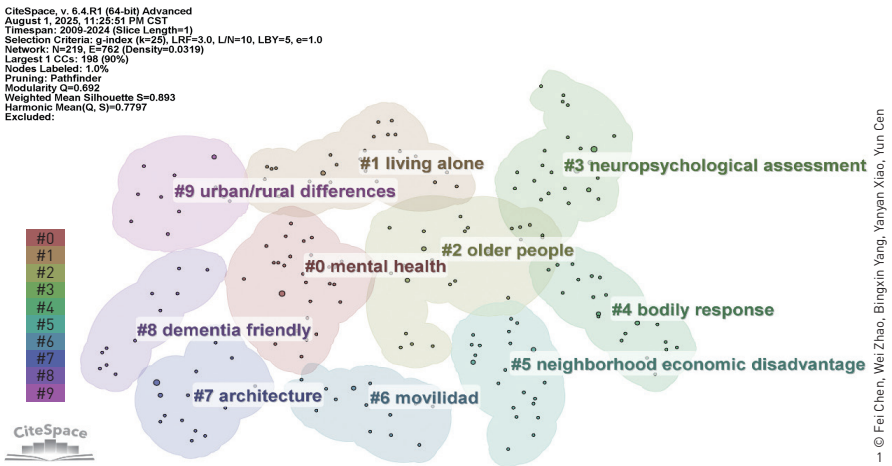

Fig. 1 Keyword clusters of dementia-friendly environment research ("movilidad" is a Spanish term, meaning mobility).

and 762 links were generated, resulting in 10 clearly defined clusters (Q = 0.692 > 0.3; S = 0.893 > 0.7), indicating that the cluster network structure is well-constructed, exhibits high heterogeneity, and yields reliable classification outcomes. The themes of the 10 clusters are: 1) mental health; 2) living alone; 3) older people; 4) neuropsychological assessment; 5) bodily response; 6) neighborhood economic disadvantage; 7) mobility; 8) architecture; 9) dementia friendly; and 10) urban/rural differences. The clustering results indicate that mental health is the core topic within dementia-friendly environment research. The field is progressing along a multi-scalar integrative pathway, ranging from individual health, community environment, and spatial equity, with research hotspots shifting from singular medical concerns toward interdisciplinary, evidence-based practices emphasizing human–environment interaction and age-friendly renewal.

3.2 Commentary on Cluster Contents

3.2.1 Mental Health

The mental health cluster primarily encompasses issues related to the psychological well-being and cognitive decline of older adults, with particular emphasis on the influence of the built environment, natural environment, and social support on mental health. Research topics include risk factors for mental health, the associations between environmental features and cognitive deterioration, and assessments of quality of life. Several studies point out that exposure to green space may contribute to cognitive maintenance of "identity/selfhood," improving late-life cognition, and cognitive protection effects[59,79–80]. Other scholars explore how neighborhood environmental characteristics affect cognitive function[69,71]. Research suggests that dementia gardens can be created through diverse landscaping, soft natural edges, safe and convenient walking paths, and multi-sensory, everyday activity spaces, thereby providing comfort, pleasure, and a sense of security[20]. Other studies indicate that spatial connectivity and layout in dementia care units directly shape residents' movement, emotional well-being, and social interaction; rather than relying on enclosure for safety, a combination of visible and accessible outdoor areas, lingerable corridors, and "communicable" boundaries can promote safety and dignity[73]. Jingwen Lei et al. argued that public activity spaces should be upgraded from "being manageable" to "companionship-oriented," shifting concern from merely meeting basic mental and safety needs toward enabling a "meaningful" and "normalized" life for older adults with dementia[76]. Seiko Goto et al. reported that viewing garden landscapes can significantly lower heart rate and improve behavioral symptoms, thereby benefiting mental health[81]. Hong Chen et al. linked traffic exposure (e.g., air pollution, noise) with cognitive decline and rising incidence of Parkinson's disease and Alzheimer's disease, and found that traffic exposure may negatively affect cognitive health[85]. Overall, this cluster indicates that research on mental health is shifting from a focus on disease and quality of life toward an integrated health framework of environment–psychology–society.

3.2.2 Living Alone

This cluster focuses on the mental health risks and lack of social support faced by older adults who live alone, addressing themes such as loneliness, social isolation, cognitive decline, and their relationship to the environment. Some studies examine dementia-friendly public spaces and community-based support systems[39], while others investigate the links among living environments, living alone status, and cognitive trajectories[45]. For instance, a dementia care center in the Netherlands constructed a virtual "fence" using smart wristbands, intelligent access control, and 3D beacons, enhancing spatial legibility and wayfinding and providing residents with autonomy, activity engagement, and high-quality daily life, which offers valuable insights for dementia-friendly environmental design worldwide[67]. Overall, the living alone cluster highlights the critical role of housing typologies and social support systems in building dementia-friendly environments.

3.3.3 Older People

This cluster includes research across varied national and regional contexts and addresses issues such as quality of life, social support, and community environmental factors. Overall, this cluster

emphasizes systematic demographic analyses of health risks among aging populations[24-25]. For example, Susanne Röhr et al. noted that urban environments hold significant potential for fostering lifestyles that support brain health among community-dwelling older adults, thereby reducing risks of cognitive decline and dementia[33]. Some studies focus on the architectural environment of care institutions and its association with the quality of life of older adults with dementia[40]. Large-scale empirical research examining community settings and cognitive function among older residents found that higher land-use mix can significantly reduce the risk of dementia, whereas an excessive proportion of natural environment is unexpectedly associated with increased risk[91]. Some studies suggested that organizing key spaces (e.g., entrances, living areas) according to familiar spatial sequences may enhance environmental usability for older adults with dementia[35]. Others argued that improving older adults' perceived confidence requires spatial environments with straight paths, few turns, minimal decision points, and visible endpoints/anchors[94]. Fei Lian et al., using the UK as an example, outlined an integrated support system enabling older adults with dementia to age in place within familiar communities, drawing from national/local policies, community and residential design guidelines, and exemplary practice and evaluation systems[77]. Jinghua Dai et al., focusing on the Chinese context, reviewed spatial and operational practices of typical international models from the USA, the Netherlands, Japan, etc., as well as preliminary domestic experiences, to distill design strategies and conceptual models for care environments in elderly care institutions and community-based care in China[90].

3.2.4 Neuropsychological Assessment

This cluster concerns the evaluation and measurement of cognitive function of older adults, including neuropsychological tools, spatial navigation tests, and emerging assessment technologies (e.g., GIS systems, heat-map analysis, accessibility modeling). Some studies systematically compared the performance of older adults with mild cognitive impairment and various types of dementia (especially Alzheimer's disease) on spatial navigation tasks to examine how task context (real/virtual), strategy type (environment-centered/object-centered), and navigation mode (active/passive) affect cognitive discriminability[31]. Other studies explored neuropsychological differences in spatial vision[72,83,93]. Additional research highlighted the impact of environmental factors on cognitive ability—for example, higher urban tree-canopy coverage (rather than simply "total green volume" or "open grassland") is associated with lower dementia incidence[52]—and the influence of road network structure on the risk of wandering among older adults with dementia[58]. With the development of assistive humanoid robots, wearable sensors, and spatial-positioning and monitoring technologies, the feasibility of building intelligent and responsive environments that adapt to the changing needs of older adults with dementia continues to increase[19]. Geke D. S. Ludden et al. integrated environmental-psychology evidence with interactive technologies into care environments, creating meaningful multi-sensory experiences grounded in presence, and pointed out that although cognitive abilities decline with disease progression, the ability of sensory exploration of surroundings and focused "in-the-moment" experiences remain largely intact[68]. Through visuospatial tasks and computerized testing programs, designers can gain deeper insights into the needs of older adults with dementia and adjust design strategies accordingly[83]. In addition, some studies have advanced the discussion of spatial disorientation in dementia-friendly environments from empirical guidelines toward design decisions grounded in psychological and neuroscientific evidence[87]. Overall, this cluster suggests that neuropsychological assessment is increasingly incorporating multimodal data and environmental factors, expanding toward early diagnosis and intervention.

