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BIOPHILIC DESIGN FOR ELDERLY HOMES IN MALAYSIA FOR IMPROVED QUALITY OF LIFE

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Abstract

The demand for homes for elderly housing has significantly increased in recent years. However, in Malaysia, the attention to the living quality of the elderly has been inadequate, leading to the prevalence of elderly care homes resembling institutional settings. Such environments contribute to social isolation and depression among elderly residents. This study went beyond examining the health benefits of biophilia and investigated how incorporating biophilic principles could enhance overall health and wellbeing. Specifically, the study explored the advantages of integrating biophilic patterns in promoting the health and wellbeing of the elderly and assessed the extent to which such design patterns are implemented in Malaysian elderly homes. A quantitative survey approach was employed, involving the participation of seniors residing in elderly care homes across Malaysia. The survey examined existing design elements in these homes and gathered the preferences of the elderly regarding an improved living environment incorporating biophilic elements. The findings revealed that only three essential biophilic patterns were generally present in most homes. Consequently, the study highlights the critical biophilic design patterns that should be incorporated when designing elderly homes to enhance the quality of the elderly in Malaysia.

Keywords: Biophilic pattern, Elderly homes, Health, Malaysia, Wellness.

1. Introduction

According to research conducted by the Malaysia Research Institute on Ageing, it is projected that the number of elderly individuals in the country will reach 3.3 million by 2020, accounting for approximately 11% of the total population at that time. This proportion is expected to increase to 15% by 2045. The number of Malaysians aged 65 and above is also anticipated to triple from two million to over six million by 2040, with the number of individuals aged 80 and above rising from 0.3 million to nearly 1.4 million by the same year (equating to three senior citizens for every 20 Malaysians) [1].

The majority of individuals spend about 80% of their time within enclosed or indoor spaces, such as their homes, workplaces, or shopping malls. As a result, there has been a growing emphasis on sustainable building designs, leading to the introduction of various green-building design rating systems. While this focus is crucial for sustainable design, construction, and development, there appears to be an imbalance between user experiences, human health, and overall wellbeing. Designers must consider this modern lifestyle as a foundation for their designs, ensuring that buildings positively impact their users. The demand for elderly care homes or retirement homes is increasing in line with the growth of the senior population.

In Malaysian culture, it has been a traditional practice for families to assume the responsibility of caring for the elderly. However, in cases where elderly individuals lack family support or when families cannot provide care, government or private elderly care centres come into play. A study conducted by Jawad [2] at a state-run elderly care home in Malaysia, which had a capacity of 200 beds, as documented by the Asian Institute of Medicine, Science and Technology in 2007, revealed that out of 167 elderly residents, 67% experienced varying degrees of depression. This can be attributed to inadequate planning and design of spaces and a lack of emotional and medical support from the facility staff, resulting in visible depression and dementia in residential and nursing homes.

Furthermore, with modern urbanisation and societal advancements, it has become common for young adults to migrate to cities for employment, leaving their parents and hometowns behind [3]. Consequently, the younger generation cannot provide direct care and support to their elderly parents daily. As a last resort, many young individuals have decided to place their parents in institutional settings for elderly care [4].

Although the elderly population in Malaysia is not currently a dominant demographic group, its numbers have been rapidly increasing in recent times. The Department of Social Welfare, operating under the Ministry of Women, Family, and Community Development, oversees public institutions and elderly homes. Non-profit organisation elderly homes are often established by charitable groups that aim to serve impoverished or abandoned elderly individuals. Furthermore, private elderly homes that provide similar services as public elderly care centres have emerged in response to the growing demand. It is crucial to create a supportive environment for the elderly, as ageing can lead to feelings of depression and loneliness. Ageing, loss of loved ones, social isolation, and the challenges of performing daily activities can result in various physical and mental disabilities [5].

Numerous studies have explored how natural living environments and contact with nature can contribute to faster recovery, improved sleep patterns, reduced

physical discomfort, and increased longevity [6]. The biophilia hypothesis, proposed by Kellert and Wilson [7], suggests an inherent connection between humans and the environment. Browning and colleagues [8] classified and defined 14 specific patterns of biophilic design, which encompass a variety of intentional and modified applications found throughout the built environment on a global scale. These patterns highlight the interconnectedness between the built environment, human biology, and nature. Incorporating these patterns, designers can implement and justify biophilic designs in landscapes, urban spaces, and buildings. Additionally, these patterns demonstrate these spaces' significant psychological impact on human wellbeing and productivity [9].

