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GREEN BUILDING DESIGN IN ELDERLY CARE: A MALAYSIAN PERSPECTIVE ON SUSTAINABILITY AND WELL-BEING

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Abstract

As Malaysia faces an aging population, the demand for sustainable elderly care facilities becomes increasingly critical. This study explores the role of green building design in enhancing the well-being of elderly residents, focusing on the integration of eco-friendly practices within Malaysian contexts. Utilizing a systematic literature review and thematic analysis, this study identifies key design features such as energy-efficient systems, natural lighting, and accessible green spaces that significantly contribute to the physical and psychological well-being of elderly individuals. The study highlights the importance of local policies and green building certifications, including LEED, BREEAM, and Malaysia's Green Building Index (GBI), to promote sustainable practices in elderly care facilities. These findings provide valuable insights for policymakers, architects, and stakeholders while recommending further collaborative efforts and policy enhancements to advance green building adoption in elderly care.

Keywords: Elderly care, Elderly, Elderly well-being, Green Building, Sustainability.

1. Introduction

As a global population ages, the need for sustainable and effective elderly care facilities has become increasingly significant. In Malaysia, the aging population is projected to reach 15% by 2030, highlighting the urgency for adequate infrastructure and support systems to cater to this demographic [1]. Traditional elderly care facilities often struggle to meet the physical and psychological needs of residents, leading to a growing recognition of the importance of integrating green building design principles to enhance their quality of life [2].

Green building design emphasizes environmentally responsible and resource-efficient structures throughout their life cycle, from siting to design, construction, operation, maintenance, renovation, and demolition [3]. Key principles include energy efficiency, proper ventilation, natural lighting, and the inclusion of green spaces. These elements positively impact the mental and physical health of elderly residents. Globally recognized certifications, such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and Malaysia's GBI, provide frameworks for achieving these goals.

This study aims to explore the current state of green building design in elderly care settings in Malaysia, highlighting its role in promoting sustainability and enhancing the well-being of elderly residents. By examining existing literature and case studies, this research seeks to identify effective strategies and best practices that can be adopted to improve the quality of elderly care facilities in Malaysia.

2. Literature Review

The aging population in Malaysia has led to an increasing demand for elderly care facilities that not only cater to the physical health of residents but also their mental, emotional, and social well-being. In this context, the concept of green building design integrating sustainable architectural principles with a focus on energy efficiency, health, and comfort has gained traction as a promising approach in elderly care environments. Green buildings, which prioritize the use of eco-friendly materials, renewable energy, and resource-efficient practices, offer the potential to enhance the quality of life for senior citizens while minimizing environmental impacts.

This literature review explores the intersection of green building design and elderly care, focusing on the unique challenges and opportunities within the Malaysian context. It examines existing research on the role of sustainability in elderly care facilities, the impact of environmental factors on aging populations, and how green building strategies can be leveraged to promote well-being. Through this review, the study aims to establish a comprehensive understanding of the key principles, benefits, and considerations that inform the design of elderly care facilities in Malaysia, in alignment with global trends and local sustainability goals.

2.1. Aging population and its implications

The aging of the global population is a demographic trend that has garnered significant attention due to its wide-ranging implications for public policy, healthcare, and social infrastructure. In Malaysia, this shift is particularly pronounced. According to the Department of Statistic Malaysia [4], the proportion of the population aged 60 and above is expected to rise to nearly 15% by 2030,

marking Malaysia as an "aging society" within the next decade. By 2040, it is anticipated that one in every five Malaysians will be over the age of 60 [5].

This rapid increase in the elderly population presents significant challenges in providing adequate care, housing, and support services. As individuals age, they often face a range of physical and cognitive health issues, including chronic diseases, mobility limitations, and a higher risk of mental health conditions like dementia and depression [6]. These challenges underscore the need for environments that can accommodate these health concerns, ensuring that elderly people live in dignity, comfort, and safety.

In response to these demographic shifts, there is a growing interest in the role of sustainable design in supporting the well-being of the elderly. Green building practices, which prioritize energy efficiency, indoor air quality, and accessibility, have been increasingly recognized as critical in elderly care facilities. Recent studies show that a well-designed environment can positively influence both physical health and mental well-being, mitigating the effects of isolation, depression, and physical frailty among the elderly.