3.2.5 Bodily Response

This cluster focuses on the psychophysiological response mechanisms of older adults with dementia, including the coupling of heart rate, gait, sentiments, and environmental stimuli. Research topics include therapeutic landscapes, physical activities, and physiological-indicator monitoring. Studies examined the role of age-friendly therapeutic landscapes in emotional and physical rehabilitation[37], conducted qualitative investigations on walking experiences among individuals with dementia[88], or employed digital technologies—such as wearable sensors, spatial technologies, robotic assistance, and intelligent monitoring—to develop dementia-friendly environments capable of capturing physiological and behavioral responses and thereby enhancing quality of life[19,34]. A study conducted participatory walking interviews, GPS tracking, and travel-diary documentation with seven older adults with dementia in Canada, and found that they generally felt safe in familiar suburban environments, but their travel range was limited and relied heavily on familiar landmarks for navigation; supportive environmental features included mixed land use, accessible everyday destinations, straight streets, and pedestrian paths, while hindering factors included complex intersections, noisy main roads and parking lots, and inadequate pedestrian-protection facilities[16]. Numerous publications further emphasized the positive effects of

sensory environments and emotional stimuli (e.g., music, garden landscapes) on alleviating emotional symptoms and enhancing subjective well-being[22,53,55]. Overall, existing research in this cluster leverages digital monitoring and sensory interventions, underscoring the importance of psychophysiological coupling and driving the incorporation of digital methods.

3.2.6 Neighborhood Economic Disadvantage

Numerous studies highlighted the importance of community and social environments in dementia-friendly design[17,43,47–49]. This cluster, named according to its economic dimension, emphasizes how inequalities in built environment quality, community functional configuration, and social support networks—essentially the external manifestations and derivative outcomes of economic disparities—affect the mental health and cognitive function of older adults. Some studies revealed the negative impact of social isolation within the community on the mental health of older adults[17], while others examined how walkability, street patterns, neighborhood relations, and social support influence cognitive outcomes[54,56,69–70]. Another large-scale study, based on the UK Medical Research Council Cognitive Function and Ageing Study (CFAS) database, analyzed the effects of community-level built and social environments on cognitive impairment among older adults. It found that community poverty and crime rates were not significantly associated with cognitive impairment; in contrast, older adults in communities with higher land-use diversity (e.g., a mix of residential, commercial, and recreational use) showed a significantly lower risk (approximately a 60% reduction) of cognition-related disorders. This is likely due to the greater cognitive stimuli provided by the increased access to services and social opportunities[91]. Overall, the trend in this cluster reflects a growing convergence between mental-health research and social equity, emphasizing the profound impact of socio-spatial disparities on the health of older adults.

3.2.7 Mobility

The mobility cluster centers on the effects of freedom of movement, travel environments, and accessibility facilities on the mental well-being among older adults. Topics include mobility impairment, gait analysis, and wayfinding design. Some studies addressed mobility support for older adults with dementia in suburban settings[16], noting that their "life space" outside the home tends to shrink, reducing their social participation outside the household[44]. Another study approached the design of dementia care facilities from the perspective of outdoor environment quality and wayfinding friendliness[27]. Jiajing Li et al. identified different types of autonomous behaviors among individuals with dementia and extracted spatial characteristics that support autonomy[41]. Research also integrated multiple intelligent methods—such as maintaining social connections with communication technologies (mobile phones, Skype/WhatsApp), and collecting physiological, behavioral, and cognitive-response data by filming home tours—to develop perception-driven, age-friendly spatial design approaches[54]. Jingwen Lei et al. translated the concept of "everyday activities as design agenda" into actionable spatial language: the clearer and more dominant the path, the richer the multisensory cues and directional landmarks they have, and the more single-corridor layouts are used, the easier it becomes for individuals with dementia to find their way[75]. Other studies expand the design of dementia-friendly environments beyond safety and medical considerations to incorporate quality of life propositions in behavioral, social, and emotional aspects[84]. Virtual environments can also function as cognitive-training tools, helping individuals with dementia retain daily-living skills and exercise spatial memory, thus holding dual significance for rehabilitation and intervention[86]. Overall, this cluster underscores mobility as a critical factor in promoting social participation and sustaining independence among older adults with dementia.

3.2.8 Architecture

Architecture constitutes the largest cluster, covering care facilities, long-term care institutions, therapeutic gardens, and public spaces in residential environments. Overall, this cluster demonstrates that environmental and spatial design represents a major application field within research on mental health among older adults[23,26,28,32,36,57,78,82]. Numerous studies examined spatial optimization and user-centered design[21–22,62–66], design guidelines and empirical evaluations for long-term care environments[50,89,92,94], tools and standards for dementia-friendly environmental design from the perspective of caregiving families[18], and the association between visuospatial functional impairment and the subtype diagnosis of cognitive disorders[72,83,93]. Jiajing Li and Qiuyun Huang, drawing on 12 cases from the USA, summarized the scale and spatial layout characteristics of dementia therapeutic gardens[42]. Another study investigated how architectural design affects spatial orientation and wayfinding abilities among dementia patients, finding that simple and clear circulation layouts with limited yet prominent reference points can significantly improve the independent wayfinding ability of individuals with moderate to severe cognitive impairment[94].

3.2.9 Dementia Friendly

This cluster centers on the concept and practice of dementia-friendliness, covering themes such as social inclusion, community design, and the advancement of related concepts and policies. The research focuses on public-space and landscape environments within communities[29,38], as well as the documentation and evaluation of dementia-friendly initiatives and community-based practices[13,30,43]. Fei Lian and Hui Li categorized dementia-friendly community environments into three levels: macro-, meso-, and micro. The macro-level includes land-use composition, land-use patterns, and street networks; the meso-level includes street forms, architectural features, green spaces, landmarks, and signage; and the micro-level consists of environmental elements such as shape, color, light and shadow, and texture[29]. Paul A. Rodgers argued that co-creative design can transforms older adults with dementia from passive recipients of care into socially engaged collaborators with income, visibility, and dignity[46]. Jie Yang constructed a framework of therapeutic needs–weighting–evidence–strategy, and proposed eight principles for designing dementia-care environments[51]. Other research pointed out that easy-to-navigate spaces with recognizable features and visible and accessible outdoor landscapes can significantly enhance independence and navigation of dementia individuals, thereby increasing the dementia-friendliness of the environment[60]. Additional research highlights spatial needs of older adults with dementia such as organizing indoor–outdoor environments with clear orientation cues and legible pathways, convenient access to outdoor gardens, as well as quiet recreational and social spaces[61]. Overall, this cluster demonstrates the global dissemination of dementia-friendly concept, and its close integration with social policy and community renewal.

3.2.10 Urban/rural Differences

This cluster focuses on mental-health issues of older adults in the context of urban–rural disparities, examining differences in facility distribution, social equity, and their relationship to cognitive health. Representative studies include a comparison of aging-care facility systems in Chinese and Japanese cities[74], and analyses of the relationship between cognitive function of older adults and their living community environments in the UK—including objective indicators derived from publicly available government data, such as area-level poverty, land-use mix, proportion of natural environment, and crime rate[91]. Research examining the influence of China's urban–rural differences on cognitive decline revealed that older adults living in communities with better accessibility features, more public transport lines, improved employment services, and higher socioeconomic status experience slower cognitive decline; road conditions, infrastructure, and levels of social participation strongly correlate with baseline cognitive function[71]. The study further emphasized that improving infrastructure and social resources in rural communities is essential for slowing cognitive decline, and highlighted that vulnerable groups are more dependent on community resources—thus rural areas should be prioritized in policy interventions. Other research explored the relationship between community social environment and dementia risk and analyzed the mediating effect of social isolation[17]. It found that older adults living in socioeconomically deprived neighborhoods and disordered areas (e.g., environmental decay, garbage accumulation, high crime) face significantly higher dementia risks (increased by 18% and 27%, respectively), whereas low social cohesion did not show a significant effect. Overall, this cluster indicates that urban–rural disparities affect not only facility provision and resource allocation but also directly shape the impact of social equity on the mental health of older adults.