1.1. Biophilia

Biophilia, a term coined initially by Fromm [10] in his book "The Anatomy of Human Destructiveness", gained popularity through the work of Kellert and Wilson [7]. They popularised the hypothesis that humans have an innate connection to nature, stemming from our origins, which leads to a solid attraction for life and life-like processes. The biophilia hypothesis, if proven, presents a compelling argument for the conservation of biological diversity. Moreover, it implies significant consequences for human wellbeing as society becomes increasingly disconnected from the natural world. The relentless destruction of the environment can profoundly impact people's quality of life, affecting not only material aspects but also psychological and spiritual dimensions.

In their article, "14 Patterns of Biophilic Design: Improve Health and Wellbeing in the Built Environment", Browning et al. [8] propose a framework for biophilic design that highlights the essential elements of the built environment related to the relationship between nature and human health. This framework aims to enhance the quality of individuals' lives and promote their wellbeing through a connection with nature.

This study briefly discusses the critical considerations for implementing biophilic designs and places them in architectural history, practices, and health science. Additionally, it combines theory and implementation by incorporating the three classifications of user experience, along with their corresponding patterns listed in the book “Biophilic Design: The Theory, Science and& Practice of Bringing Buildings to Life” by Kellert [11], as the foundation.

The biophilic responses discussed in these publications have revealed valuable patterns for designers working in the built environment. These patterns have been summarised and incorporated into the suggested implementation content within this paper. Building upon this point, the author has also established a link between the 14 patterns of biophilic design and their impact on human health and wellbeing, which is supported by a range of empirical research and studies (as depicted in Fig. 1).

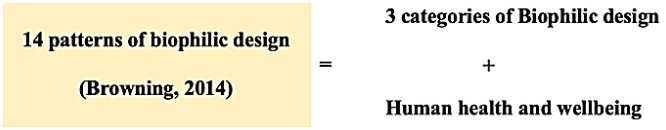

Fig. 1. Main structure of the “14 Patterns of Biophilic Design”.

Figure 2 shows the evolution of biophilic design from a theoretical base to implementation in design and the connection of the nature-health relationship.

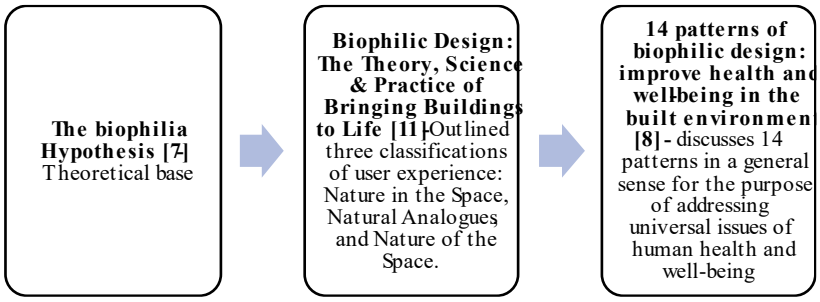

Fig. 2. The evolution of biophilic design theory.

Kellert [11] has extensively categorised over 70 different mechanisms that contribute to creating a biophilic experience. This comprehensive framework provides designers with crucial insights into the essential aspects of nature to consider when designing a building. Additional authors, such as Cramer and Browning [12], have contributed to this field by highlighting three user experience classifications: Nature in the Space, Natural Analogues, and Nature of the Space. Their work explores the innate human affinity for connecting with natural processes and systems. This understanding is recognised as a crucial aspect of design within the built environment. The book offers precise guidelines on the attributes, elements, and dimensions of biophilic design, which developers and planners can adopt to achieve their goals and vision in the context of the modernised urban built environment.

This study supports biophilic design's measurable and significant benefits on wellbeing, reinforcing the empirical evidence regarding the connection between humans and nature. It emphasises the increasing importance of incorporating this understanding into design practice and research. However, comprehensive guidance for implementing biophilic design is lacking despite the recognised significance.

