

Integrating Biophilic Design in Multi-Generational Housing: A Conceptual Framework for Enhancing Well-Being and Quality of Life

Che Muhamad Hanif Che Wil @ Ismail¹, Hafiszah Ismail^{2*}

¹*Jabatan Kerja Raya Negeri Selangor, 42000 Shah Alam, Selangor, Malaysia*

²*Real Estate Studies & Building Surveying, College of Built Environment, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*

ARTICLE INFO

Article history:

Received 01 November 2024

Revised 20 November 2024

Accepted 16 May 2025

Online first

Published 31 July 2025

Keywords:

Multi-Generational Housing

Well-Being

Quality of Life (QoL)

Scoping Review

DOI:

10.24191/bej.v22iSI.6498

ABSTRACT

This paper explores the integration of biophilic design principles into multi-generational housing environments to enhance the well-being and quality of life (QoL) of residents in Malaysia. Through biophilic design, the study aims to develop a conceptual framework that identifies key factors contributing to improved mental health, reduced stress, and overall QoL in multi-generational households. Adopted a scoping review methodology, using secondary data from the existing literature published between 2019 and 2024 to build the framework. The analysis consisted of a concept matrix to collate the data that has been collected and determine the key drivers of housing environment preference along with the sub-factors. Overall, the findings suggest that biophilic design elements like natural light, ventilation, green spaces and views of nature greatly contribute to residents' wellbeing across generations. Additionally, the research also discovered that Generation Alpha, Millennials, Generation X and Baby Boomers have such different needs which means spaces must be built for them all. The conceptual framework therefore provides a pragmatic guide that targets improved QoL by integrating biophilic principles in the design of multi-generational housing to alleviate stress, which is detrimental to mental health, among residents. This framework should help architects, urban planners and policymakers working towards healthier and more sustainable living environments.

^{2*} Corresponding author. hafiszah@uitm.edu.my
<https://doi.org/10.24191/bej.v22iSI.6498>

INTRODUCTION

As multi-generational housing becomes more common, it offers both challenges and opportunities for improving resident well-being and quality of life. Introduction with the growth of urbanization, both East and West countries face issue of population ageing that directly impacts living arrangement; therefore, there is a need to design housing environments following categories of accessibility for all generations. Ou et al., (2018) Biophilic design connects natural elements with the built environment while improving mental health, stress reducing, and enhancing quality of life (Wong et al., 2021). This paper presents a conceptual framework for biophilic design in multi-generational housing to promote sustainable and health-enhancing living environments in Malaysia.

Extant research suggests that it significantly positively affects mental health, reduces stress, and improves the quality of life (Ulrich et al., 1991; Browning et al., 2014); (Feng & Shi, 2021; Loder, 2022). But a well-structured framework taking into account the unique requests and suitability factors of different generations in multi-gen housing would be welcome. For example, In Malaysia where multi-generational living is common there is a need for relevant research that can lead the integration of biophilic design in these homes to benefit all occupants (Ismail et al., 2020).

The intention of this study is to provide a conceptual framework for wrapping up biophilic design into multigenerational housing sense; thereby, improving overall health and wellbeing. Based on this, the framework will pinpoint critical biophilic components appreciated by distinct generational generations and outline actionable guidelines for architects, city planners, and policy makers.

METHOD

This was a desktop research analysis. This makes secondary research a cost-effective method (Gandhi et al., 2018) as it explores previously accessible data sources. The desktop research was to collect academic studies, papers and publications related to biophilic design, multi-generational housing and their impacts on well-being and QoL. Insights from this conceptual framework and data from previous studies highlight the gaps in the field and state-of-knowledge.

Scoping reviews are designed to map key or main concepts of the research area, indication of types of available evidence within that area and/or identifying the gaps in current literature (Munn et al., 2018). This scoping review was conducted in two steps that are schematically represented in Figure 1 where we address the first step of defining the research question. For example, the question is, 'What are the key biophilic design elements that can be integrated into multi-generational housing to enhance the well-being and quality of life for residents in Malaysia?' The second step is identifying Relevant Studies. A comprehensive literature reviews of searching was conducted using Google Scholar databases. Keywords used included 'biophilic design', 'multi-generational housing', 'well-being', and 'quality of life'. Two (2) criteria were used for this study: inclusion criteria and exclusion criteria. Inclusion criteria: Studies published between 2019 and 2024 focus on biophilic design in residential settings, multi-generational housing, well-being, and quality of life (QoL). Exclusion criteria are studies not in English, those focusing solely on commercial or non-residential buildings, and those outside the specified date range. The third step is charting the data. Data from selected studies were organised into a literature matrix, categorising information on biophilic attributes, generational preferences, well-being outcomes, and implementation guidelines. The fourth step is collating, summarising, and reporting results. The findings were synthesised to identify key themes and relationships between biophilic design elements and well-being outcomes across different generations of housing arrangements.