3.3 Summary

The cluster analysis results reveal the multidimensional structure and interdisciplinary trend of research on dementia-friendly environments. The ten identified clusters encompass not only individual health issues within the realms of medicine and psychology (such as mental health, cognitive function assessment, and psychophysiological responses) but also broader sociospatial-level topics (including living-alone older adults, neighborhood socioeconomic disparities, mobility, and urban/rural differences), while involving domains of spatial and environmental practice (such as architectural design and community development). Overall, the research focus has shifted from passive care toward proactive prevention and the construction of supportive environments. Related literature in this field shows a clear trend toward interdisciplinary integration, refined inquiry, and stronger application implications, particularly through the deep convergence of medicine, psychology, architecture, and public health.

4 Discussion

4.1 Analysis of Research Trends in Dementia-Friendly Environment Studies

4.1.1 Temporal Evolution of Research Topics

The timezone map of keyword co-occurrence (Fig. 2) illustrates dynamic changes in research topics over the past 15 years, which can be divided into three stages:

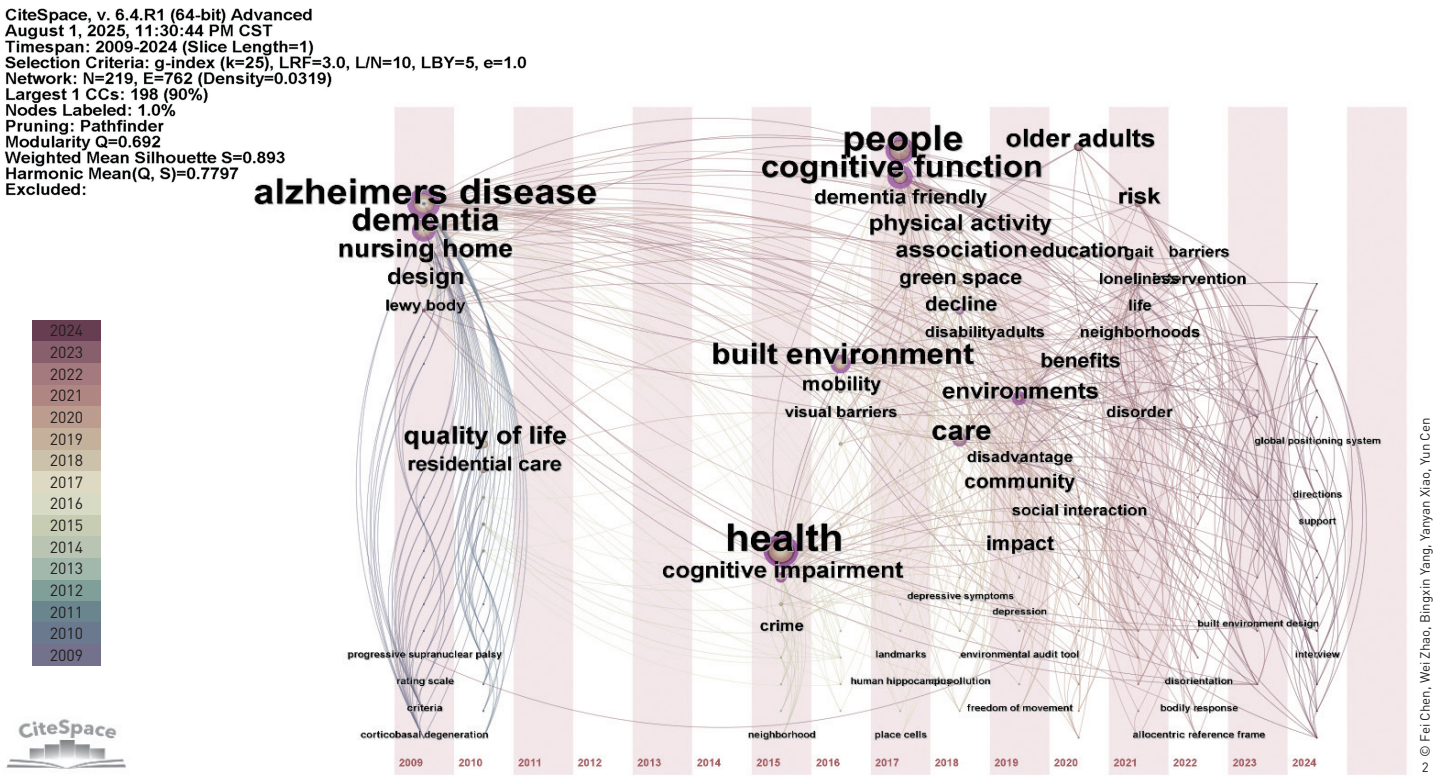

Fig. 2 Timezone map of keyword co-occurrence in dementia-friendly environment research.

1) Early stage (2009–2014): Dominated by medical and nursing research, concentrating on topics such as "Alzheimer's disease," "dementia," "nursing home," "quality of life," and "residential care." Research during this stage mainly focused on age-related dementia and associated disorders, long-term care institutions, and quality of life.

2) Middle stage (2015–2020): scholarly attention gradually shifted toward topics of "cognitive function," "health," "cognitive impairment," "community," and the "built environment," reflecting an emerging interest in cognitive function and mental health, and the interactions between built environments, community structures, and the well-being of older adults. The emergence of keywords such as "mobility" and "green space" indicates that environmental factors (e.g., accessible facilities and natural spaces) entered the research agenda, pushing the field from macro-level health discussions toward micro-level cognitive mechanisms and comprehensive analyses of supportive environments.

3) Recent stage (2021–2024): The prominence of keywords such as "barriers," "freedom of movement," "neighborhoods," "benefits," "disability," and "risk" suggests a transition toward risk identification and intervention. Scholars have moved beyond responding to existing health problems and placed a greater emphasis on forward-looking interventions through environmental optimization and risk prevention. Highlighted topics such as freedom of movement, barrier reduction, and disability prevention reflect the field's increasing focus on practical applications, implementation pathways, and interdisciplinary trend.

4.1.2 Evolution of Research Hotspots in Burst Keywords

The burst keyword analysis (Table 2) further reveals the stage-based evolution of research hotspots, where "strength" refers to the burst intensity of a keyword relative to the baseline during a given period, calculated using Kleinberg's burst detection algorithm in CiteSpace (dimensionless; higher values indicate stronger bursts).

1) 2009–2014: Burst keywords included "older people," "outcome," "physical environment," and "quality of life," with the longest lasting, indicating that early research focused on older populations, living environments, and quality-of-life issues.

2) 2015–2020: Burst keywords shifted toward "community environment," "cognitive function," "community," "dementia friendly," "physical activity," "built environment," and "association." Research gradually centered on cognitive function and community-level support. Notably, the emergence of "dementia friendly" signaled that dementia-friendly communities had become a broadly recognized research hotspot with significant policy guidance and practical value.

3) 2021–2024: Burst keywords concentrated on "dementia," "risk," "gait," and "barriers." On the one hand, identifying dementia-related risks and gait-monitoring have become important methods

Table 2: Top 20 keywords with the strongest citation bursts

Keywords	Strength	2009–2024
Older people	1.25	
Outcome	1.13	
Physical environment	1.13	
Quality of life	0.74	
Community environment	0.92	
Crime	0.92	
Dementia friendly	0.84	
Cognitive function	0.60	
Physical activity	1.99	
Association	1.99	
Decline	0.79	
Built environment	0.68	
Impact	1.31	
Community	0.96	
Care	1.26	
Dementia	2.84	
People	1.85	
Risk	1.37	
Gait	0.92	
Barriers	0.98	

for early warning and assessment. On the other hand, removing community barriers and improving accessible design have become a new center in research and practice.