Browning et al.'s [8] research successfully bridged the gap between current research and implementation by presenting a framework for biophilic design. These adaptable and flexible design patterns allow project-specific implementation in exterior and interior environments [13]. From a designer's perspective, these biophilic design patterns can redefine the discourse on environmental quality by considering the needs and wellbeing of individuals on equal footing with conventional building performance metrics that have traditionally overlooked human health and wellbeing. This framework reflects the essential interrelationships between health and nature, which remain important in the built environment and aims to enhance individuals' lives through meaningful connections with nature.

'Nature in the Space' encompasses the presence and diversity of plant life, water bodies, animal species, and other natural elements within the built environment. This category comprised seven identified patterns of interaction that include 1) Visual connection with nature, 2) Non-visual connection with nature, 3) Non-rhythmic sensory stimuli, 4) Access to thermal and airflow variability, 5) Presence of water, 6) Dynamic and diffuse light, and 7) Connection with natural systems.

'Natural Analogues', on the other hand, involve objects, materials, colours, shapes, patterns, and algorithms that evoke elements of nature. These analogues can be seen in various forms in architecture and design, such as representational artwork, ornamentation, biomorphic forms, and natural materials. Three patterns identified within the Natural Analogues category include 8) Biomorphic forms and patterns, 9) Material connection with nature, and 10) Complexity and order.

Lastly, the 'Nature of the Space' pertains to different spatial configurations and the psychological and physiological responses they elicit. This category identified four patterns that include 11) Prospect, 12) Refuge, 13) (Mystery, and 14) Risk/Peril. Hence, the 14 patterns of biophilic design provide the fundamentals for implementing biophilia into building design. Hence, 14 patterns of biophilic design were used as the baseline in this study, which were used to map against the themes formed from the literature review and general survey questions.

1.2. Biophilic design in elderly homes

Several recent studies have pointed out the importance of integrating biophilic design into elderly homes and the positive effects it can bring. The book "Biophilic Cities: Integrating Nature into Urban Cities and Planning" by Beatley [14] suggests that integrated housing facilities provide more opportunities for seniors to integrate with society than housing specifically catered to elders. Bhatt [5] investigated the creation of a senior living community in Delaware using biophilic patterns and elements, emphasising the importance of encouraging humans to stay connected to and interact with nature as part of the natural system. This connection helps individuals feel that they are part of a larger system. Hillary and McCall [15] examined integrating biophilic elements into sustainable designs for senior living in overseas projects.

Several studies have been conducted in Malaysia on the relationship between biophilic design and elderly living. Mansor [16] explored the connection between residents exposed to green infrastructure in Taiping, a small colonial town in Peninsular Malaysia. Othman [17] conducted a study on the influence of outdoor space on the wellbeing of the elderly in a typical care centre, highlighting the emotional, physical, social, and psychological effects of outdoor space on the elderly and their responses to their surrounding environments. Rai et al. [18] investigated mental health issues related to build and indoor environments, emphasising the interrelation and interconnection with nature.

However, there is a gap in the literature as most studies acknowledge the positive effects of integrating biophilic design in the elderly community, but there is a lack of research on implementing biophilic design in elderly homes in Malaysia. Therefore, this investigated the preferences for biophilic design in elderly homes in Malaysia.

1.3. Importance of biophilia to elderly

The need for the elderly to stay connected to nature is not just a choice but a necessity [14]. It has been observed that living environments isolated from natural surroundings can lead to increased depression among the elderly. Bhatt's study [5] provided evidence that neighbourhood designs considering the needs of elderly residents assisted them in seamlessly incorporating nature into their daily routines, leading to healthier lives. The study also highlighted the vital connection between

the elderly and the natural environment, as supported by the Attention Restoration Theory, which showed increased concentration and attention span resulting from interactions with nature, whether through viewing or active engagement [19].

A recent study on dementia care in assisted living emphasised the importance of securing outside activity spaces as a crucial aspect of designing living spaces for the elderly [20]. This finding revealed the seniors' desire to engage with the natural environment. Another study by Tang and Brown [21] explored the effects of viewing a landscape on the physiological health of elderly women and found that it led to lower blood pressure and heart rates. Curl et al. [22] reported a positive correlation between the personal projects of the elderly and their overall quality of life.

These studies provide scientific and theoretical evidence of the benefits of the elderly's engagement with the natural environment. They also reveal the preferences of the elderly to be in nature and demonstrate the positive health effects associated with such engagement. Therefore, it can be inferred that engaging with the natural environment is essential in promoting active ageing and improving the quality of life for the elderly.

