Analysis of research hotspots and trends in interior and exterior design of age-friendly buildings based on Citespace – taking WOS data as an example (2016-2025)

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Abstract: Against the backdrop of an increasingly severe aging population, the interior and exterior design of age-friendly buildings is crucial for addressing the rapid aging trend. Current research on the interior and exterior design of age -friendly buildings still has shortcomings, such as insufficient attention to hidden health, psychological well-being, and low-skill adaptation. Therefore, this study aims to explore the research trends and hot topics in the interior and exterior design of age-friendly buildings to better address aging. To achieve this goal, this study employs a quantitative and qualitative analysis methodology, using CiteSpace 6.4 R1 literature visualization software to conduct a visual analysis of literature data on the interior and exterior design of age-friendly buildings from the Web of Science (WOS) from 2016 to 2025. The qualitative analysis utilizes case studies. The study identified three key findings: 1) Keyword clustering revealed that research hotspots in the field of age- friendly buildings focus on core issues such as optimizing elderly care service models, caring for special elderly groups, resource allocation, and the integration of medical and elderly care; 2) Time trend analysis showed that the focus of elderly care research has shifted from traditional physical care to meeting psychological needs, and from implementing single solutions to cultivating professional talent and designing age-friendly environments, indicating increasingly diversified and professional research; 3) The Fengzhiya Nursing Home was selected as a case study, demonstrating how it achieves a balance between privacy and openness in age-friendly spaces through functional zoning, modular design, and intelligent adaptation. Based on these findings, the study proposes that the nation, government, and enterprises collaborate to keep pace with the research trends in the interior and exterior design of age- friendly buildings, promoting the compliant development of smart elderly care through a “human-led, intelligent-assisted” model.

Keywords: Interior and exterior design of age-friendly buildings; CiteSpace; WOS

1. Introduction

Elderly care is currently a hot topic. Looking at past experience, the pension system originated in the United States with the Social Security Act of 1935. China established its pension system in 1951 and subsequently began implementing a retirement pension system. With the deepening of population aging, China's “14th Five-Year Plan” for elderly care services elevates the cause of elderly care to a national strategy. Providing refined services to the elderly population across multiple fields

and exploring industrial development opportunities are also directions many countries are striving towards. To address aging, the silver economy is expanding. Leveraging land resources and development experience, comprehensive elderly care communities integrating residence, medical care, and entertainment are being developed. To make elderly care services more professional and the lives of the elderly more comfortable, the interior and exterior design of age-friendly buildings has become particularly important.

Furthermore, scholars have conducted extensive research on elderly care. For example, Hu Haoyu (2025) explained that the interior and exterior design of age-friendly buildings neglects the problems of mobility difficulties and physiological function decline in the elderly, resulting in safety hazards and many inconveniences for the elderly in their daily lives in urban residential spaces. Specifically, this is reflected in the aging of residential building facilities and the lack of age- friendly design [1]. Wang Wenjie (2025) believes that in the interior and exterior design of age-friendly buildings, the demand for age- friendly renovation of indoor residences is becoming increasingly urgent on the basis of green building [2]. In addition, Liu Weiyi (2025)’ s research on community activity spaces based on gerontology focuses on creating an interior design strategy for community activity spaces around the psychological needs of the elderly. By creating an emotional atmosphere, designing intergenerational interaction scenarios, and optimizing the human-environment interaction interface, the space can be transformed from a simple behavioral venue into a carrier that can regulate psychology [3]. Shi Bi (2025) discussed the design details of elderly care buildings. He believes that these six points cannot be avoided: space size, space richness, privacy, barrier-free design, safety design, and detailed design. These six key points of space design for senior living buildings are very important [4]. Du Hongyuan (2025) explored in depth how to serve the elderly in modern health industry buildings and make them more comfortable, which is to incorporate space accessibility and age-friendly design, and showed how to apply it in actual projects [5].