4.2 Future Research Trends

4.2.1 Interdisciplinary Collaboration and Quantitative Research

Currently, studies on dementia-friendly environment is gradually forming an interdisciplinary research paradigm and shifting from empirical summaries toward approaches combining quantitative models and experimental methods. This not only deepens the theoretical foundations of academic inquiry but also provides sound evidence for precise design and informed decision-making, promoting interdisciplinary collaborations that integrate medicine, psychology, architecture, and public health. Such studies enable researchers to reexamine, from multidimensional perspectives, the profound influence of the environment on the behaviors and emotions of older adults with dementia. This perspective is crucial for developing more integrated and sustainable design paradigms. In constructing dementia-friendly environments, it not only helps compensate for declines in perception, memory, orientation, and social interaction, but also enhances environmental legibility and predictability through optimized spatial and informational design, thereby reducing the daily care burden on caregivers.

4.2.2 Multi-Stakeholder Collaboration and Digital Technology Support

By incorporating digital technologies, it is possible to build intelligent and interconnected dementia-friendly communities embedded within local neighborhoods. Integrating governmental agencies, private capital, third-party service providers, market actors, and community resources, a multi-stakeholder collaboration mechanism is essential for the effectiveness of dementia-friendly environment construction. Moreover, digital tools enable designers to more accurately simulate and predict how environments affect older adults with dementia, informing more targeted design interventions. The application of digital technologies in dementia-friendly design offers innovative pathways to enhance their safety, autonomy, and quality of life. For example, sensor integration (environmental monitoring with smart wristbands, 3D beacons, sensor networks, etc.) and embodied sensing (environmental simulation, including virtual reality, augmented reality, and spatial behavior analysis tools) have advanced implementable design solutions and supported research progress (Fig. 3).

4.2.3 In-depth Exploration of Individual and Regional Differences

With global population aging and the continued increase in older adults with dementia, the design concept of dementia-friendly environments is shifting from “universal adaptation” toward multidimensional responses that emphasize personalization, differentiation, and cultural sensitivity. On the one hand, research needs to address the differentiated needs of individuals with varying types and stages of cognitive impairment, balancing standardization and customization—for example, through moderated interventions enabled by dynamic lighting, voice prompts, and behavior-recognition algorithms. On the other hand, dementia-friendly environments in different countries and regions should give rise to

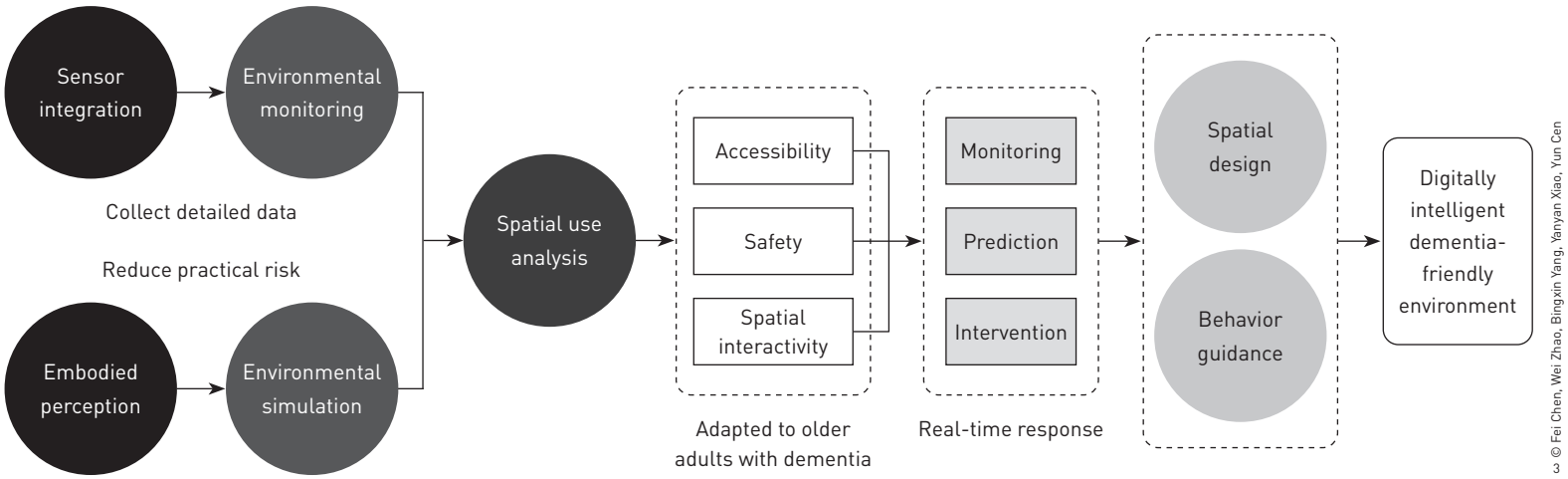

Fig. 3 Framework of digital interventions for dementia-friendly environmental design.

locally distinctive practices. For instance, in the Netherlands, "De Hogeweyk" dementia-friendly village constructs multiple lifestyle zones and stylistically distinct neighborhoods to create a simulated social environment that evokes a sense of familiarity and belonging among residents[84]. Moreover, the differences of how individuals with dementia in different cultural contexts perceive, interpret, and adapt to spatial environments need to be explored.

5 Conclusions

Through cluster analysis, keyword timeline map, and burst keyword analysis, this study systematically reviews the research development and trends of dementia-friendly environments, revealing how research themes and methodological approaches have shifted across this field. Overall, the field has progressed from early attention to cognitive diseases and quality of life, to mid-stage investigations of cognitive functions and built-environment interactions, and more recently toward multidimensional concerns involving risk identification, accessible environments, and community-based support.

Based on current research progress, this study offers three policy and practical implications: firstly, guidelines for the spatial construction and renovation for older adults with dementia should be established by integrating indicators such as wayfinding, accessibility, safety, and sensory comfort into urban renewal and public-space planning, while strengthening cultural sensitivity by incorporating local cultural and memory elements to enhance familiarity and the sense of belonging. Secondly, pilot projects for "smart + age-friendly" dementia-supportive environments should be advanced. Community-based platforms may integrate intelligent systems such as smart monitoring, fall alerts, emotion recognition, and navigational guidance. For example, Yves Galvão et al. employed an efficient multimodal deep-learning framework (e.g., CNN-LSTM) for automated fall detection[95]. Such systems can form intelligent care environments with individualized responsiveness, enabling deeper integration between spatial design and management. Finally, a multi-stakeholder participation and dynamic evaluation mechanism for dementia-friendly environments should be established. Through collaboration among governments, communities, families, and designers—supported by funding mechanisms and behavioral data feedback—it is possible to promote low-intervention, highly accessible micro-renewal strategies and long-term institutionalized operation, thereby gradually forming a sustainable model for creating dementia-friendly environments.

Despite offering a multidimensional perspective on dementia-friendly environment research, this study has several limitations. Firstly, the literature review relied mainly on Chinese and English databases, leaving research and practical experiences from non-English-speaking countries only partially represented. Secondly, the study was largely based on secondary analysis of existing literature, lacking first-hand case data to capture the nuanced behavioral–environment interactions in complex spatial practices. Thirdly, although this study proposed an initial multidimensional integrative pathway, it has not yet developed a comprehensive tool with quantitative indicators and evaluative standards. Future efforts require coordinated advances in theory, technology, and institutional frameworks to ensure that dementia-friendly environments can be implemented and continuously optimized at a broader societal scale.

Competing interests | The authors declare that they have no competing interests.