2. Methodology

The study employed a quantitative research method to investigate the current living environment and preferences for biophilic design in elderly homes in Malaysia. A commonly used and widely recognised quantitative research technique, the self-administered survey questionnaire, was utilised [23]. This approach allowed for the collection of data from a large number of participants, enabling a comprehensive analysis of the current living conditions and the preferences for biophilic design in elderly homes. The use of a survey questionnaire in this study offered several advantages, including the ability to gather substantial information from a large number of participants within a relatively short period.

2.1. The instrument

The questionnaire was developed to assess the respondents' perspectives on their current living environment and preference for nature-integrated living homes, using a consistent increment of difference ranging from strongly agree (5) to strongly disagree (1). The self-administered survey questionnaire consisted of three sections: (1) respondents' demographic information, (2) the existing living environment of the respondents, and (3) the preferred living environment concerning biophilic elements. The survey questionnaire was distributed to the respondents through the respective person in charge of the homes. Most respondents completed the survey form by themselves, while the researchers, nurses, and staff aided those who required assistance. Once the completed survey questionnaires were collected, the data was transferred to Microsoft Excel for further analysis.

2.2. Study sample

The survey questionnaire was distributed to the residents of senior elderly homecare centres to collect data that would be used to examine the presence of biophilic design patterns in elderly homes in Malaysia and to determine the residents' preferences for improved living conditions related to biophilic elements. The study specifically focused on residents residing in purpose-built elderly care

homes or centres that aimed to provide high-quality retirement living for the elderly, aligning directly with the research objectives. To identify suitable participants, several elderly homes were selected based on reviews and ratings on Yelp and their inclusion in The Star News. Subsequently, the selected elderly homes were approached for potential collaboration. The respondents from the following elderly homes participated in the study:

- The Mansion, Petaling Jaya
- Golden Years Elderly, Puchong
- Good Will Care Center, Johor Bahru
- KLC Senior Care, Kuala Lumpur
- Zen Villa Elderly Home, Petaling Jaya

3. Findings and Discussion

The study included a sample size of 98 seniors who were selected from five different elderly homecare centres. The analysis revealed that 55.1% were male and 44.4% were female within this sample. This distribution aligns with the general population of residents in elderly homecare centres in Malaysia. More than half of the respondents (55%) were 55 years or above. Specifically, 40.8% of respondents were aged 75 and above, 38.7% were between 65 and 75, and 20.4% were between 55 and 65.

Regarding geographical distribution, 36.7% of the respondents were from the Klang Valley, 30.3% were from Johor, 16.4% from Kuala Lumpur, and 16.2% from Ipoh. Most of the seniors (56.6%) had been residing in elderly care homes for more than six months, while approximately 42.8% had been staying for less than six months. When selecting their home, 50.5% of the respondents reported choosing based on the facilities offered, 26.5% considered the proximity of the eldercare facility to their homes, and 22.2% prioritised medical support (as presented in Table 1).

Table 1. Demographic data.

		N	Percentage (%)
Gender	Male	54	55.1
	Female	44	44.4
Age	55-65	20	20.4
	65-75	38	38.7
	75 and above	40	40.8
Area of location	Kuala Lumpur	16	16.4
	Klang Valley	36	36.7
	Ipoh	16	16.2
	Johor	30	30.3
Duration	Less than half a year	42	42.8
	More than half a year	56	56.6
Reason choosing the facility	Distance (near my family members)	26	26.5
	Facility	50	50.5
	Medical Support	22	22.2
	Total	**98**	**100**

Notably, all respondents expressed satisfaction with their current living environment; however, they believed there was room for improvement. Consequently, it can be concluded that the existing living environment is deemed sufficient and capable of meeting their expectations.

3.1. Existing living environment of the elderly care homes

The study's findings revealed that the most reported biophilic patterns in the outdoor environment of respondents were the presence of gardens with turfing or grass and flowering plants. Consequently, visual connections with nature, non-rhythmic sensory stimuli, and connections with natural systems were the biophilic patterns that had the highest occurrence (as illustrated in Table 2). More than half of the respondents reported the presence of shaded settings, with most having patios in their outdoor spaces. These elements contribute to the variability of the thermal environment, airflow, and refuge, which is crucial in providing sufficient comfort and protection for seniors.