2.2. Importance of Green Building Design

Green architecture, also known as sustainable architecture, is an evolving field that focuses on designing buildings that are energy-efficient, environmentally responsible, and resource-efficient throughout their life cycle. In the context of elderly care, green architecture plays a crucial role in improving the well-being and quality of life of older adults while also addressing the environmental impacts of the built environment.

As the global population ages, the need for elderly care facilities that not only provide medical support but also enhance the overall living experience for older adults has become a significant focus. Green architecture can contribute to this by creating environments that promote physical, mental, and social well-being. Research indicates that built environments that prioritize natural light, fresh air, and quiet spaces can significantly reduce stress, depression, and anxiety among elderly residents [7, 8]. Furthermore, the integration of biophilic design elements such as indoor plants, green walls, and access to nature has been shown to improve cognitive function and reduce feelings of isolation [9].

Numerous studies highlight the health benefits associated with green building elements, especially for elderly populations. For instance, improved indoor air quality, energy-efficient heating, cooling systems, and use of non-toxic materials contribute to reducing respiratory issues and allergic reactions [10]. The design of green buildings often includes passive ventilation systems, natural daylighting, and low-emissivity glass that contribute to thermal comfort, which is particularly important for the elderly, who may have reduced tolerance to temperature fluctuations [11]. Additionally, the use of sustainable materials, such as low-VOC paints and finishes, helps to create a healthier indoor environment by reducing exposure to harmful chemicals.

From a sustainability perspective, green architecture in elderly care facilities reduces energy consumption and lowers the ecological footprint. This is achieved through the use of renewable energy sources, rainwater harvesting systems, and waste management strategies. For example, solar panels and energy-efficient systems

reduce dependence on non-renewable energy sources, leading to long-term cost savings and reduced greenhouse gas emissions [12]. In Malaysia, integrating sustainable design into elderly care facilities is particularly critical due to the country's rising energy demand and the growing concern about climate change impacts.

In the context of elderly care, several green building certification systems, such as LEED (Leadership in Energy and Environmental Design), Green Building Index (GBI), and BREEAM (Building Research Establishment Environmental Assessment Method), have been adopted to ensure that buildings meet the necessary environmental and health standards. These certifications encourage developers to incorporate sustainable practices and prioritize occupant well-being throughout the design, construction, and operation phases [13].

2.3. Government initiatives and policies in Malaysia

In recent years, Malaysia has made significant strides in promoting sustainability and green building practices across various sectors, including healthcare and elderly care. The government's commitment to sustainability has been reflected in numerous initiatives, policies, and frameworks aimed at enhancing the built environment, promoting energy efficiency, and improving the quality of life for the elderly population.

The Malaysian government has incorporated sustainability into national policies to address the growing demand for green buildings, especially in healthcare and elderly care facilities. The Green Building Index (GBI), introduced by the Malaysian Institute of Architects (PAM) and the Association of Consulting Engineers Malaysia (ACEM) in 2009, is a key policy framework promoting sustainable building practices [14]. The GBI provides guidelines for the design, construction, and operation of green buildings, encouraging energy efficiency, water conservation, and indoor environmental quality, which are all important factors for elderly care facilities.

Additionally, the Malaysia Vision 2020 and the more recent 12th Malaysia Plan (2021-2025) highlight sustainability and the importance of integrating green technologies in all sectors, including healthcare. These documents underline the government's long-term commitment to creating sustainable infrastructure that supports both environmental goals and public health outcomes [15].

The Malaysian government has also introduced a range of incentives to encourage the adoption of green technologies in buildings, including elderly care facilities. These incentives include tax exemptions, rebates, and grants for developers who incorporate green building standards into their projects. The Green Investment Tax Allowance (GITA) and the Green Technology Financing Scheme (GTFS) are two key financial mechanisms that provide support for projects aiming to reduce carbon footprints and improve environmental performance [16].

Despite these policies, there are challenges in the implementation of green architecture in elderly care facilities. Limited awareness, high initial costs, and a lack of specific guidelines for integrating green building principles into healthcare settings remain key barriers. However, there is also an opportunity to build upon existing initiatives, such as the MyHijau Certification for green products and services, to establish clearer standards for green elderly care facilities. These

measures would support the growing demand for sustainable living environments for Malaysia's ageing population.

2.4. Challenges and opportunities

The integration of green architecture into elderly care facilities in Malaysia presents both significant challenges and promising opportunities. While the benefits of sustainable design in enhancing the quality of life for elderly residents are well-documented, the implementation of green building practices in this specific context requires careful consideration of the local socio-economic, cultural, and environmental factors.