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针对老年群体的认知障碍友好环境研究综述

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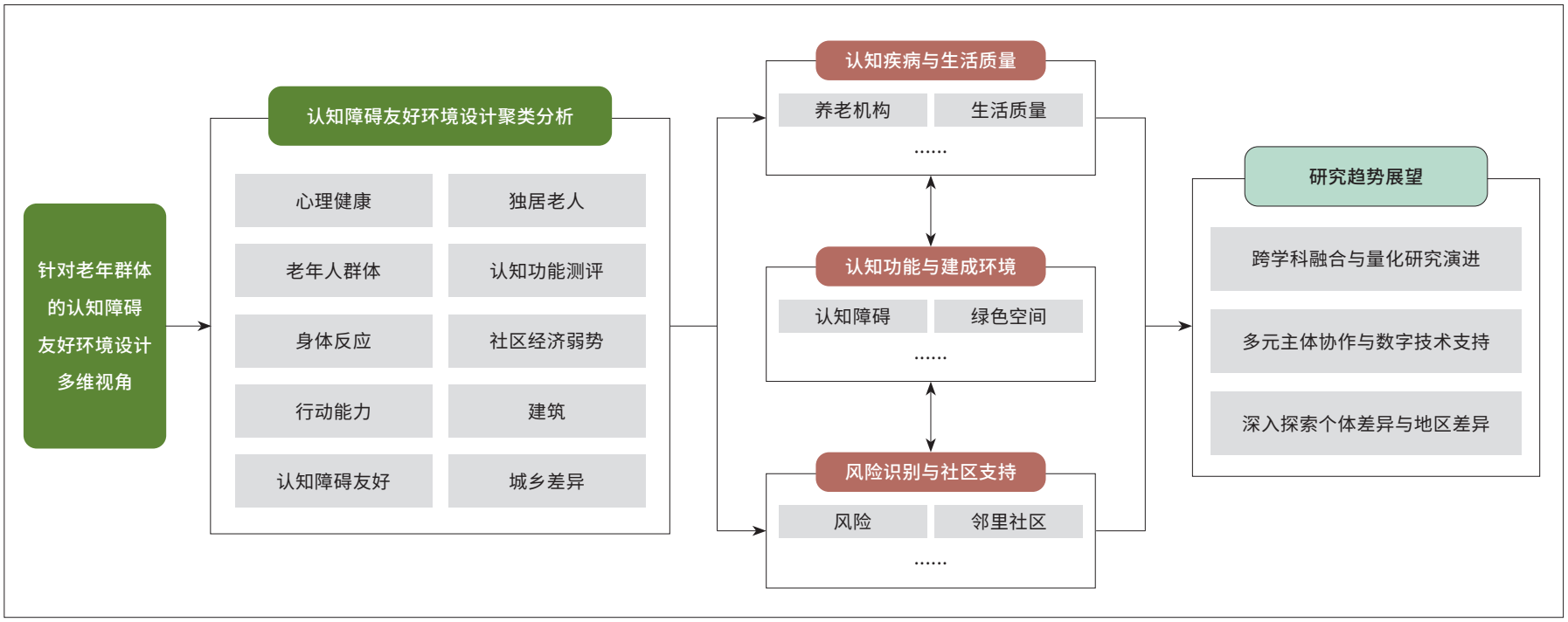
图文摘要



摘要

全球认知障碍患者数量的持续增长已对社会公共卫生与照护体系构成重大挑战，亟需营造既能提升生活质量又可延缓症状进展的友好环境。为了系统梳理认知障碍友好环境的研究脉络与热点，本文采用系统文献综述与CiteSpace知识图谱可视化分析相结合的方法，系统检索了2009～2024年间的中英文文献，最终纳入80篇。研究发现：该领域研究关键词聚类分析共识别出心理健康、独居老人、老年人群体、认知功能测评、身体反应、社区经济弱势、行动能力、建筑、认知障碍友好及城乡差异十大研究热点；历经3个阶段演进，从早期关注疾病本身与生活质量，逐步扩展至认知功能与建成环境的交互机制，近年来进一步发展为强调风险识别、无障碍设计及社区支持的应用导向研究。在此基础上，本文提出未来研究的3个重点方向：1）推动跨学科融合与量化研究演进；2）依托多元主体协作与数字技术支持，构建智慧响应型友好环境；3）深入探索个体差异与地区背景，提升认知障碍友好环境设计的适应性与文化敏感性。本综述结果为构建更具适应性、可持续性与文化嵌入性的认知障碍友好型环境提供了理论参考与实践启示。

关键词

认知障碍友好环境；环境设计；社区支持；数字化干预；老年群体；CiteSpace；跨学科整合

文章亮点

- 使用CiteSpace知识图谱系统梳理认知障碍友好环境研究发展
- 聚类分析结果揭示10类认知障碍友好环境设计跨学科建构要点
- 揭示研究由疾病照护转向功能－环境交互与风险防控
- 认知障碍友好环境从封闭型机构化照护迈向社区嵌入与社会包容化
- 数字化与多元主体协作成为认知障碍友好环境设计的研究前沿

编辑 田乐

1 研究背景

认知障碍①相关疾病，特别是阿尔茨海默病，已成为全球公共卫生和社会关怀的重大挑战之一[1-4]。2021年，全球约有5 700万人患有认知障碍，其中超过60%生活在中低收入国家[5]。认知障碍已成为全球老年人致残和生活不能自理、需要他人照护的主要原因之一。根据世界卫生组织（WHO）的数据，全球认知症患者人数预计将从2019年的约0.55亿增至2050年的约1.39亿[6]。认知障碍病因复杂且治疗难度大，但通过控制风险因素或可降低发病率，例如有研究指出社区建成环境与老年人认知功能之间存在关联[7]。因此，认知障碍友好环境的营造对于公共卫生系统、病人及其家属具有重要意义。

“认知障碍友好”（dementia-friendly）用于描述旨在支持认知障碍老年群体生活、参与和融入社会的环境与举措[8-10]。它不仅强调物理空间的无障碍与可识别性，还包括社会态度、服务体系和社区支持网络的优化，以提升该群体的安全感、独立性与生活质量[11-12]。认知障碍老年人存在记忆障碍、定向力障碍、注意力下降、执行功能障碍等认知功能显著退化问题，这要求认知障碍友好型环境设计必须更加精细化和更具针对性，并改变以往强调缺陷和为社会及亲属增添压力的叙述方式，转而强调包容性[13]。

目前，国际上已经从环境设计指南及相关数字化技术介入等方面进行了探索[14-15]。然而，当前相关研究多聚焦于单一维度的干预效果——如空间设计、照护技术和社会互动机制——较少有基于多维框架、全面分析认知障碍友好环境设计路径与机制的系统性研究成果。针对这一缺口，本研究借助可视化知识图谱分析方法，梳理认知障碍友好环境设计相关文献，识别研究脉络与热点趋势，试图构建认知障碍友好环境的多维分析框架，从而为未来更具整合性与可操作性的设计干预提供理论基础与实践支撑。

2 研究方法

本研究采用系统综述方法，旨在全面梳理和分析与认知障碍友好环境设计相关的文献。研究选取Web of Science、Scopus、PubMed、ScienceDirect、中国知网（CNKI）这5个国内外权威数据库检索文献，从“认知障碍与失智”“照护与设施”“社区与环境”“空间与设计”“设计导则与理念”“情绪与健康”“景观与自然环境”几个类别进行关键词检索（表1），文献类型限定为“论文”（article）、“综述”（review）和“学位论文”（dissertation）。检索时间范围设定为2009年1月1日至2024年12月31日。为保障所筛选文献的质量及与空间设计的相关性，本研究遵循如下筛选标准：1）文献须为中文或英文，以确保研究团队能够准确理解和分析研究内容；2）文献须明确聚焦认知症/认知障碍老年群体②，以确保研究对象具有典型性；3）研究内容须探讨空间环境、设计因素和社区环境对认知障碍老年人的生活质量、认知功能或情绪健康的影响。剔除无关文献后，共有80篇文献[13,16-94]纳入研究，其中中文文献27篇，英文文献53篇。

3 认知障碍友好环境研究的聚类分析

3.1 聚类分析结果

对研究文献进行聚类分析，有助于揭示研究对象之间的共性主题与潜在脉络，并据此推断该领域的研究热点与发展趋势（图1）。通过CiteSpace的自动聚类，得到219个节点和762条连线，最终形成10个清晰的聚类模块（Q=0.692＞0.3，S=0.893＞0.7），表明该聚类网络结构合理、异质性高，分类效果可信。此10个聚类主题分别为：1）心理健康（mental health）；2）独居老人（living alone）；3）老年人群体（older people）；4）认知功能测评（neuropsychological assessment）；5）身体反应（bodily response）；6）社区经济弱势（neighborhood economic disadvantage）；7）行动能力（mobility）；8）建筑（architecture）；9）认知障碍友好（dementia friendly）；10）城乡差异（urban/rural differences）。聚类结果表明，整体上心理健康为认知障碍友好环境研究