Table 2. Existing features in the outdoor living environment of the respondents.

Feature	Type	Frequency (%)	Biophilic patterns mapping
Presence of garden	Cone-cylinder	80.8(80)	Visual Connection with Nature
Presence of plants		100(98)	Non-Rhythmic Sensory Stimuli
Type of plants	Flowering plants	57.1(57)	Connection with Natural Systems
	Non-flowering plants	48.9(48)	
Presence of big tree (more than 1 storey high）		48.9(48）	Mystery
Presence of grass		72.4(72)	Visual Connection with Nature
Presence of a swimming pool		15.3(15)	Presence of Water
Presence of a water pond		21.2(21)	Presence of Water
Feature in the water pond	Fish	8.2(8)	Non-Rhythmic Sensory Stimuli
	Plants	2(2)	Connection with Natural Systems
	Sculpture	11.2(11)	Non-Visual Connection with Nature
	Fountain	11.2(11)	
Presence of wood-furnished furniture		36.4(36)	Material Connection with Nature

Presence of pet		21.2(21)	Non-Rhythmic Sensory Stimuli
Type of pet	Cat	7.1(7)	
	Dog	13.2(13)	
	Fish	6.1(6)	
Presence of shaded seating		57.6(57)	Thermal & Airflow Variability
Type of shaded seating	Gazebo	7.1(7)	Refuge
	Patio	42.8(42)	
	Seating under tree	13.2(13)	
	Total	**100(98)**	

Furthermore, nearly half of the respondents reported the presence of large trees (higher than 1 storey height), which corresponds to the biophilic pattern of Mystery. This significant pattern facilitates engagement between seniors and the natural environment. However, the presence of water features, companions, and furniture made of wood materiality was reported to be low.

3.2. Existing features in the indoor living environment

Most respondents (80%) reported having access to daylight and wind in their living rooms, compared to less than 71% having such access in their bedrooms. Approximately 75.5% of the respondents had a direct view of the garden from their living rooms, whereas only 31.6% had a view from their bedrooms (as depicted in Table 3). These findings indicate that the design of indoor living spaces often prioritises providing views towards the garden in common areas rather than in private spaces.

Table 3. Existing features in the indoor living environment of the respondents.

Feature	Frequency, %		Mean	Biophilic Patterns Mapping
	Living room	Bedroom		
Direct sunlight from outdoor	85.7(84)	71.4(70)	78.55	Dynamic& Diffuse Light
Direct view of the garden	75.5(74)	31.6(31)	53.55	Visual Connection with Nature Connection with Natural Systems
Direct wind into the house	85.7(84)	64.3(63)	75	Thermal & Airflow Variability
Wallpaper with animal pattern	2(2)	3.1(3)	2.55	Biomorphic Forms & Patterns
Wallpaper with plant pattern	3.1(3)	2(2)	*2.55*	Biomorphic Forms & Patterns
Wallpaper with geometric pattern	12.2(12)	3.1(3)	7.65	Complexity & Order

Courtyard	12.2(12)	4.1(4)	8.15	Visual Connection with Nature
Indoor pond	4.1(4)	0(0)	2.05	Presence of Water
Indoor plant	14.3(14)	6.1(6)	10.2	Visual Connection with Nature
Window seating	37.8(37)	17.3(17)	27.55	Refuge
Double volume with balcony	11.2(11)	11.2(11)	11.2	Risk/Peril
Wood sculpture	13.2(13)	4.1(4)	5.65	Material Connection with Nature
Stone sculpture	6.1(6)	0(0)	3.05	Material Connection with Nature
Use of fragrance candle	9.2(9)	7.1(7)	8.15	Non-Visual Connection with Nature
Wood furniture	44.9(44)	37.8(37)	41.35	Material Connection with Nature
Stone furniture	2(2)	2(2)	2	Material Connection with Nature
Wood flooring	5.1(5)	17.3(17)	11.2	Material Connection with Nature
Balcony	25.5(25)	17.3(17)	21.4	Thermal & Airflow Variability
Window	73.5(72)	79.6(78)	76.55	Dynamic& Diffuse Light
Sliding door	57.4(56)	23.5(23)	40.45	Thermal & Airflow Variability Dynamic & Diffuse Light

Approximately two-thirds of the respondents had windows in their living rooms (73%) and bedrooms (79%). More than half of the respondents (57.4%) had sliding doors in their living rooms, whereas only about 23.5% had sliding doors in their bedrooms. A quarter of the respondents (25%) reported having a balcony in their living room area, while 17.3% had one in their bedroom. The presence of courtyards was reported to be the least common, with 12.2% in the living room and 4.1% in the bedroom. This finding aligns with the high access to natural energy (light and ventilation) observed in the respondents' indoor living environments. Scented candles were reported to be used by only 9.2% of respondents in their living rooms and 7.1% in their bedrooms.