In summary, while there is considerable research on aging-friendly environments and related topics, the field is fragmented and suffers from significant overlap. Therefore, this study aims to clarify the development trends, hot topics, and future research directions of aging -friendly building interior and exterior design. It utilizes existing literature, employs CiteSpace 6.4 R1 for literature visualization analysis, and conducts case studies on aging-friendly building interior and exterior design in conjunction with current hot research topics, thereby contributing to a better understanding of aging populations.

2. Analysis Methods and Data Sources

2.1 Research Methods

This study uses a combination of quantitative and qualitative research methods. Quantitative analysis is commonly used in fields such as statistics, economics, and data visualization, and can ensure the advancement and rationality of data analysis in research. This study uses the Citespace tool. CiteSpace is a tool developed by Professor Chen Chaomei and the WISE Laboratory of Dalian University of Technology for scientific analysis of literature [6]. It is used to analyze the clustering of age-friendly keywords in various literatures through visualization and to predict the future development of age- friendly research. The analysis of this software can identify the pain points of the interior and exterior design of age-friendly buildings, which is conducive to our further research on the future development trend of age- friendly buildings. It lays a solid foundation for the subsequent project design. Qualitative analysis is commonly used in gerontology, aesthetics, sociology, etc. It

judges the nature and characteristics of things and the essence of things by summarizing and inductively. This study uses case analysis to analyze the cutting-edge research fields of interior and exterior design of age-friendly buildings.

2.2 Data Sources and Data Collection

The data for this study came from the Web of Science (WOS) database. For data retrieval, the search method on WOS was limited to the keyword "Aging-friendly building design," with a time frame of 2016-2025, and then plain text was exported.

3.Trend Analysis of Interior and Exterior Design of Age-Friendly Buildings

3.1 Keyword Clustering Analysis of Interior and Exterior Design of Age-friendly Buildings

Based on CiteSpace's LLR clustering function, a visual analysis was performed on 331 selected documents, resulting in the keyword clustering map of aging-friendly building interior and exterior design, as shown in Fig. 1. It can be observed that international research on aging-friendly building design focuses on seven dimensions: nursing home resident, nursing home, Colombian sample, COVID-19 pandemic, nursing staff, dementia living, and feasibility (Fig. 1). To better understand the clustering of aging-friendly building design, a detailed analysis was conducted on the top three clusters.

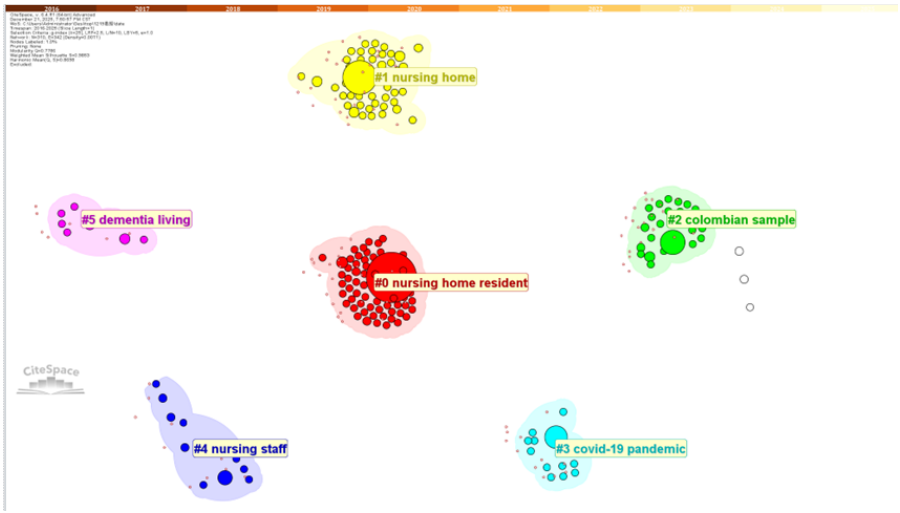

Figure 1: Keyword Clustering (co-occurrence) Analysis (WOS) for Interior and Exterior Design of Age-friendly Buildings.