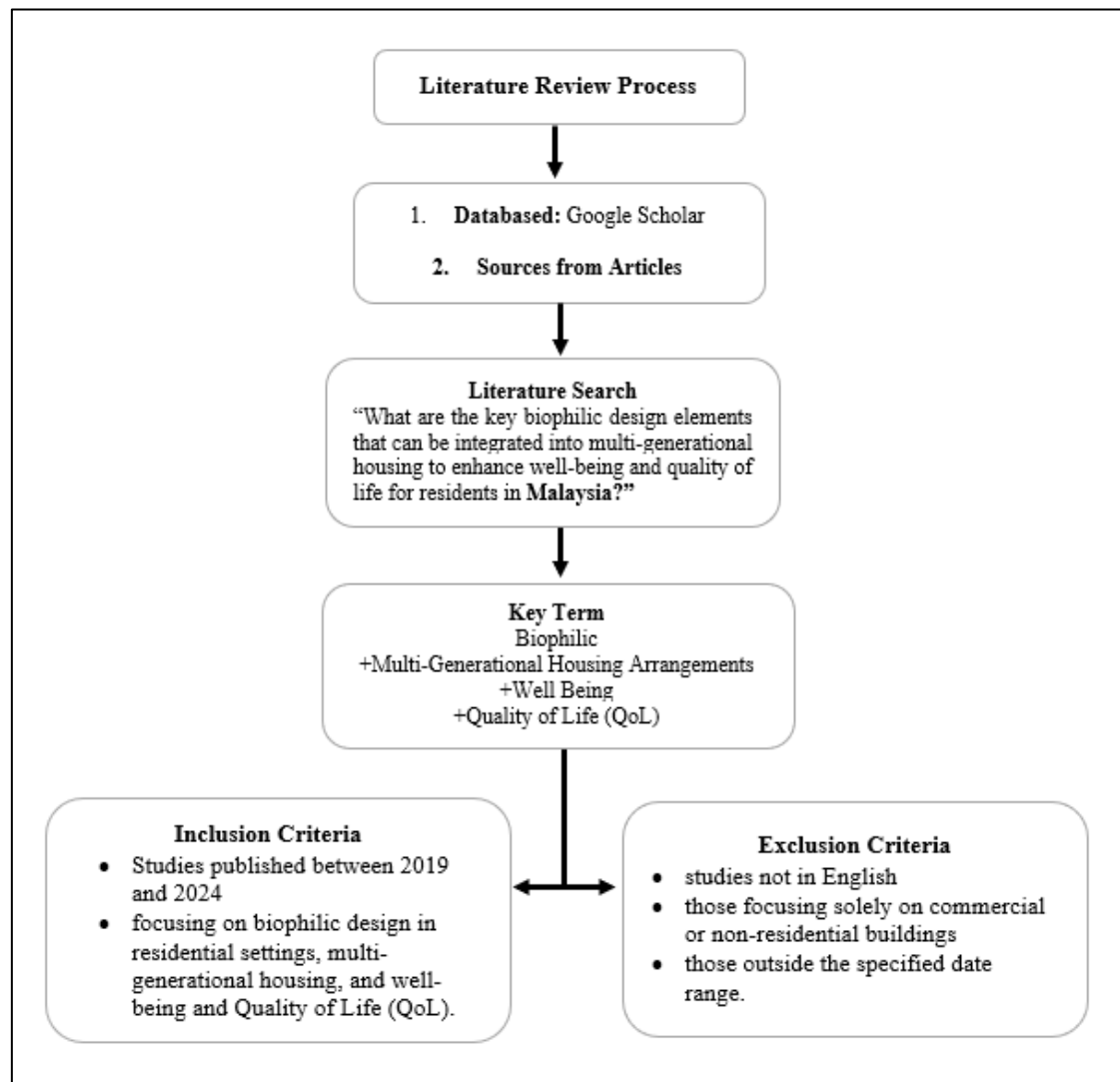


Fig. 1. Narrative Review Process

Source: Author (2024)

The data was arranged into a literature matrix, a method for graphing and displaying research findings. This study's literature matrix visually represents the connections between different biophilic design components and how they affect multiple generations' housing choices and well-being. The research problem statement serves as the basis for each column in the matrix, and each row includes a list of sources in abridged APA format for convenient access.