The presence of daylight was most frequently reported (78.55%), corresponding to the presence of windows (76.55%). Thus, the existing biophilic patterns observed in the respondents' indoor environments are primarily Dynamic and Diffuse Light. Additionally, the presence of sliding doors (more than half) indicates the presence of the biophilic pattern of Thermal and Airflow Variability. The direct view (53.55%) can be associated with the biophilic patterns of Visual Connection with Nature and the Natural System.

Table 4 presents the most frequently occurring and similar biophilic patterns observed in both indoor and outdoor living environments. The study identified several significant biophilic patterns consistently reported in the respondents' living spaces. These patterns include the thermal environment, airflow variability, visual connection with nature, and connection with natural systems from nature in space. The biophilic patterns of dynamic and diffuse light, refuge, and non-rhythmic sensory stimuli were also commonly observed.

Table 4. The most occurring and similar biophilic patterns in living environments of the elderlies.

Most occurring Biophilic Patterns	
Outdoor	**Indoor**
Visual connection with nature	Dynamic and diffused light
Non-rhythmic sensory stimuli	Thermal and airflow variability
Connection with natural system	Visual connection with nature
Thermal and airflow variability	Connection with natural system
Refuge	
Similar biophilic patterns	
Thermal and airflow variability, Visual connection with nature, Connection with natural system	

3.3. Preferred outdoor living environment features

Turfed gardens were most preferred (70.4%), followed by flowering plants (65.3%) and fruit trees and vegetables (61.2%), as shown in Table 5. Less than non-flowering plants were preferred at 19.3%, while gardens without grass got the least percentage, only 2%. The result revealed that most respondents preferred a garden with green features and flowering plants in their outdoor living environment as there would be a greater variety of species and colours, intensifying their engagement with nature. About 35.7% of respondents preferred fishponds to fountains (24.4%), and the swimming pool preferred the least (12.2%). Interestingly less than one quarter (23.4%) preferred wood decking and furniture. And having pets (22.4%). Findings revealed that respondents do not strongly prefer biophilic elements intervention.

As for relaxation spaces, the study found that sitting under a tree was the most preferred option among respondents, accounting for 36.7% of the preferences. This was followed by gazebos at 29.5% and patios at 25.5%. These results indicate that most participants favoured spaces that allowed them to interact closely with the natural environment. In terms of specific features, the most preferred ones were gardens with grass/turfing, followed by flowering plants and fruit or vegetable plants. These preferences aligned with the biophilic patterns of Connection with

Natural Systems, where seniors can directly engage with nature. Additionally, more than one-third of the respondents expressed a preference for fishponds and seating areas under trees. These features are associated with biophilic patterns such as Refuge, Thermal and Airflow Variability, Presence of Water, and Non-rhythmic Sensory Stimuli.

Table 5. Preferences of features in the outdoor living environment.

Item	N	Frequency (%)	Biophilic patterns mapping
Garden with grass	69	70	Connection with natural systems
			Visual connection with nature
Garden without grass	2	2	Connection with natural systems
Flowering plants	64	65.3	Connection with natural systems
Non-flowering plants	19	19.3	Connection with natural systems
Fruit trees/ vegetables	60	61.2	Connection with natural systems
Fishpond	35	35.7	Presence of water
			Non-rhythmic sensory stimuli
Fountain	24	34.4	Non-rhythmic sensory stimuli
Swimming pool	12	12.2	Presence of water
With pets	22	22.4	Non-rhythmic sensory stimuli
Gazebo	29	29.5	Refuge
Patio	25	25.5	Refuge
Seating under the tree	36	36.7	Thermal & airflow variability
			Refuge
Wood decking	23	23.4	Material connection with nature
Total	98	100	

3.4. Preferred indoor living environment features

According to Table 6, a significant majority of respondents (91.8%) expressed a preference for direct air circulation and a view of the garden. Similarly, 91.8% of respondents indicated a preference for having daylight in their living areas. These findings suggest that the participants valued spending time in spaces with natural light and ventilation.