The cluster for nursing home residents (#0) included keywords such as "European right-time place care project," "facilitated approach," and "Alzheimer's disease research." This is because, facing an aging population, countries are constantly exploring the real needs of the elderly. Given the increasing number of elderly people suffering from Alzheimer's disease, comprehensive care systems and age-friendly facilities in nursing homes have become essential. Furthermore, the timely and effective nursing programs in Europe not only provide readily available reference samples for research but also help future nursing home designs steadily move towards the goals of improving social welfare and sustainable development.

The nursing home (#1) cluster included keywords such as consistent assignment, depressive

symptoms, and care quality. The study suggests that these keywords in nursing homes are due to resource allocation issues, frequent occurrences of depression among the elderly, and inconsistent quality of care. These problems urgently need to be addressed, and their root causes lie in the lagging development of the medical and elderly care system and insufficient professional support. Therefore, society needs to pay more attention to elderly care, implement welfare and policies effectively, and ensure that professionals are employed in these roles and age-friendly renovations.

The Covid-19 pandemic (#3) cluster included keywords such as adult admission, hospital partnership, and cross-sectional survey. During the COVID-19 pandemic, international control measures were relatively strict, and the management systems for nursing homes also became increasingly stringent, such as strictly enforcing adult admission regulations and preventing the spread of the virus. Researchers also conducted cross-sectional surveys and proactively collaborated with hospitals to provide the elderly with better access to professional hospital examinations and medical resources, thereby better protecting their health, safety, and legal rights.

3.2 Analysis of Research Trends in Interior and Exterior Design of Age-Friendly Buildings

A visualization analysis of the research trends of 331 documents on the interior and exterior design of age-friendly buildings revealed that the number of studies increased from a small number to a large number. The research was dominated by the keyword "nursing home" in 2016, and gradually became more diversified as age-friendly design further developed (Fig. 2).

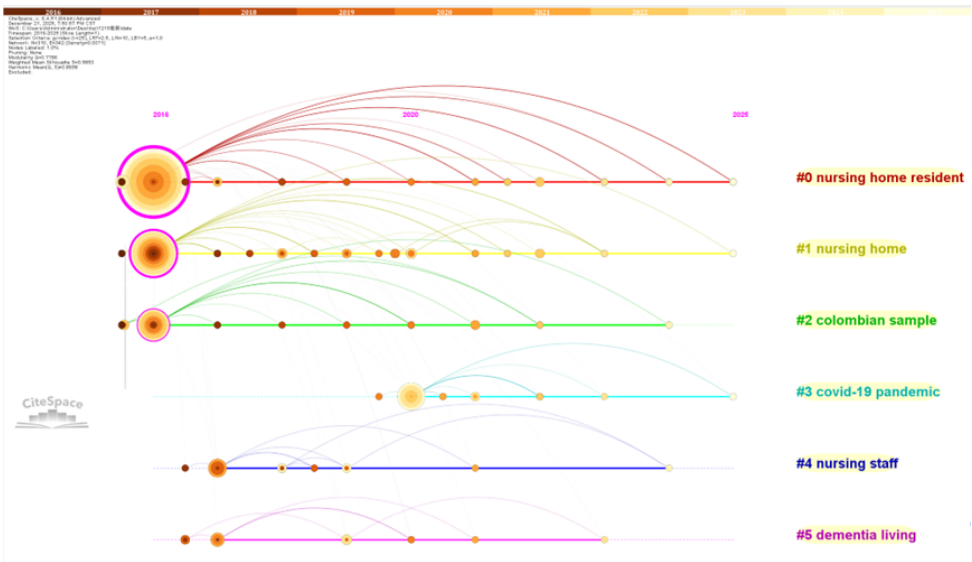

Figure 2: Research Trend Analysis of Key Terms in Interior and Exterior Design of Age- Friendly Buildings.