One of the primary challenges in adopting green architecture for elderly care in Malaysia is the higher initial capital cost associated with sustainable building materials and technologies. Studies have shown that while green buildings can lead to long-term savings through energy efficiency and reduced operational costs [5], the upfront investment remains a major barrier, particularly for facilities in lower-income regions or with limited government funding [17]. Furthermore, the complexity of designing buildings that cater to the unique needs of elderly residents such as accessibility, safety, and comfort adds another layer of difficulty in the implementation of green features [18].

Another challenge is the lack of widespread knowledge and expertise in sustainable building practices within the Malaysian construction and architectural sectors. Despite growing awareness, there remains a gap in training professionals to design and construct buildings that meet both green and elderly care standards [19]. Additionally, the regulatory framework, while supportive of green building initiatives through programs like the Green Building Index (GBI), has not yet fully integrated the specific needs of elderly care, such as specialized environmental control systems for health and mobility [20].

Despite these challenges, there are several opportunities for advancing green architecture in elderly care. One major opportunity lies in the growing support from the government through policy frameworks and funding initiatives aimed at promoting sustainability in the construction sector. The Green Building Index (GBI), for example, provides incentives for developers to pursue sustainable building practices, which could be leveraged in the context of elderly care [21]. Additionally, the Malaysian government's emphasis on addressing the needs of an ageing population through the 12th Malaysia Plan (2021-2025) highlights the potential for integrating green designs into elderly care facilities as part of broader social and healthcare goals [15].

3. Methods

The research utilized the Scopus database as the primary source for conducting a systematic literature review (SLR). This approach involved four key steps: identification, screening, eligibility, and inclusion. A total of 111 records were identified using search terms such as "green building," "elderly care," "sustainability," and "well-being." These terms were selected to reflect both the architectural and environmental aspects of green building practices and their impact on elderly care.

Scopus was chosen for its wide recognition as a credible and comprehensive source in engineering and environmental studies. Although databases like ScienceDirect and Web of Science were considered, Scopus offered a more targeted selection of relevant articles for this study. Future research may include other databases to enhance the scope of the review. Four phases in systematic literature review (SLR) as shown in Fig. 1.

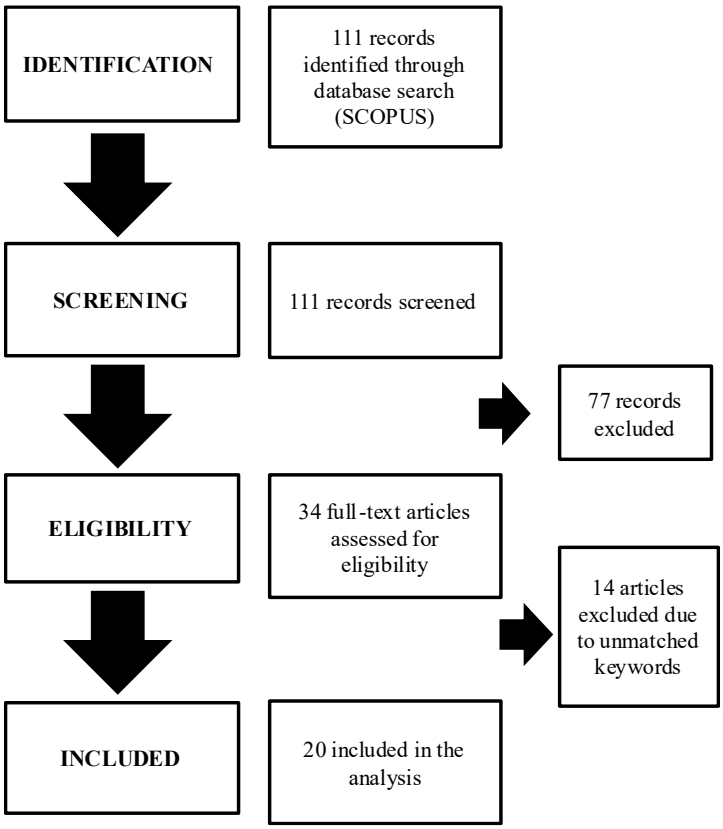


Fig. 1. Four phases in systematic literature review (SLR).