This study ensured that the pertinent aspects influencing well-being and quality of life were clearly recognised by consolidating significant themes and insights from secondary sources using the concept matrix approach. Following the compilation of this data, a conceptual framework was created by considering how the variables interacted. This framework outlines the implementation of biophilic design principles in multi-generational housing in different age groups to enhance quality of life. This matrix

facilitated development of a relevant and systematic conceptual framework underpinning this study by visually mapping the relationships between variables and study findings.

CONCEPTUAL FRAMEWORK

Usually, a conceptual framework is like a road map that provides an exact structure and a theoretical basis which guide the research process at all stages of the research conducted. The objective of this project is to establish a means of integrating biophilic design principles into multi-generational housing scenarios, conceptually aimed at enhancing the resident's wellbeing and Quality of Life (QoL). A series of actionable design guidelines are formed based on this framework bringing in knowledge from multiple fields such as gerontology, architecture, urban planning and environmental psychology to give a wholistic set of guidance for designing residential units that would cater to people across various life phases living together under one roof.

Biophilic Elements

Biophilic design aims to reconnect human beings with nature in the built environment via architecture and urban planning. Based on the idea that humans are naturally attracted to nature and that a healthy connection between people and nature is essential for mental and physical health (in Figure 2) (Women & Childrens Health Hub, 2020; Kellert, 2021), it underpins the biophilia hypothesis. Biophilic design focuses on using natural light, ventilation, green spaces, water features, natural materials and views of the outdoors.



Fig. 2. Benefit of Biophilic Design

Source: Women and Children's Health Hub (2020)

The framework's first part lists the precise biophilic design elements that can be used in multi-generational homes. These components, which come from previously published works, consist of:

- (i) Natural Light and Ventilation - Sustaining physical and mental well-being requires living areas to have enough natural light and fresh air. Circadian cycles, critical for mood and sleep, are regulated by natural light (Kellert & Calabrese, 2015; Choi, 2020; Kent, 2021).
- (ii) Green Spaces and Indoor Plants - Access to green spaces through gardens, parks, or indoor plants has been shown able to reduce stress, improve mood, and enhance cognitive function (Liu et al., 2022; Raji et al., 2021)
- (iii) Views of Nature - Incorporating windows and design features that offer views of natural landscapes can enhance psychological well-being and reduce feelings of confinement (Ulrich et al., 1991; Zhang & Tang, 2021; Van den Berg et al., 2022).
- (iv) Natural Materials and Textures - Using natural materials, such as wood, stone and water in one habitat can be designed to create an inviting and warm living space where the area is safe and calm (Ryan, 2019; Attia et al., 2021; Pereira et al., 2019).
- (v) Communal Areas with Biophilic Elements - Communal areas promote social interaction and community building (Cattell et al., 2020; Menatti & Casado da Rocha, 2021)

Multi-Generational Housing Arrangements

The next section of the framework tackles the needs and wants presented by the different generations living in a multi-generational home. Multi-Generational Housing which multiple generations of a family live under one roof. This may include parents, children, grandparents and occasionally other family members (as shown in Figure 3). Globally, including in Malaysia (Sussman & Roberts, 2020; Ismail et al., 2023), this kind of accommodation has gained importance due to socioeconomic factors, cultural expectations and increase in cost of living. Each generation will have different needs based on social obligations, health, and stage of life.