Regarding wallpaper preferences, the study found that a plant print was the most favoured choice among respondents, with 28.5% selecting it as their preferred option. Geometric prints followed closely behind at 19.3%. On the other hand, animal print was the least preferred option, chosen by only 4.1% of the respondents. These findings indicate that the participants desired a wider variety of contemporary geometric printed wallpaper options, suggesting a preference for more current and modern designs.

Only a small proportion of respondents (6.1%) preferred having an indoor pond in their living area. In contrast, more than one-third (35.7%) preferred indoor plants, three times the number of respondents who currently have plants in their spaces. This suggests that respondents favoured including natural elements in their indoor

living environments. Additionally, more than one-third (35.7%) of respondents desired window seating, while 44% preferred a balcony in their living environment. Although less than one-quarter (20.4%) of respondents preferred scented candles, this figure was higher than those currently using candles. Thus, these findings indicate a preference for increased engagement with nature within their indoor living environments.

Table 6. Preference of features in the indoor living environment.

Items	N	Frequency (%)	Biophilic patterns mapping
View to garden	90	91.8	Visual Connection with Nature
Direct sunlight	87	88.7	Dynamic & Diffuse Light
Direct wind	90	91.8	Thermal & Airflow Variability
Window	*87*	*88.7*	Thermal & Airflow Variability
Sliding door	46	46.9	Thermal & Airflow Variability
Wallpaper with animal prints	4	4.1	Biomorphic Forms & Patterns
Wallpaper with plant prints	28	28.5	Biomorphic Forms & Patterns
Wallpaper with geometric prints	19	19.3	Complexity & Order
Indoor pond	6	6.1	Presence of Water
Indoor plant	35	35.7	Non-Rhythmic Sensory Stimuli
			Visual Connection with Nature
Window seating	35	35.7	Refuge
Balcony	44	44.8	Thermal and Airflow Variability
			Risk/Peril
Wood sculpture	30	30.6	Material Connection with Nature
Stone sculpture	15	15.3	Material Connection with Nature
Use of fragrance candle	20	20.4	Material Connection with Nature
Wood furniture	54	55.4	Connection with Natural Systems
Stone furniture	8	8.1	Connection with Natural Systems
Wood flooring	38	38.7	Material Connection with Nature
Total	98	100	

In terms of furniture and materials, 30% of respondents preferred sculptures made from wood, while 15% preferred stone sculptures. Wooden surface furniture also had a higher preference rate than stone furniture, with 55.1% and 8.1%, respectively.

Approximately one-third of the respondents desired wood flooring in their indoor living environments. The majority (88.7%) expressed a preference for windows, followed by sliding doors (46.9%) and balconies (44.8%). These preferences align with respondents' comfort in naturally ventilated and well-lit spaces.

Based on the findings in Table 6, the preferences for a view of the garden and access to prevailing winds align with the biophilic patterns of Visual Connection with Nature and Thermal and Airflow Variability. This preference is further supported by the desire for features such as windows and sliding doors. Furthermore, the preference for dynamic and diffuse light patterns, as evidenced by the preference for direct daylight (88.7%), is consistent with the biophilic patterns of Dynamic and Diffuse Light. Additionally, wooden furniture aligned with the biophilic pattern of Connection with Natural Systems and was somewhat preferred by respondents (55.1%).

Table 7 illustrates the respondents' most preferred biophilic patterns, including Thermal and Airflow Variability, Visual Connection with Nature, and Connection with Natural Systems patterns in indoor and outdoor living environments.

Table 7. The most preferred biophilic patterns in indoor and outdoor living environments.