Specifically, the nursing home residents (#0) cluster shows a shift in research keywords from the 2016 controlled trial to "new home." The initial purpose of nursing homes was primarily to provide physical care and medical attention, fulfilling the traditional concept of "elderly care." However, with deeper research into age-friendly design, researchers have discovered that the psychological needs and emotional support of the elderly are just as important as physical care. Furthermore, society is increasingly emphasizing the dignity of the elderly, pursuing a true sense of "support and care in old age." This has led to a surge in age-friendly building and environmental design, shifting the focus from solely physical care and medical treatment to a more holistic approach that considers both

physical and mental well-being and upholds dignity. Transforming nursing homes into new homes for the elderly has become a current and future goal.

For the nursing home (#1) cluster, the research shifted from defining characteristics in 2016 to care professionals. This shift is because the early stages of the elderly care industry were still in their infancy. Nursing homes, as emerging age- friendly facilities, initially focused on clarifying the functions and spatial forms of elderly care units, answering the fundamental questions of "what is a nursing home and what should it look like?" As the population ages, the care needs of disabled and cognitively impaired elderly continue to evolve. The core issue for nursing homes has shifted from supply-side supplementation ("whether they exist") to competition on service quality ("how good they are"). Simultaneously, the successive issuance of industry standards and professional standards for nursing staff by various countries has further driven research to focus on the practical aspects of nursing talent training systems and career development paths, ultimately leading to a shift in the focus of elderly care research.

Specifically, the study of the Colonian sample (#2) shifted from family members to living facilities. Analysis revealed that the research period, from 2016 to 2024, primarily reflects the increasing aging population and the growing caregiving burden on family members during this time. Coupled with the economic climate, societal pressure on younger generations is generally higher, leading to a more pronounced phenomenon of elderly people aging alone at home. Furthermore, with the development and in-depth research into age -friendly design, the psychological needs of the elderly have been studied and analyzed in detail, placing higher demands on the architectural design of nursing homes. Finally, the study found that elderly care facilities need to place greater emphasis on environmental design, thus making age-friendly interior and exterior design increasingly popular.

For the nursing staff (#4) cluster, the research period was concentrated between 2017 and 2024, and the keywords gradually shifted from daily living to challenging situations. Initially, the daily work of nursing staff was to take care of the daily life of the elderly. Subsequently, with the advancement of technology and the increasing needs of the elderly, their daily work has shifted to refined care relying on professional nursing facilities. They need to use their professional skills to deal with various emergencies in a timely manner, and their professionalism and coping abilities have become stronger and stronger.

For the dementia living (#5) cluster, the research period is concentrated between 2017 and 2023, and the keywords have gradually shifted from green care farms to the European right-time place care project and hospital. Admission. This shift has occurred as research on the care of elderly people with dementia has become increasingly specialized, moving beyond the relatively singular model of green nursing farms to encompass diverse professional settings such as hospital admission experiments and pilot nursing projects in Europe. This shift in research is also reflected in finding more suitable elderly care methods and architectural models for their later years.

4. Case Analysis

We selected popular research topics under the theme of age-friendly environment renovation and design, and conducted detailed analysis by combining environmental and psychological design cases.

4.1. Background

Japan is facing a severe challenge from its aging population, with the proportion of elderly people continuing to rise. This directly drives the increasing demand for space related to elderly care,

and the elderly's demands for age-friendly environment design and renovation are becoming increasingly urgent. Meanwhile, the Japanese government has introduced a number of policies to support the development of the elderly care industry. Traditionally, caring for the elderly is considered an important virtue of filial piety, and in a patriarchal society, this caregiving responsibility has long been borne by female family members. However, with the gradual disintegration of traditional family structures, the responsibility for elderly care is shifting from the family to the societal level, leading to the emergence of various age-friendly buildings. This study takes the Kaze no Gai nursing home in Japan as an example to analyze its age-friendly characteristics and innovative environmental design elements.