① 本文中，“认知障碍”是指一种广义的症状性描述，而“认知症”是一个特定医学诊断，通常指不可逆的、进行性的神经退行性疾病。

② 无论从认知症患者整体还是从阿尔茨海默病患者来看，老年人确实占绝大多数；其他年龄群体患者的相关零星案例不计入本研究中。

表 1：文献检索关键词概览

关键词类别	语言	关键词
认知障碍与失智	中文	认知障碍；认知症；失智；阿尔茨海默病（症）；轻度认知障碍；认知功能衰退
	英文	Cognitive impairment; dementia; Alzheimer’s disease; mild cognitive impairment; cognitive decline
照护与设施	中文	照料设施；照料中心；养老机构；长期照料设施；社区居家养老；认知症照护设施
	英文	Care facility; care center; nursing home; long-term care; residential aged care; dementia support facility
社区与环境	中文	认知友好社区；失智包容；住区公共空间；邻里环境
	英文	Dementia-friendly community; dementia-inclusive; community public space; neighborhood environment
空间与设计	中文	空间环境；环境设计；生活空间设计；疗愈景观；寻路；康复花园；街区感营造；空间记忆；视觉障碍
	英文	Built environment; environmental design; living space design; healing landscape; wayfinding; healing garden; neighborhood place-making; spatial memory; visual barrier
设计导则与理念	中文	设计导则；设计策略；循证设计；以人为中心的照护；友好化设计；设计人类学
	英文	Design guideline; design strategy; evidence-based design; person-centered care; user-centered design; design anthropology
情绪与健康	中文	情绪效益；情绪健康；生活质量；非药物干预；感官疗法；健康；认知改善
	英文	Emotional benefit; emotional well-being; quality of life; non-pharmacological intervention; sensory therapy; well-being; cognitive improvement
景观与自然环境	中文	景观环境；绿色空间；户外环境；康复花园；公共公园
	英文	Landscape; green space; outdoor environment; healing garden; public park

的核心议题，本领域正沿着个体健康—社区环境—空间公平的多尺度整合路径演进，且研究热点正由单一医学议题转向跨学科的人—环境交互与老年友好更新的基于证据的实践。

3.2 聚类具体内容评述

3.2.1 心理健康

心理健康聚类主要涵盖老年人群的心理健康与认知衰退等问题，尤其强调建成环境、自然环境和社会支持对心理健康的影响。研究内容包括老年人心理健康的风险因素、认知功能下降与环境的关联，以及生活质量评价。部分研究指出绿地暴露有助于“强化身份 / 自我”的认知维持、晚年认知和认知保护效应[59,79-80]；也有学者探讨社区邻里环境对认知功能的影响[69,71]。亦有研究指出，可通过丰富多元的景观、柔和自然的边界、便捷安全的散步道、多感官和日常活动空间的配置等手段营造舒适、愉悦且安心的认知障碍友好花园[20]。其他研究指出，认知障碍照护单元的对外连通性与空间组织直接影响居民的自由移动、情绪与社交；与其以封闭换安全，不如通过可见可达的户外、可停留的走廊与“可沟通的”边界，同时实现安全与尊严[73]。雷静雯等把公共活动空间从“可管理”升级为“可陪伴”，对认知障碍老年人的关注点从基本的生理和安全需求逐渐向“有意义”的“正常化”的生活方向转变[76]。五岛圣子等指出观看庭园景观能显著降低心率，并改善行为症状，从而对心理

健康产生影响[81]。陈洪（音）等通过将道路交通暴露（空气污染与噪声等）与认知能力下降、帕金森病和阿尔茨海默病发病率的增加联系起来，指出道路交通暴露可能影响认知健康[85]。总体上，该聚类显示心理健康研究正在从关注疾病与生活质量，逐渐转向环境—心理—社会的综合健康框架。

3.2.2 独居老人

此聚类强调独居老人面临的心理健康风险与社会支持缺失，研究主题涉及孤独、社会隔离、认知功能下降及其与环境的关系。部分研究关注公共空间友好化与社区支持[39]，部分则关注居住环境、独居状态和认知轨迹的关系[45]。例如，荷兰某认知症照料中心通过利用智能手环、智能门禁、三维信标等技术构建虚拟“围墙”，并通过提升空间识别性和导向性，为认知症老人提供自主、积极、高品质的生活环境，为全球认知障碍友好环境设计提供了宝贵经验[67]。整体而言，独居老人议题凸显出居住形态与社会支持系统在认知障碍友好环境建设中的重要性。

3.2.3 老年人群体

此聚类的研究对象涵盖不同国家与地区的老年人群，内容涉及生活质量、社会支持及社区环境因素。总体趋势上，该聚类强调从人口学层面对老龄化背景下的身心健康风险进行系统分析[24–25]。例如，苏珊娜·勒尔等指出，城市环境具有为促进社区老年人脑健康的生活方式创造有利条件的巨大潜力，从而降低其认知能力下降和痴呆的风险[33]。有研究关注养老机构建筑环境改善与认知障碍老年人生活质量的关联性[40]；也有大规模实证研究从社区环境与老龄人群认知功能入手，发现土地利用混合度较高的地区老年认知障碍的发生风险显著降低，而自然环境比例过高反而与认知障碍风险增加相关[91]。此外，有研究指出，通过以熟悉的空间序列组织入口与起居等关键位置，可以改善认知障碍老年人在空间中的使用便利性[35]；也有研究认为，提升老年人感知自信需要具备直线、少转折、少决策点、可见终点／锚点等结构特征的空间环境[94]。连菲等以英国为例，从国家与地方政策、社区与住宅的设计导则、典型实践项目与评估体系入手，勾勒出让认知障碍老年人群在熟悉社区长期居住的整合式支持系统[77]；戴靓华等以中国情境下的认知障碍老年人居住环境为对象，梳理美国、荷兰、日本等国际典型模式的空间与运营经验，并结合国内初步实践提炼面向中国养老机构与社区化照护的设计策略与构建模型[90]。

3.2.4 认知功能测评

此聚类涉及老年人认知功能的评估与测量方法，包括神经心理学工具、空间导航测试及新型测评技术（如GIS系统、热力图分析、通达性建模等）。部分研究系统比较了老年轻度认知障碍与各类痴呆（尤其是阿尔茨海默病）患者在空间导航任务上的表现，并考察任务情境（真实／虚拟）、策略类型（以环境为中心／以客体为中心）与导航方式（主动／被动）对认知判别力的影响[31]，同时也对空间视觉的神经心理学功能差异进行了探讨[72,83,93]。另一些研究强调环境因素对认知能力的影响——如更高的城市树冠覆盖（而非单纯“总绿量”或“开阔草地”）与更低的痴呆发病风险相关[52]——以及道路网络结构对认知障碍老年人走失风险的影响[58]。随着人形机器人、可穿戴传感器、空间定位和监控技术等工具和方法的发展，构建智能、响应迅速的环境，满足认知障碍老年人不断变化的需求的可行性不断提升[19]。盖克·D．S．卢登等把环境心理学证据与互动技术融合进护理环境，通过多感官与在场感创造有意义的感官体验，并指出随着认知障碍病程的推进，虽然患者的认知功能会逐步减退，但对周遭事物的感官探索能力及当下的专注式体验则基本保持完好[68]。通过视觉空间任务和计算机化测试方案，设计师可以更好地理解认知障碍老年人的需求，并据此调整设计方案[83]。此外，也有研究把认知障碍友好环境的空间迷失问题从经验性指南推进到以心理学和神经科学证据为依据的设计讨论[87]。这一聚类表明，认知功能测评正逐步结合多模态数据与环境因素，向早期诊断与干预拓展。