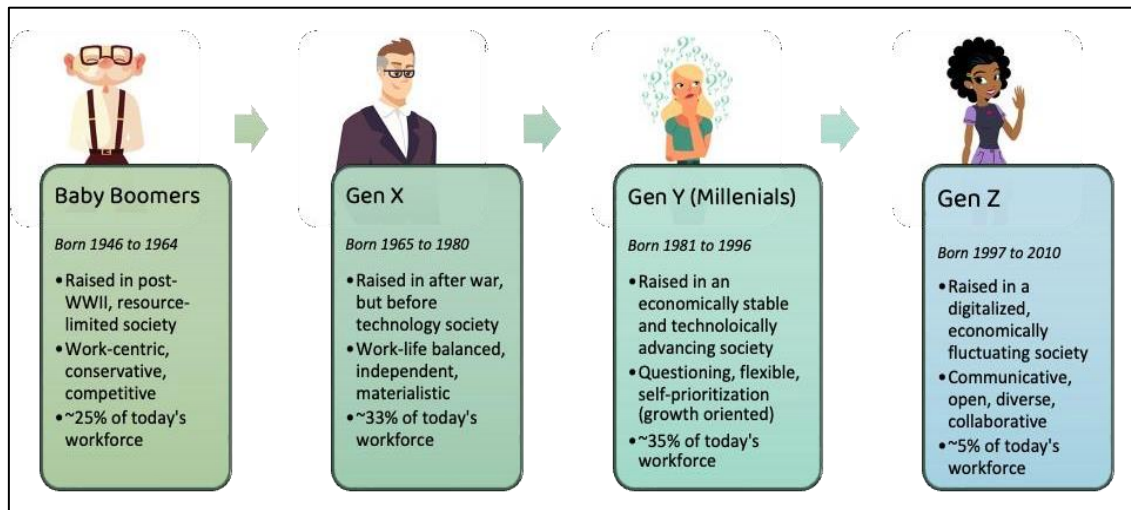


Fig. 3. Type of Generations

Source: Johns Hopkins University (2022)

The design of multi-generational housing must consider the diverse requirements of residents in different age groups while integrating biophilic principles. Strata design focus on optimising vertical and shared green spaces, community designs emphasise social cohesion through central communal areas, and single-house sharing designs balance shared and private green spaces. In all housing arrangements, biophilic elements such as natural light, greenery, and nature-inspired communal areas are essential for enhancing the well-being and quality of life.

(i) Generation Alpha (Born 2010 and onwards)

Generation Alpha, the youngest cohort, is growing up in a highly digitalised world. However, studies suggest that despite their affinity for technology, they still benefit greatly from regular exposure to natural environments. For Generation Alpha, biophilic design elements such as interactive green spaces, nature-inspired play areas, and technology-integrated natural features are particularly appealing (Genc Z, 2021; Luttik, Sijtsma & Arisz, 2021). Designing multi-generational housing that includes spaces where children can engage with nature in a playful and educational manner can support the children cognitive and emotional development.

(ii) Generation Y or Millennials (Born 1981-1996)

Millennials are often characterised by their preference for sustainable living and a strong connection to nature. This generation values green spaces, natural light, and communal areas that promote social interaction and community engagement (Lombardini et al., 2020; Bauman & Brown, 2021). In multi-generational housing, incorporating biophilic design elements that align with Millennials' preferences, such as rooftop gardens, eco-friendly materials, and co-working spaces with abundant natural light, can enhance their satisfaction and well-being.

(iii) Generation X (Born 1965-1980)

Generation X typically values practicality and balance in their living environments. They appreciate biophilic design elements that relieve relaxation and stress, such as access to nature, indoor plants, and quiet, green spaces (Newton & Tucker, 2019; Chen et al., 2020). For this generation, multi-generational housing should include private outdoor spaces, such as balconies or patios, and communal green areas where they can unwind and connect with nature.

(iv) Baby Boomers (Born 1946-1964)

Baby Boomers, who are entering retirement or are already retired, prioritise health and well-being in their living environments. Components of biophilic design that encourage physical activity (e.g., walking paths and fitness trails) along with those offering relaxation and opportunities for socialization are critical for this group (Yuen & Wong, 2020; Kwok et al., 2021). Accessibility and safety of green spaces, community gardens, as well as public natural environments in multi-generational housing contribute significantly to the quality of life of the Boomers.

Multi-generational housing accommodates the needs of different age groups by offering varied housing arrangements. The integration of biophilic design into these housing types, strata, community, and single-house sharing designs can significantly enhance the well-being of residents.

Well-Being and Quality of Life (QoL)

The third section of the framework focuses on biophilic design's long-term impact (across generations) on occupants' health and happiness. Well-being and quality of life in general encompass physical, mental

and social health. When it comes to housing, these terms indicate how much a person's home fosters his or her quality of life and satisfaction with living. According to Diener et al. In Figure 4 (2018), contributors of well-being and quality of life include aspects that provide comfort to the psyche, mechanisms for social engagement, spatial environments and sense of community.



Fig. 4. 17 Goals of Sustainable Development Goals (SDG)

Source: United Nations (2015)

This study has a conceptual framework that presupposes a search worm in harmony with the Sustainable Development Goals (SDG) effect on considering whether biophilic design may be systematically integrated to potentially enhance multi-generational housing across well-being and quality of life dimensions. Based on the framework, biophilic components in the built environment are expected to produce the following:

Improved Mental Health

Lower levels of stress, anxiety, and depression are linked to exposure to natural elements and environments. The framework suggests that the mental health characteristics of residents living in biophilic-designed homes (compared to traditionally designed homes) will show more positive outcomes (Feng & Shi, 2021; Loder, 2022).