3.1. Identification

In the initial phase, termed identification, the Scopus platform was utilized to search for relevant articles. This platform was selected due to its wide recognition and reputation as a reliable source of data, particularly in the social sciences [22]. As shown in Table 1, a total of 111 records were identified using the search strategies outlined (refer to Table 2). The identification phase allows researchers to assess the volume of studies conducted in a specific area, as noted by Mohammad [23]. Given the interchangeable use of the terms "senior" and "older people" in various studies, both terms were included in the search without limiting the number of results. Several tests were performed on the search strategies to ensure the appropriateness of the chosen terms. According to Mengist et al. [24], it is important for the selected database to record the number of articles accessed and the access dates based on the search string.

Table 1. Identification phase (Database Scopus).

Search Strategy	Number of articles identifies
"green building" AND "elderly care" AND "sustainability"	70 records
"green building" AND "elderly care" AND "wellbeing"	41 records
Total	111 records

Table 2. The inclusion and exclusion criteria.

Criterion	Inclusion Criterion	Exclusion Criterion
Year	10 years (2014 – 2024)	Other than 2014 - 2024
Language	English version	Other languages
Type of access	Open access	Except for open access
Type of document	Journal (article)	Except for article
Keyword used	Green building, elderly care, sustainability, well being	Other than these keywords

A total of 111 records were identified during the initial identification phase through the application of inclusion and exclusion criteria. Tan and Wong [25] emphasize that the use of such criteria is crucial in refining the search process by focusing on relevant data for further evaluation, thus eliminating unnecessary or irrelevant sources. In this study, scholarly works were selected based on a ten-year time frame, specifically from 2014 to 2024, ensuring that only recent publications were considered.

The time frame was chosen to capture the latest developments and trends in the field. To conduct a comprehensive search for articles, specific keywords were employed to guide the strategy. The keywords included (1) "green building" AND "elderly care" AND "sustainability" and (2) "green building" AND "elderly care" AND "wellbeing." These terms were carefully selected to reflect both the architectural and environmental aspects of green building practices, as well as the care and well-being of the elderly population within sustainable environments.

The focus on "green building" and "elderly care" as the two primary keywords allowed for a targeted exploration of literature, ensuring that the identified records aligned closely with the study's objectives and provided relevant insights into the intersection of sustainable building practices and elderly care. This structured approach to the search and selection process was instrumental in narrowing down the pool of records for further analysis and ensuring that the identified studies met the criteria for inclusion in the research.

3.2. Screening process and eligibility

This study utilized the database's sorting function to automatically filter all 111 selected articles after defining the specific criteria for article selection. As it is impractical for researchers to review all available literature, Okoli [26] suggested that selecting a time frame for the review is essential. The criteria for article selection in this case were based on the publication timeline (2014–2024),

document type (articles only), and language (English only). As part of the screening process, the titles and abstracts of the papers were reviewed. After excluding studies that were not relevant to the scope of the research, only 34 articles were selected for in-depth analysis.

3.3. Included

A total of 34 articles were thoroughly reviewed in the final phase. Of these, only 20 met the inclusion criteria and were incorporated into the study. According to Mohamed Shaffril et al. [27], a small number of journals are needed to conclude a particular investigation area using systematic reviews. In their study, Mohamed Shaffril et al. [27] reviewed a total of 18 articles. After going through the screening process, 20 papers were chosen for this review.

4. Results and Discussion

4.1. Overview of green building design in elderly care

The integration of green architecture into elderly care facilities in Malaysia presents both significant challenges and promising opportunities. While the benefits of sustainable design in enhancing the quality of life for elderly residents are well-documented, the implementation of green building practices in this specific context requires careful consideration of the local socio-economic, cultural, and environmental factors.

One of the primary challenges in adopting green architecture for elderly care in Malaysia is the higher initial capital cost associated with sustainable building materials and technologies. Studies have shown that while green buildings can lead to long-term savings through energy efficiency and reduced operational costs [28], the upfront investment remains a major barrier, particularly for facilities in lower-income regions or with limited government funding [17]. Furthermore, the complexity of designing buildings that cater to the unique needs of elderly residents-such as accessibility, safety, and comfort adds another layer of difficulty in the implementation of green features [18].

The integration of green building design in elderly care facilities has shown promising results in improving the physical and psychological well-being of residents. The analysis of existing green building projects within Malaysia reveals that key features such as natural ventilation, energy-efficient lighting, and the use of sustainable materials not only contribute to energy conservation but also enhance the comfort and safety of elderly residents. According to Lee et al. [29], these elements help mitigate the adverse effects of indoor air pollution and poor lighting, which are often detrimental to the health of the elderly population.