Highest Preferred Biophilic Patterns	
Outdoor	**Indoor**
Connection with natural systems	Visual Connection with Nature
Refuge	Thermal and Airflow Variability
Presence of water	Dynamic and diffuse
Non-rhythmic sensory stimuli	Connection with Natural System
Thermal and airflow variability	
Visual connection with nature	
Similar Biophilic Patterns	
Thermal and Airflow Variability, Visual Connection with Nature, Connection with Natural System	

3.5. Summary of findings

Results of the study have revealed that the most prevalent biophilic patterns in elderly care homes were Thermal and Airflow Variability from the Nature Analogues category and Visual Connection with Nature and Connection with Natural Systems from the Nature in Space category. The biophilic patterns of Dynamic and Diffuse Light and Refuge and Non-Rhythmic sensory stimuli followed this. The study also indicated that the respondents expressed satisfaction and comfort with their current living environment, suggesting that the available biophilic patterns in their living environment were sufficient and met their expectations. Interestingly, most existing biophilic patterns aligned with the respondents' preferences. These critical biophilic patterns included Thermal and Airflow Variability, Visual Connection with Nature, and Connection with Natural Systems, which may explain the respondents' satisfaction with their living environment.

In a study by Ryan et al. [13], it was stated that a building can only be considered biophilic if it incorporates all 14 known patterns of biophilic design. However, the level of satisfaction reported by the respondents was unexpectedly high, even with the presence of only three basic biophilic design patterns. Therefore, it can be concluded that in the design of an elderly care home, including these basic biophilic patterns is sufficient to meet the satisfactory level of the residents. However, it should be noted that the building may not be officially recognised as a biophilic structure or building according to strict criteria.

Furthermore, the findings revealed that the Nature in Space category is the most essential in designing an elderly home, as all the essential biophilic patterns identified in the study fall under this category. Consequently, it can be concluded that direct engagement with nature is crucial in designing an elderly care home, which aligns with the Biophilia Hypothesis asserting that humans have an innate connection with nature and are naturally attracted to it [7].

4. Conclusion

The primary objective of this study was to explore the benefits of biophilic patterns on the health and wellness of the elderly population, as well as to examine the presence and preferences of biophilic design patterns in elderly homes in Malaysia. Biophilic design has piqued interest due to its emerging trend in design and the growing body of research demonstrating its positive impact on occupants' health and wellbeing.

The study addressed the gap in the literature concerning the implementation of biophilic design in the elderly community and the limited research conducted in Malaysia on integrating biophilic design patterns in elderly care homes. Despite numerous theories highlighting the benefits of biophilia for the health and wellbeing of the elderly, little was known about the level of implementation and the preferences of elderly individuals in Malaysian elderly homes. This knowledge gap resulted in a lack of comprehensive guidelines and considerations for the design of elderly homes. Therefore, this thesis sought to investigate the benefits of biophilic patterns for the health and wellness of the elderly and examine the presence and preferences of biophilic design patterns in elderly homes in Malaysia, thus bridging the gap in evaluating the current implementation of biophilic design and identifying the most significant biophilic patterns essential for designing an elderly home.

The study revealed an interesting finding that the highest frequency of existing biophilic patterns and the most preferred biophilic patterns reported by the respondents were identical. These patterns included Thermal and Airflow Variability, Visual Connection with Nature, and Connection with Natural Systems. This finding suggests that the participants' preferences align with the existing design elements present in the elderly homes, which may explain the high level of satisfaction reported by the respondents.

Based on these results, the study concluded that the three most essential biophilic patterns for designing an elderly home are Thermal and Airflow Variability, Visual Connection with Nature, and Connection with Natural Systems. The study further emphasised that the Nature in Space category is of utmost importance for designing an elderly home, as all the essential biophilic patterns identified in the study fall under

this category. Therefore, direct engagement with nature is a vital consideration in the design of elderly homes. These findings align with the Biophilia Hypothesis, which suggests that humans are naturally attracted to nature, as almost all the biophilic patterns can be found in the selected elderly homes.

The study challenges the notion that a building can only be considered biophilic if it incorporates all 14 known patterns of biophilic design. Despite focusing on only three essential biophilic design patterns, the high level of satisfaction reported by the respondents indicates that including these patterns is sufficient to meet the satisfaction levels of the elderly in the design of elderly care homes.

This study holds significant importance for future designers as it serves as a guide for understanding the benefits and importance of integrating biophilic design patterns into the design of elderly homes. The study also highlights the essential biophilic design patterns that should be incorporated to enhance the living quality of the elderly population in Malaysia. These findings can contribute to developing more age-friendly and sustainable design solutions for elderly care homes.

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