Enhanced Social Interaction

Meaning that, biophilic design does encourage a sense of community through the creation of common spaces promoting social interaction amongst residents. Communal gardens, courtyards and green walkways can act as meeting points that encourage social cohesiveness (Kellert 2021; Chan & Marafa 2022; Cattell et al.).

Physical Health Benefits

In particular, factors such as natural light, clean air and outdoor areas can improve physical health by encouraging more movement, better sleep and a lower likelihood of chronic diseases (Van den Berg et al., 2022).

Environmental and Cultural Context

The fourth component of the framework contextualises the study within Malaysia's unique cultural and environmental landscape. This paradigm understands that the well-being and quality of life contextualised through biophilic design may be influenced by cultural values, climate and urban development characteristics in Malaysia as follows:

(i) Cultural Considerations

The Malaysian concept of village (kampung) living is rooted in the cultural psyche, focussing on community, family ties and a close relationship with nature. It is argued that biophilic design must be in harmony with the cultural values which reflect communal living and respect traditional architectural forms (Yuen et al., 2018; Ismail & Azman, 2020).

(ii) Climatic Adaptation

The biophilic design in Malaysia poses both opportunities and challenges because of her tropical climate. Not only does the framework focus on critical orientations for dwellings in order to harness shade, breeze and rainfall in conjunction with the influences of heat and moisture but also stresses primarily that many building designs do not incorporate comfort level functions which is essential (Ismail & Azman, 2020). The final element of the framework is devoted to its practical application in incorporation of biophilic design into multi-generational housing projects. It offers a more systematic approach for developers, architects and city planners to adhere.

(iii) Design Guidelines

Clearly explain how to incorporate biophilic elements into home designs. There are also rules that should be versatile to cover different scales and types of housing. Promise residents, organizational authorities and members & people so that the design is inclusive of all age generation needs and embraces social requirements (Vyas & Satsangi, 2021). Test the implementation through pilot projects. Such initiatives can provide valuable feedback and critique for the advancement of the framework.

RESULTS AND DISCUSSION

Table 1. Matrix Table of Literature Review Findings

1. BIOPHILIC ELEMENTS		
1.	Natural Light	(Choi, 2020; Kent, 2021)
2.	Green Spaces	(Hartig et al., 2019; Liu et al., 2022)
3.	Indoor Plants	(Bringslimark et al., 2020; Raji et al., 2021)
4.	Access to Nature	(Zhang & Tang, 2021; Van den Berg et al., 2022)
5.	Communal Areas	(Cattell et al., 2020; Menatti & Casado da Rocha, 2021)
6.	Sustainable Materials	(Pereira et al., 2019; Attia et al., 2021)
2. MULTI-GENERATIONAL HOUSING ARRANGEMENT		
1.	Single-House Sharing Design	(Ryan, 2019, Newton & Tucker, 2019; Zhang & Tang, 2021).
2.	Strata Design	(Ismail & Azman, 2020; Cattell et al., 2020; (Choi, 2020).
3.	Community Design	(Liu et al., 2022; Attia et al., 2021; Menatti & Casado da Rocha, 2021).
3. WELL-BEING AND QUALITY OF LIFE (QOL)		
1.	Improved Mental Health	(Feng & Shi, 2021; Loder, 2022)
2.	Reduced Stress	(Neale & Fuller, 2020; Capaldi et al., 2022)
3.	Enhanced Quality of Life	(Tan et al., 2021; Zhao & Pan, 2022)
4. IMPLEMENTATION GUIDELINES		
1.	Design with Diversity in Mind	(Vyas & Satsangi, 2021)
2.	Prioritise Accessibility and Inclusivity	(Salama et al., 2021)
3.	Engage the Community in the Design Process	(Duchhart et al., 2020; Chan & Marafa, 2022)
4.	Integrate Technology with Nature	(Luttik et al., 2022)
5.	Monitor and Evaluate Well-Being Outcomes	(Feng & Shi, 2021; Zhao & Pan, 2022)

Source: Authors (2024)

Biophilic Elements

(i) Natural Light

Natural light is one of the most important components of biophilic design, which has been demonstrated to affect both general and mental health profoundly. Recent research emphasises the value of natural light in residential settings since daylight exposure is associated with greater mood, less depressive symptoms, and higher-quality sleep (Choi, 2020; Kent, 2021). Natural light is beneficial in multi-generational housing because it supports circadian rhythms in all age groups (from young children to the elderly) and improves their quality of life in general.

(ii) Green Spaces

The presence of green spaces like parks, gardens and other landscaped area that one finds within a community is one example of a critical biophilic element. They enable residents to be physically active, socialise with another and relax on green spaces, thus improving mental health and general well-being (Hartig et al., 2019; Liu et al., 2022). In multi-generational neighbourhoods' green areas can be designed to accommodate the different needs of different age groups including active and passive recreation activities.