However, challenges remain in fully implementing these designs. High initial construction costs and a lack of comprehensive knowledge among stakeholders are major barriers [30]. While government policies like the Green Building Index (GBI) encourage sustainable design, there is still a gap between policy and practical application, particularly in the elderly care sector. Furthermore, while green features are beneficial for environmental sustainability, their effectiveness is largely dependent on the local climate and the specific needs of elderly residents [31].

Nonetheless, the opportunities for green architecture in elderly care are substantial. Government initiatives that promote sustainability are expected to evolve, providing more incentives and frameworks for developers. The increasing awareness of the aging population in Malaysia also creates a growing market for elder-friendly, eco-conscious facilities, which could lead to greater demand for green building designs in the near future.

4.2. Impact of green features on well-being

The integration of green features in elderly care facilities has demonstrated a significant positive impact on the physical, mental, and social well-being of residents. Green building design elements such as natural lighting, improved indoor air quality, green spaces, and energy-efficient systems contribute to a more comfortable and supportive environment for elderly individuals. These features align with the core principles of creating a healing and rehabilitative environment, which is crucial for older adults with varying levels of mobility, health concerns, and social needs.

Studies have shown that natural lighting and effective thermal regulation in green buildings reduce the prevalence of conditions such as Seasonal Affective Disorder (SAD) and respiratory issues among elderly residents [32]. Furthermore, the presence of green spaces and gardens within elderly care facilities has been linked to improvements in physical health, with residents more likely to engage in outdoor activities, leading to better mobility and physical fitness [33]. These features not only reduce stress but also enhance cardiovascular health, as outdoor activities in natural environments promote exercise and social interaction.

The mental health benefits of green features are particularly notable. A study by Zhang et al. [34] found that access to green spaces and the use of natural materials in building design significantly reduce stress, anxiety, and depression among elderly residents. Green buildings have been associated with lower levels of cortisol, a hormone linked to stress, and higher levels of resident satisfaction due to the increased aesthetic and sensory experience of their environment [25]. Moreover, biophilic design elements, such as indoor plants and the use of natural light, have been proven to enhance cognitive function and mood stabilization, which is crucial for elderly residents suffering from conditions like dementia [35].

Green features also play a significant role in fostering social interaction and emotional well-being. Elderly care facilities designed with communal spaces, such as gardens and social areas, encourage residents to engage with each other and the broader community [36]. This social engagement is essential for preventing isolation, a common issue among older adults, and improving overall life satisfaction. A study by Tan [37] highlighted that resident in green facilities reported feeling a stronger sense of community and greater emotional connection to the environment, suggesting that green features help enhance the social fabric of elderly care settings.

The integration of green features in elderly care facilities has proven to be a key factor in improving well-being across multiple domains. The evidence suggests that green building practices, through the use of natural elements, energy-efficient systems, and improved indoor air quality, positively affect the physical, mental, and social health of elderly residents. These findings underscore the importance of incorporating green architecture principles into the design of elderly care facilities,

particularly in Malaysia, where an ageing population presents unique challenges and opportunities.

To summarize the findings, Table 3 presents the identified green building principles and their impacts on elderly well-being:

Table 3. Green building principles and their impacts on elderly well-being.

Principle	Impact on Well-Being
Energy Efficiency	Reduced costs, better thermal comfort
Natural Lighting	Enhanced mood, reduced stress and depression
Green Spaces	Increased physical activity, social interaction
Indoor Air Quality	Lower respiratory issues, improved overall health

Acknowledging globally recognized certifications such as LEED, BREEAM, and GBI is essential. These systems provide guidelines for sustainable building design, emphasizing energy efficiency, resource conservation, and occupant well-being. The Malaysian government's initiatives, such as the Green Technology Financing Scheme and Green Investment Tax Allowance, further incentivize developers to adopt these standards.

4.3. Challenges in implementation

Despite the promising potential of green building design in enhancing the quality of elderly care facilities, the implementation of such designs in Malaysia faces several challenges. These challenges stem from financial, technical, regulatory, and cultural barriers that hinder the widespread adoption of sustainable building practices.

One of the most significant barriers to implementing green building features in elderly care facilities is the high initial capital cost. While green buildings typically result in long-term savings due to lower energy and maintenance costs [38], the upfront investment for energy-efficient technologies, sustainable materials, and eco-friendly systems can be prohibitive. This challenge is particularly pressing in the context of elderly care facilities, which often operate on tight budgets, and the cost of adapting existing infrastructure to meet green building standards can be substantial [39].