4.2 Functional division and design innovation

Functionally, the facility is divided into five senior living areas, two-day care areas, and one management area, all connected by a central administration building. Considering the mobility of the elderly, the dining area is located on the north side to optimize food delivery. It adopts a modular unit design of "small living room + three guest rooms," with each pair of units equipped with a service desk, kitchen, and bathroom to meet nighttime care needs. Combining traditional bedroom partitioning with resident survey results, a 9 ㎡ bedroom (private room) and a 6 ㎡ multi-functional area (room partition space) are combined to create private rooms. This "private room + room partition space" layout balances the privacy of the elderly with their need for open activities, enhancing communication between the elderly and the outside world. The modular units are equipped with retractable partitions; when opened, these partitions create a multi-bed care environment, allowing staff to fully observe the room and improve care efficiency.

4.3 Revelation

provides a practical path for improving the quality and efficiency of age-friendly spaces at Fengzhiya Nursing Home. Intelligent robots are deeply involved in daily care and health data monitoring for the elderly, forming functional synergy with the facility's combinable functional units and "privacy-openness" dual - dimensional room layout. This not only improves the response efficiency of nursing services and the flexibility of space utilization but also strengthens the social connection between the elderly and the outside world, achieving an organic integration of spatial functions and intelligent services. Given these advantages, its future development also needs to consider the following factors: Firstly, ethical risks—the large-scale application of intelligent devices could lead to staff dependence on technology, weakening the emotional care aspect of manual nursing and neglecting the psychological comfort needs of the elderly. Secondly, there is the risk of machine accidents—malfunctions or improper operation of intelligent devices could cause accidental injuries such as bumps and scrapes to elderly individuals with limited mobility.

To effectively prevent the above risks, it is necessary to build a service model of "human-led, intelligent-assisted" care, clarify the core responsibility of emotional care in human nursing, and conduct regular training on professional ethics and practical skills. Furthermore, it is essential to establish a full lifecycle operation and maintenance system for intelligent equipment, implement regular inspection and maintenance mechanisms, install emergency shutdown and intelligent alarm modules, and simultaneously conduct training on the safe and standardized use of equipment for both the elderly and staff.

5. Findings and Conclusions

Through keyword clustering and time trend analysis, this study reveals a multi- dimensional deepening trend in research on elderly care. Clustering of research related to nursing homes covers core issues such as European facility-based care, Alzheimer's disease intervention, unequal resource allocation, geriatric depression, and improving the quality of care. In terms of time, it shows a continuous shift in the focus of existing research on elderly care and age-friendly living: elderly care services are shifting from physical care to meeting psychological needs; nursing home research is shifting from implementing specific solutions to training professional personnel; and age -friendly living research in Colombia is shifting from home care to age- friendly environment design. The functions of nursing staff are extending to complex scenarios, and dementia care is shifting from a single model to a medicalized, European-style professional care system, resulting in increasingly diverse and professional research overall. Furthermore, the study utilizes the functional division of housing, care, and management areas at Fengzhiya Nursing Home, creating flexible care spaces through retractable partitions. Future integration with AI technology can improve efficiency and effectiveness, but ethical and machine-related risks must be mitigated. A human-led and AI-assisted model, along with a robust equipment operation and maintenance system, is needed to avoid potential problems.

Based on the above analysis, this study proposes that it is necessary to keep pace with the trend of elderly care services shifting towards psychological needs, professional care, and age-friendly environments, and to leverage AI to empower age- friendly renovations. For different groups, the state needs to improve ethical standards and policy support, the government needs to strengthen supervision and resource coordination, and enterprises need to adhere to the ethical standard of human intervention as the primary method and AI as a supplement, strictly control data privacy and algorithmic fairness, and mitigate ethical and safety risks through technology adaptation and personnel training to promote the compliant development of smart elderly care. However, due to the limitations of the research scope, the study period is limited to 2016-2025, and only the WOS database is used. Future studies can expand the time frame and database for supplementary research.

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