(iii) Indoor Plants

It is relatively easy to introduce nature into the built environment by means of indoor plants. They are related to less stress, better air quality, and more productivity (Bringslimark et al., 2020; Raji et al., 2021). When it comes to multi-generational housing, indoor plants could foster a relaxing atmosphere and visual appeal for all ages.

(iv) Access to Nature

Natural landscapes views, nearby parks, and water features are the most important biophilic elements that improve well-being. Previous research indicates that regular exposure to natural settings may decrease stress, blood pressure and enhance mental clarity (Zhang & Tang, 2021; Van den Berg et al., 2022). To second homes areas, it is the very basis of health, physical and psychological and having access to nature on a regular basis for everyone in multi-generational housing is essential.

(v) Communal Areas

Use of biophilic design elements, like natural materials and vegetation in common spaces that promote social connection and community development. In environments of multi-generational living, these aspects are particularly important to solidify generational ties and diminish social isolation and loneliness (Cattell et al., 2020; Menatti & Casado da Rocha, 2021). Biophilic design typically provides atmospheric environments that are uninviting and act as incubators of social relationships, allowing for the fulfilment of community needs for all partakers.

(vi) Sustainable Materials

Sustainable materials like reclaimed wood, bamboo or natural stone support environmental sustainability and provide better aesthetic as well as experience. Use of sustainable materials contributes to biophilic aspects and have been positively linked with psychological outcomes, including lower stress levels and increased well-being (Pereira et al., 2019; Attia et al., 2021). Sustainable materials can also be used in multi-generational housing to promote a healthier and more resilient living environment.

Multi-Generational Housing Arrangements

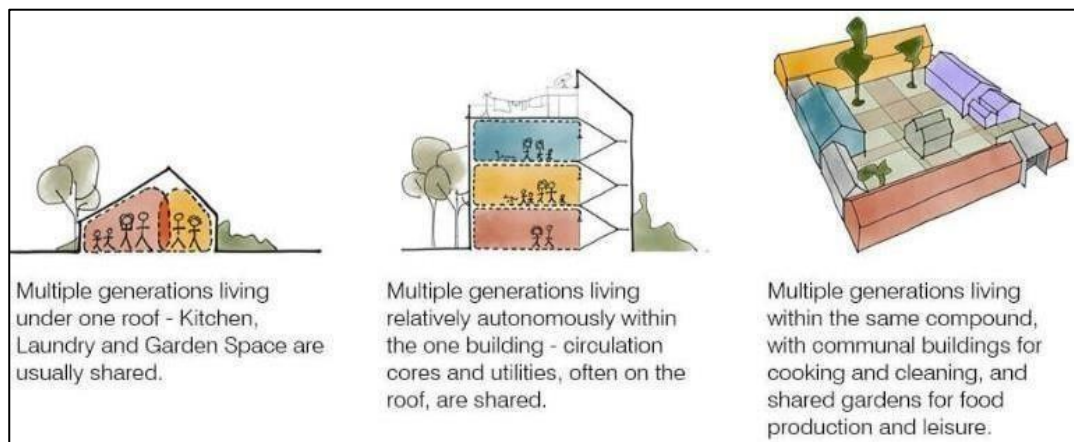


Fig. 5. Types of Multi-Generational Living Arrangements

Source: Lewis (2019)

Single-House Sharing Design

Single-house sharing design involves extended family members or different generations living under the same roof, with shared spaces for communal activities as well as private areas for personal needs, as shown in Figure 5. This arrangement benefits from biophilic design in the following ways:

(i) Integrated Indoor and Outdoor Spaces

Designing homes with seamless transitions between indoor living areas and outdoor spaces such as patios, gardens, and courtyards can promote social interaction and reduce feelings of isolation (Ryan, 2019).

Strata Design

Strata design refers to housing complexes with shared ownership of communal spaces, often used in apartments and condominium developments. These designs typically feature shared amenities such as gardens, walkways, and common recreational areas. Examples of biophilic design in strata housing can include:

(i) Green Terraces and Vertical Gardens

In a highly urbanized environment, we can introduce rooftop gardens and vertical green walls as well as sharing open green areas that will provide access to natural environments for the public; these green space plays a positive impact on resident mental health (Ismail & Azman, 2020).

(ii) Communal Green Spaces

Communal green spaces can also promote intergenerational relationships as they are designed to encourage social interaction between residents of all ages. The communal areas for recreation and relaxation can include patios, courtyard spaces, garden lounges and play areas (Cattell et al., 2020).