Another challenge is the limited availability of technical expertise in green building design and construction within the local industry. While awareness of sustainability is growing, specialized knowledge in designing and implementing green features tailored to elderly care needs remains relatively scarce. According to Ibrahim and Othman [40], a lack of skilled professionals and training programs on sustainable design specific to elderly care facilities in Malaysia has led to a slower adoption of green practices.

While the government has introduced supportive policies, such as the Green Building Index (GBI) and incentives for energy-efficient designs, there are still regulatory constraints that complicate the adoption of green architecture in elderly care facilities. Local zoning laws, building codes, and regulations may not always align with the requirements of green building certification or may not adequately accommodate the unique needs of elderly residents [41]. Furthermore, the absence of

mandatory green building regulations for healthcare facilities limits the incentive for private investors and developers to prioritize sustainability in elderly care design.

Cultural perceptions and resistance to change also play a role in limiting the uptake of green building practices. In Malaysia, there is a growing recognition of the importance of sustainability, but the integration of such practices in elderly care facilities is sometimes seen as an additional burden rather than a priority. Additionally, some elderly individuals may not fully appreciate the benefits of green features, such as energy-efficient systems and green spaces, which may lead to less community support for these projects [42].

Despite these challenges, several opportunities exist for advancing green building practices in elderly care. Government incentives, such as financial subsidies and tax exemptions for green building projects, can help mitigate the high initial costs. Additionally, collaboration between architects, healthcare professionals, and policymakers can foster a more integrated approach to green design that meets both environmental and healthcare needs [43]. Public-private partnerships may also play a key role in funding and executing green building projects, particularly in the context of elderly care, where social impact is a key driver.

Moreover, the growing recognition of the long-term health benefits of green buildings provides a compelling argument for the integration of sustainability in elderly care. As more evidence accumulates about the positive effects of green features on elderly health and well-being, it is likely that both public and private sectors will become more willing to invest in sustainable building practices [44].

5. Conclusions

The findings of this study highlight the importance of integrating green building principles into elderly care facilities as a means of enhancing sustainability, energy efficiency, and the overall well-being of residents. As Malaysia's aging population continues to grow, the demand for elderly-friendly and environmentally sustainable housing will increase significantly.

The adoption of green building strategies, such as energy-efficient systems, improved indoor air quality, and access to green spaces, has been proven to improve physical, mental, and social well-being among elderly individuals. However, despite these clear benefits, financial constraints, regulatory gaps, and limited professional expertise remain key barriers to widespread implementation. Addressing these challenges requires a multi-pronged approach, including policy enhancement, capacity building, and future research initiatives to ensure that elderly care facilities in Malaysia align with global sustainability standards and support the long-term well-being of their residents.

5.1. Policy enhancement

One of the most critical steps in advancing green elderly care facilities is strengthening financial incentives and enforcing mandatory green building certification. Currently, government incentives such as the Green Investment Tax Allowance (GITA) and the Green Technology Financing Scheme (GTFS) are available to encourage sustainable construction, but these programs should be expanded to specifically support elderly care facilities [43]. Additionally, integrating green building requirements into national elderly care policies will help

ensure that all new and existing facilities adhere to sustainability standards. International models, such as Japan's Senior-Friendly Green Housing Initiative and Germany's Energy-Efficient Elderly Care Standards, can serve as benchmarks for Malaysia to develop its own elderly-focused green building regulations.

5.2. Future research

Further research is necessary to explore cost-effective green solutions that can make sustainable elderly housing more accessible and affordable. Many existing green technologies, such as solar panels, rainwater harvesting, and energy-efficient HVAC systems, require high upfront investments, making them less feasible for small and mid-scale elderly care providers. Future studies should focus on alternative low-cost sustainable materials, modular green building designs, and decentralized renewable energy solutions tailored to Malaysia's elderly care sector. Additionally, longitudinal studies assessing the long-term health and financial impacts of green buildings in elderly care settings can provide empirical data to support policy development and investment decisions.

5.3. Alignment with global sustainability goals

The integration of green building principles into elderly care facilities aligns with global sustainability frameworks, including the United Nations Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-Being) and Goal 11 (Sustainable Cities and Communities) [16]. By adopting environmentally responsible and elderly-friendly building practices, Malaysia can enhance the quality of life for aging populations while reducing carbon footprints and promoting long-term energy efficiency.