3.2.5 身体反应

此聚类聚焦认知障碍老年人心理—生理反应机制，包括心率、步态、情绪与环境刺激之间的耦合。研究内容涵盖景观疗愈、身体运动，以及生理指标监测。这些研究探讨了适老化疗愈景观对情绪与身体康复的作用[37]，进行了关于步行体验与认知障碍的定性研究[88]，或运用了诸如可穿戴传感器、空间技术、机器人辅助与智能监测等数字化技术构建认知障碍友好环境，以捕捉患者的生理与行为反应，进而提高生活质量[19,34]。有研究对加拿大的7位认知障碍老年人进行了参与式步行访谈、GPS追踪与出行日记记录，发现他们普遍在熟悉的郊区环境中获得安全感，但出行范围受限，主要依赖熟悉的地标进行导航；出行支持性因素包括混合用地、可达的日常目的地、直线街道和步行小径，而阻碍性因素则包括复杂的交叉口、噪声繁杂的干道和停车场，以及缺乏保护的过街设施等[16]。此外，不少文献强调了感官环境与情绪刺激的作用，例如音乐、花园景观等对缓解情绪症状和提升主观幸福感具有积极效应[22,53,55]。总体来看，该方向现有研究借助数字化监测和感官干预，展现出心理—生理耦合研究的重要性，并推动了数字化方法的介入。

3.2.6 社区经济弱势

多项研究指出社区和社会环境在认知障碍友好环境中的重要性[17,43,47–49]。此聚类以经济差异为命名基础，强调建成环境质量、社区功能配置及社会支持网络等方面的经济不均衡现象对老年人心理健康与认知功能的影响——这些因素本质上是经济差异的外部表现与衍生结果。部分研究揭示了老年人在社区中被孤立对其心理健康的负向影响[17]，也有研究探讨

社区步行友好性、街道格局、邻里关系、社会支持等对认知功能的影响[54,56,69-70]。另有研究基于英国大规模医学研究理事会认知功能与衰老研究数据库，分析了社区层面的建成与社会环境对老年人认知障碍的影响，发现社区贫困度和犯罪率与认知障碍并无显著关联，但土地利用多样性高的社区（如住宅、商业、休闲混合）中老年人患认知障碍相关病症的风险显著降低（约减少60%），这可能因为更便利的服务和社交机会带来更多的认知刺激[91]。聚类整体趋势表明，心理健康研究正与社会公平性紧密结合，强调社会空间差异对老年人健康的深远影响。

3.2.7 行动能力

行动能力聚类聚焦老年人行动自由、出行环境与无障碍设施对心理健康的影响，内容涵盖行动障碍、步态分析与导向设计。部分研究讨论郊区社区中认知障碍老年人的出行支持[16]，指出随着认知障碍患者在家庭之外的“生活空间”缩小，他们与外出相关的社会参与也会减少[44]。部分研究从户外环境与寻路友好性为切入点，展开对认知障碍养老机构环境优化的探讨[27]。李佳婧等对认知障碍老年人的自主行为进行了分类，并提炼出支持自主性的空间环境特征[41]。也有研究通过集成多种智能方法——比如通过通信工具（手机、Skype / WhatsApp）维系社会联结，以及借助录像式家庭导览采集老年人的生理、行为和认知反应数据——为感知驱动的适老化空间设计提供科学方法[54]。雷静雯等把“日常活动即设计纲领”落到了可执行的空间语言上——路径越清晰且越占主导地位、多感官线索越多、具有越多方向性的地标，以及使用越多的单廊形式，认知障碍老年人就越容易找到路径[75]。其他研究把认知障碍友好环境的设计问题从单一的安全及医疗命题，扩展为兼顾行为、社会性与情感设计等方面的生活质量命题[84]。虚拟环境还可作为认知训练工具，帮助患者保持生活技能、锻炼空间记忆，具有康复与干预的双重意义[86]。总体而言，该聚类强调行动能力在促进认知障碍老年人社会参与和维持独立性中的关键作用。

3.2.8 建筑

建筑是研究数量最多的聚类，涵盖护理设施、长期照护机构、康复花园与住区公共空间等。总体来看，该聚类显示，环境与空间设计是老年人心理健康研究的一大应用领域[23,26,28,32,36,57,78,82]。其中有大量研究涉及空间优化与用户友好化设计[21-22,62-66]、长期照护环境的设计指南与实证评估[50,89,92,94]和基于照护家庭提出认知障碍友好环境设计的具体工具与标准[18]，以及视觉空间功能障碍与认知障碍分型诊断之间的关系[72,83,93]。李佳婧和黄秋韵以12个美国案例归纳了认知症康复花园的规模和布局特征[42]。另有研究探讨了建筑设计如何影响认知障碍患者的空间定向和寻路能力，发现简单清晰的动线布局、有限且显著的参照点能显著提升中重度认知障碍患者的独立寻路能力[94]。

3.2.9 认知障碍友好

此聚类以认知障碍友好的理念与实践为核心，研究议题涵盖社会融合、社区设计，以及理念与政策推进。研究集中于社区公共空间与景观环境[29,38]，以及认知障碍友好倡议和社区实践的总结与评估[13,30,43]。连菲和李慧将认知障碍友好社区环境分为宏观、中观、微观3个层次，其中宏观包括用地构成、用地布局、街道网络，中观包括街道形式、建筑特征、绿色空间、地标、标识，微观包括形状、色彩、明暗、纹理等环境要素[29]。保罗·A．罗杰斯指出用共创式设计把认知障碍老年人从护理客体转为有收入、可见度与尊严的社会合作者[46]。杨杰搭建了疗愈需求—权重—证据—策略的框架，提出了8条认知症照护空间的疗愈性设计原则[51]。另有研究指出，易于导航且具可辨识特征、可见户外景观并便捷可达的空间能显著提升认知障碍患者的独立性与定向能力，从而提高认知障碍友好度[60]。也有研究指出认知障碍老年人的空间需求包括通过清晰的定向线索与可辨路径组织室内外环境、便捷可达的户外花园与可供安静休憩或社交空间[61]。总体而言，该聚类推动了认知障碍友好理念的全球化传播，并与社会政策及社区更新紧密结合。

3.2.10 城乡差异

城乡差异聚类关注城乡差异背景下的老年人心理健康问题，研究主题涵盖城乡设施布局差异、社会公平与认知健康的关系。代表性研究包括对中日城市养老设施体系的比较[74]，英国老龄人群社区环境（包括区域贫困、土地利用混合度、自然环境比例、犯罪水平等由政府公开数据构成的客观指标）与认知功能的关系[91]等。其中，有研究探讨了中国城乡差异对认知衰退的影响显示，居住在无障碍设施更完善、公交线路更多、就业服务和社会经济地位更高的社区的老人，其认知衰退速度更慢；道路状况、基础设施和社会活动参与度则与基线认知水平密切相关[71]。文章同时强调，改善农村社区的基础设施和社会资源是减缓认知功能下降的关键，并指出弱势群体对社区资源的依赖更强，政策应优先补足农村地区的环境与社会支持。另有研究考察了社区社会环境与认知障碍风险之间的关系，并分析了社会隔离的中介作用[17]，发现居住在社会经济贫困和存在明显无序迹象（如环境破败、垃圾堆放、犯罪丛生）的社区中，会显著增加认知障碍发生风险（分别提高18%和27%）；相比之下，低社会凝聚力并未表现出显著影响。总体趋势表明，城乡差异不仅影响设施供给与资源分配，也直接关系社会公平性对老年人心理健康的影响。

3.3 小结

本研究的聚类分析揭示了认知障碍友好环境研究的多维格局和跨学科特征。形成的10个聚类主题既涵盖了医学与心理学层面的个体健康问题（如心理健康、认知功能测评、心理—生理反应），又拓展至社会空

间层面的议题（如独居老人、社区经济差异、行动能力、城乡差异），同时还涉及空间与环境实践的领域（如建筑设计和社区建设）；研究内容也由被动照护转向主动预防与支持性环境建设。总体来看，该领域整体研究趋势表现为学科交叉、精细化研究与应用导向的增强，尤其是医学、心理学、建筑学与公共健康等领域的深度融合。