(iii) Access to Natural Light and Ventilation

Skylights, large windows, and open-air atriums in multi-story buildings can help to optimise natural light so that all residents are able to share the benefits of better circadian rhythms and ventilation (Choi, 2020).

Community Design

Community-centric housing developments centres around similar houses, usually organised in a circle surrounding a common green patch or gathering place called community-based housing development. Community design policies can retain a focus on biophilic elements in:

(i) Centralised Parks and Gardens

Green spaces in residential neighbourhoods open to all inhabitants of the community help induce a sense of belonging and provide opportunities for physical activity, which are vital to maintain mental health and physical health (Liu et al., 2022).

(ii) Eco-Friendly and Sustainable Infrastructure

The environmentally friendly building materials, including bamboo and reclaimed wood, allow residents to derive a sense of nature from their built environment through an intervention (Attia et al., 2021).

(iii) Nature-Inspired Community Features

Having design aspects like natural pathways, shared orchards, and water features can enhance social connections and alleviate stress. They allow informal socialization between generations (Menatti & Casado da Rocha, 2021).

Multi-generational housing design must balance a multitude of different needs of varying age groups with the essentials of biophilic design. Vertical and shared green spaces characterise strata designs, social cohesion is emphasised by central communal areas in community designs, while single-house sharing provides a mix of both green space types. Whether it is a project within the private home-upgraded developments, or those at the community level, biophilic elements for quality living — abundance of natural light, greenery and nature-inspired communal spaces will be integral to improving wellbeing and quality of life.

Well-Being and Quality of Life (QoL)

Improved Mental Health

Over the years, biophilic design has been repeatedly associated with better mental health. Exposure to natural light, elements of nature and green areas has been found to be positively correlated with lower anxiety, depression and stress levels (Feng & Shi, 2021; Loder, 2022). Providing for these features is vital in multi-generational housing as they can reduce mental health problems of all ages, allowing generations to live harmoniously among each other (Ismail et al., 2023).

Reduced Stress

Stress reduction through exposure to natural environments and elements of biophilic design are well established. In multi-generational housing, stress from caregiving responsibilities (Nicola et al., 2020) or intergenerational conflicts (Bottorff & McGuire, 2022) might be reduced with calming features such as green spaces, water elements and indoor plants (Neale & Fuller, 2020; Capaldi et al., 2022). By considering ways to include designs that reduce stress, it is possible for these areas to improve the quality of life as a resident.

Enhanced Quality of Life

The quality of life is a multidimensional construct that includes physical, psychological, and social aspects of well-being. Biophilic design improves quality of life by providing healthy, socially interactive environments (Tan et al., 2021; Zhao & Pan, 2022). These slogans convey that when one branch of the family is designed with consideration for the diverse needs of various age groups in multi-generational housing, achieved satisfaction becomes a state of happiness and sense of belonging within families.

Implementation Guidelines

Through its identification of biophilic attributes and generational preferences, the conceptual framework puts into concrete terms how to manifest its implementation guidelines. This provides practitioners with guidance on increasing naturally occurring biophilic design features in multi-generational housing that offer opportunities to improve both well-being and quality of life.

Design with Diversity in Mind

Consider the varied needs and wants of different generations when designing multi-generational housing. This includes, for example, implementation of detailed biophilic design characteristics like green spaces for recharging and relaxation, social interaction space procedures as well as sunlight-adopted environment to help with mental health improvement (Vyas & Satsangi 2021). A flexible design that can accommodate the changing needs of its residents over time.

Prioritise Accessibility and Inclusivity

There should be a prioritisation of the two aspects which is accessibility as well as inclusivity to ensure that all residents benefit from biophilic design. This is in terms of the barrier-less spaces, accessible green space and inclusion of natural elements in all housing development zones (Salama et al., 2021). This means that if biophilic design's health and well-being benefits are to reach an entire community, inclusive design is key, making sure it can be enjoyed by residents regardless of age or ability.

Engage the Community in the Design Process

Successful biophilic design implementation will require community engagement. Taking citizens along in the design process can identify their needs and desires, which enables them to pay more attention to specific features during the period of design solutions (Duchhart et al., 2020; Chan & Marafa, 2022). Community involvement also creates a sense of stewardship and attachment to the habitat, which can improve well-being and contentment.

Integrate Technology with Nature

For the younger generations, especially Gen A and Millennials, it can improve their engagement with living nature by bringing on technology. These technology applications can include interactive green spaces, digital nature-inspired art and apps that prompt outdoor activities or exploration of one's surroundings (Luttik et al., 2022). Achieve the Perfect Balance Between Nature and Technology for Today's Residents through Biophilic Design Housing Developments can accommodate tech-savvy residents while promoting health and wellness through nature.