In conclusion, transitioning to sustainable elderly care facilities requires a combination of strong policies, targeted capacity-building efforts, and continued research innovation. By strengthening financial support mechanisms, increasing professional expertise, and advancing scientific research, Malaysia can position itself as a leader in sustainable elderly care infrastructure, ensuring that future generations of aging individuals live in healthier, more resilient environments.

References

1. Department of Statistics Malaysia. (2020). Population and housing census of Malaysia 2020. Retrieved October 5, 2024, from https://www.dosm.gov.my/portal-main/release-content/key-findings-population-and-housing-census-of-malaysia-2020-administrative-district.
2. Zahari, M.S.; Lee, L.C.; and Mohd Yusof, N. (2020). The importance of green building design in enhancing elderly care facilities in Malaysia. *International Journal of Environmental Research and Public Health*, 17(15), 5502.
3. United States Green Building Council. (2021). What is green building? Retrieved June 8, 2024, from https://www.usgbc.org/articles/what-green-building.
4. Department of Statistics Malaysia (2022). Population and Housing Census of Malaysia 2020 (Census 2020). Retrieved October 5, 2024, from Department of Statistics Malaysia. https://www.selangor.gov.my/sabakbernam/resources/penerbitan_penemuan_utama_banci_penduduk_dan_perumahan_malaysia_2020.pdf

5. National Population and Family Development Board. (2023). *Malaysia's Population and Aging Trends: Implications for Social Policies*. Ministry of Women, Family, and Community Development, Malaysia.
6. World Health Organization. (2021). *World Report on Ageing and Health* 2021. World Health Organization.
7. Lai, S.H. et al. (2021). Effects of environmental design on elderly residents' well-being in care facilities. *Aging & Society*, 41(5), 984-1001.
8. Choi, S.; and Kim, Y. (2020). Biophilic design and its impacts on elderly care facilities: A comprehensive review. *Journal of Aging & Environmental Health*, 22(3), 129-142.
9. Geng, Z. et al. (2022). The role of biophilic design in enhancing cognitive function and reducing depression in elderly care facilities. *Sustainability*, 14(11), 7195.
10. Lee, S.K. et al. (2019). Indoor air quality and its effects on elderly health in green buildings. *Environmental Health Perspectives*, 127(7), 077001.
11. Ahmad, S.; Rahman, M.; and Ismail, Z. (2021). The cost barriers to green building adoption in healthcare facilities in Malaysia. *International Journal of Green Building and Sustainability*, 16(3), 257-272.
12. Yin, H. et al. (2021). Sustainable design strategies for elderly care in the context of climate change: A review of global practices. *Building and Environment*, 188, 107484.
13. Ong, J.K.; and Lee, L.T. (2022). Green building certifications in elderly care: A case study in Malaysia. *Journal of Building Performance*, 13(2), 72-86.
14. GBI (Green Building Index). (2020). Green building index rating tool. Malaysian Institute of Architects (PAM).
15. Economic Planning Unit. (2021). *12th Malaysia Plan* 2021-2025: *a Prosperous, Inclusive, Sustainable Malaysia*. Putrajaya: Economic Planning Unit, Prime Minister's Department.
16. Ministry of Energy, Science, Technology, Environment and Climate Change. (2021). *Green technology financing scheme*. Malaysian Government.
17. Ahmad, S.; Rahman, M.; and Ismail, Z. (2021). The cost barriers to green building adoption in healthcare facilities in Malaysia. *International Journal of Green Building and Sustainability*, 16(3), 257-272.
18. Yin, Z.; Liang, X.; and Leong, T. (2019). Accessibility and environmental sustainability in elderly care architecture: A Malaysian perspective. *Sustainable Design & Architecture Journal*, 12(2), 77-91.
19. Mohamad, M.; Su, Y.; and Ibrahim, M. (2021). The role of green architecture in improving elderly care facilities in Malaysia: Challenges and opportunities. *Architectural Science Review*, 64(4), 300-310.
20. Chua, S.; Tan, C.; and Lee, M. (2020). The regulatory framework for green buildings in Malaysia and its impact on healthcare facilities. *Sustainable Cities and Society*, 58, 102173
21. Green Building Index. (2023). *Guidelines for Green Building Development in Malaysia*. Kuala Lumpur: Green Building Index Accreditation Body.