4 讨论

4.1 认知障碍友好环境研究趋势分析

4.1.1 研究主题的时区演化

关键词时区演化图（图2）揭示了近15年来研究主题的动态变化，可分为3个阶段：

1）早期阶段（2009—2014年）：以医学及护理学研究为主，集中在“Alzheimer’s disease”（阿尔茨海默病）、“dementia”（认知症）、“nursing home”（养老院／护老院）、“quality of life”（生活质量）、“residential care”（家庭照护）等主题，主要关注老年性认知障碍及相关疾病、长期照护机构和生活质量。

2）中期阶段（2015—2020年）：研究焦点逐渐转向“cognitive function”（认知功能）、“health”（健康）、“cognitive impairment”（认知障碍）、“community”（社区）、“built environment”（建成环境）等主题，显示学界开始关注认知功能与心理健康，并探讨建成环境、社区结构与老年人健康的互动机制。同时，“mobility”（出行／移动性）、“green space”（绿色空间）等关键词的出现表明无障碍设施与自然空间等环境因素逐渐进入研究者视野，推动研究由宏观健康问题走向微观认知机制与环境支持的综合分析。

3）近期阶段（2021—2024年）：“barriers”（障碍）、“freedom of movement”（行动自由）、“neighborhoods”（邻里／社区邻里）、“benefits”（益处）、“disability”（残疾／功能障碍）、“risk”（风险）等突现关键词显示研究进入风险识别与干预导向阶段。学者们不仅探讨如何改善认知障碍老年人已有的健康问题，更强调通过风险防范与环境优化进行前瞻性干预，重视出行自由、社区障碍排除、残疾预防等议题，体现出研究的应用转化取向与实施导向及跨学科特征。

4.1.2 突现词的热点演变

突现词分析（表2）进一步揭示了研究关注热点议题的阶段性变化，其中“strength”为CiteSpace采用Kleinberg突现检测算法计算的关键词在某时间段相对基线的突现强度（无量纲，数值越大表示突现越强）。

1）2009—2014年：突现词包括“older people”（老年人／老年人群）、“outcome”（结果／研究结果）、“physical environment”（物质环境）、“quality of life”（生活质量），且持续时间最长，表明早期研究集中于老年人群体、生活环境及生活质量等议题的探讨。

2）2015—2020年：突现词转向“community environment”（社区环境／邻里环境）、“cognitive function”（认知功能）、“community”（社区）、“dementia friendly”（认知障碍友好）、“physical activity”（身体活动）、“built environment”（建成环境）、“association”（相关／关联），研究逐渐聚焦于认知功能及社区层面的支持，尤其是“认知障碍友好”（dementia friendly）的出现，显示认知障碍友好型社区成为学界的共识性热点，具有较强的政策指导意义与实践价值。

表2：认知障碍友好环境研究前20突现关键词

关键词	强度	2009—2024
老年人／老年人群	1.25	
结果／研究结果	1.13	
物质环境	1.13	
生活质量	0.74	
社区环境／邻里环境	0.92	
犯罪	0.92	
认知障碍友好	0.84	
认知功能	0.60	
身体活动	1.99	
相关／关联	1.99	
退化	0.79	
建成环境	0.68	
影响	1.31	
社区	0.96	
关怀	1.26	
认知症	2.84	
人群	1.85	
风险	1.37	
步态	0.92	
障碍／阻碍	0.98	

3）2021—2024年：突现词集中于“dementia”（认知症）、“risk”（风险）、“gait”（步态）、“barrier”（障碍/阻碍）。一方面，认知障碍风险识别、步态监测等成为早期预警与评估的重要方法；另一方面，社区障碍与无障碍设计逐渐成为研究与实践的重要方向。

4.2 研究趋势展望

4.2.1 跨学科融合与量化研究演进

当前，认知障碍友好环境研究正逐步形成跨学科研究范式，也从经验性总结转向量化模型与实验方法结合的路径。这不仅拓展了学术研究的理论深度，也为精准设计与科学决策提供了坚实依据，促进认知障碍友好环境设计研究从单一的空间设计扩展到整合医学、心理学、建筑学与公共健康的多学科协作。这种跨学科协作促使研究者从多维视角重新审视空间对认知障碍老年人群行为与情绪的深层影响，从而推动形成更具整合性和可持续性的设计范式：在认知障碍友好环境的营造中，这种多维视角不仅有助于弥补认知障碍患者在感知、记忆、定位与社交等方面的能力衰退，还能通过优化空间与信息设计提升环境的可读性和可预测性，有效减轻照护者的日常照护投入。

4.2.2 多元主体协作与数字技术支持

通过结合数字技术，创建社区嵌入叠加智能互联型的友好社区，整合政府、社会资本、第三方服务机构、市场主体和社区资源，多元主体协作机制对于认知障碍友好环境建设成效的至关重要。此外，通过数字化手段，设计师能够更精确地模拟和预测环境对认知障碍老年人的影响，从而制定出更具针对性的设计方案。数字技术在认知障碍友好环境设计中的应用为提升认知障碍老年人的安全性、自主性和生活质量提供了创新途径。例如，通过传感集成（监测环境，包括智能手环和三维信标技术结合传感器网络等监测技术），以及具身感知（环境模拟，包括虚拟现实、增强现实等感知技术，结合空间使用分析工具），推动了更具可操作性的设计方案落地和研究进展（图3）。

4.2.3 深入探索个体差异与地区差异

随着全球人口老龄化与认知障碍老年人数量的持续增长，认知障碍友好环境的设计理念正逐渐从“通用适配”走向对个性化、差异化与文化敏感性的多维度回应。一方面，研究需要关注不同认知障碍分型、不同阶段患者的差异化需求，推动标准化与定制化的平衡，例如通过动态照明、语音提示、行为识别算法等方法实现适度干预。另一方面，认知障碍友好环境设计需在不同国家或地区推动具有地方特色的实践（如荷兰霍格威村认知友好小镇通过构建不同生活圈层与风格分区，为个体营造拟真社会交往氛围[84]，可有效激发患者的熟悉感与归属感），且探索不同文化背景下的认知障碍对于空间环境的理解与适应机制存在的差异。

5 结论

本文通过聚类分析、关键词时区演化和突现词热点分析，系统梳理了认知障碍友好环境研究的演变脉络与发展趋势，揭示了该领域在不同阶段的关注议题与方法路径。总体来看，研究经历了从早期聚焦认知疾病与生活质量，到中期探索认知功能与建成环境的互动机制，再到近期强调风险识别、无障碍环境与社区支持的多维度拓展。

结合现有研究进展，本文得出以下3个方面的政策与实践启示。首先，应制定面向认知障碍老年人的空间建设与改造指南，将路径识别性、可达性、安全性、感官舒适性等指标纳入城市更新与公共空间规划，同时强化文化敏感性，引导地方在地文化与记忆元素的融入，以增强环境熟悉度与归属感。其次，应推进认知障碍“智慧+适老”型环境改造试点，依托社区载体引入智能监测、跌倒预警、情绪识别、路径导引等智能技术——例如，伊夫·加尔旺等采用多模态深度学习框架（如CNN-LSTM），形成了一种高效的自动跌倒检测方法[95]——构建具备个体化响应能力的智慧照护系统，实现空间设计与管理的深度结合。最后，应建立认知障碍友好环境的多主体参与和动态评估机制，通过政府、社区、家庭与设计者的协同合作，并结合资金支持与行为数据反馈，推动低干预、高可及性的微更新与长期机制化运营，逐步形成认知障碍友好环境构建范式。

尽管本研究为理解认知障碍友好环境研究提供了多维视角，但仍存在一定的局限性。首先，文献综述以中英文数据库为主，部分非英文国家的研究和实践经验未能充分涵盖。其次，研究以已有文献的二次分析为主，缺乏一手案例数据的佐证，难以反映复杂空间实践在细节层面的行为—环境互动机制。第三，本文虽初步提出了多维融合路径，但尚未能形成具有量化指标体系和评价标准的综合工具。未来，唯有在理论、技术与制度层面协同推进，认知障碍友好环境构建才能在更广泛的社会层面实现落地与持续优化。

图 1. 认知障碍友好环境研究的关键词聚类图
图 2. 认知障碍友好环境研究的关键词共现时区图
图 3. 数字化手段在认知障碍友好环境设计中的介入框架