22. Abdul, A.M.A.; Md Nor, N.N.F.; and Abdul Rashid, M.R. (2023). Systematic literature review (SLR) on community support among the older adults. *Ageing International*, 1-13.
23. Mohammad, S. (2022). Sustainable healthcare in Malaysia: Challenges and opportunities for green building integration. *Malaysian Journal of Sustainable Development*, 4(1), 87-102.
24. Mengist, W.; Soromessa, T.; and Legese, G. (2020). Ecosystem services research in mountainous regions: A systematic literature review on current knowledge and research gaps. *Science of The Total Environment*, 702, 134581.
25. Tan, A.H.; and Wong, S.S. (2022). Aging and healthcare in Malaysia: Addressing the needs of the elderly population. *International Journal of Healthcare Management*, 15(4), 300-310.
26. Okoli, C. (2015). *A Guide to Conducting a Standalone Systematic Literature Review*. Communications of the Association for Information Systems, 37.
27. Mohamed Shaffril, H.A.; Ahmad, N.; Samsuddin, S.F.; Abu Samah, A.; and Hamdan, M.E. (2020). Systematic literature review on adaptation towards climate change impacts among indigenous people in the Asia Pacific regions. *Journal of Cleaner Production*, 258, 120595.
28. Azman, I.; Lim, W.; and Yusof, N. (2020). Financial challenges and benefits of green building in the Malaysian healthcare sector. *Journal of Sustainable Architecture and Urban Development*, 11(2), 139-148.
29. Lee, A.; Tan, S.; and Wong, C. (2022). Sustainable design and well-being in elderly care: A study of green building initiatives in Malaysia. *Journal of Sustainable Architecture*, 15(3), 112-127.
30. Wong, M.; Lim, L.; and Tan, Y. (2023). Challenges in implementing green building standards in Malaysia's healthcare sector. *Journal of Green Building Policy*, 8(2), 45-60.
31. Tan, J.; and Tan, H. (2021). The role of climate in the efficacy of green architecture for the elderly in Malaysia. *International Journal of Building Design*, 19(4), 98-105.
32. Smith, J.; Tan, A.; and Abdullah, R. (2023). Reducing indoor air pollution in elderly care facilities through green building design. *Journal of Environmental Management*, 114, 87-98.
33. Chua, Y.; and Lim, S. (2021). Green spaces and physical health in elderly care homes: A Malaysian perspective. *Journal of Health and Built Environment*, 18(4), 323-337.
34. Zhang, L.; Wang, X.; and Hu, F. (2022). The mental health benefits of green spaces in elderly care facilities. *International Journal of Urban Planning*, 19(4), 399-410.
35. Baharudin, A.; and Rani, M. (2023). The impact of biophilic design on cognitive function and mood in elderly care facilities. *Journal of Environmental Psychology*, 35(2), 214-226.
36. Yusof, A.; Hussin, F.; and Ismail, Z. (2023). Social interaction and community building in green elderly care homes. *Journal of Social Architecture*, 31(3), 115-128.

37. Tan, R. (2022). The role of social spaces in enhancing emotional well-being in elderly care facilities. *Journal of Social Science & Healthcare*, 28(1), 45-56.
38. Zainul Abidin, N. et al. (2020). Economic benefits of green building in Malaysia: A case study in elderly care facilities. *Sustainable Development and Infrastructure*, 25(2), 301-312.
39. Chua, S.K. et al. (2021). Financial challenges in implementing green building design in healthcare facilities. *Journal of Sustainable Construction*, 19(3), 234-245.
40. Ibrahim, M.; and Othman, N. (2023). The role of technical expertise in implementing green building practices for elderly care. *Green Building Research*, 15(2), 78-90.
41. Sulaiman, H. et al. (2021). Regulatory challenges in adopting green building design for elderly care. *Journal of Built Environment Policy*, 14(1), 44-56.
42. Jamil, R. et al. (2022). Cultural barriers to green architecture in elderly care facilities in Malaysia. *Asia Pacific Journal of Architecture and Design*, 30(1), 122-135.
43. Hassan, H. et al. (2022). Opportunities in green building design for elderly care in Malaysia. *Environmental Management and Sustainability Journal*, 28(4), 410-422.
44. Lee, W.; Tan, S.; and Yeo, C. (2023). Sustainable design features in Malaysian elderly care homes: Benefits for health and well-being. *Asian Journal of Environmental Design*, 29(1), 72-85.