Monitor and Evaluate Well-Being Outcomes

Finally, it is crucial to monitor and evaluate the well-being outcomes of biophilic design in multi-generational housing. This can be achieved by conducting periodic surveys, focus groups, and other resident feedback mechanisms (Feng & Shi 2021; Zhao & Pan 2022). Ongoing assessment, that can adjust the design and governance of the housing context to retain its salutary impact on all residents.

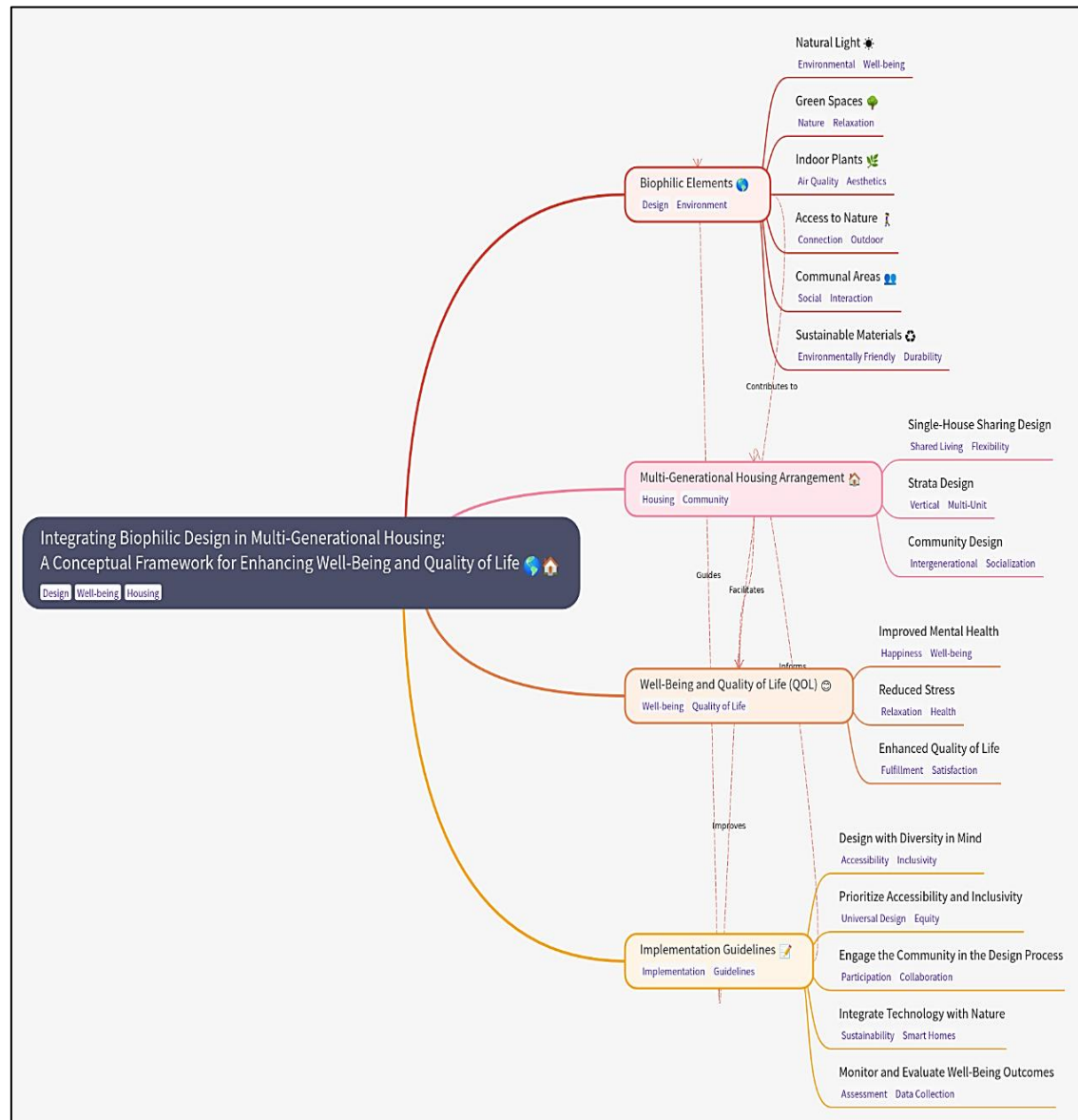


Fig. 6. Mind Map and Connection of Conceptual Framework

Source: Authors (2024)

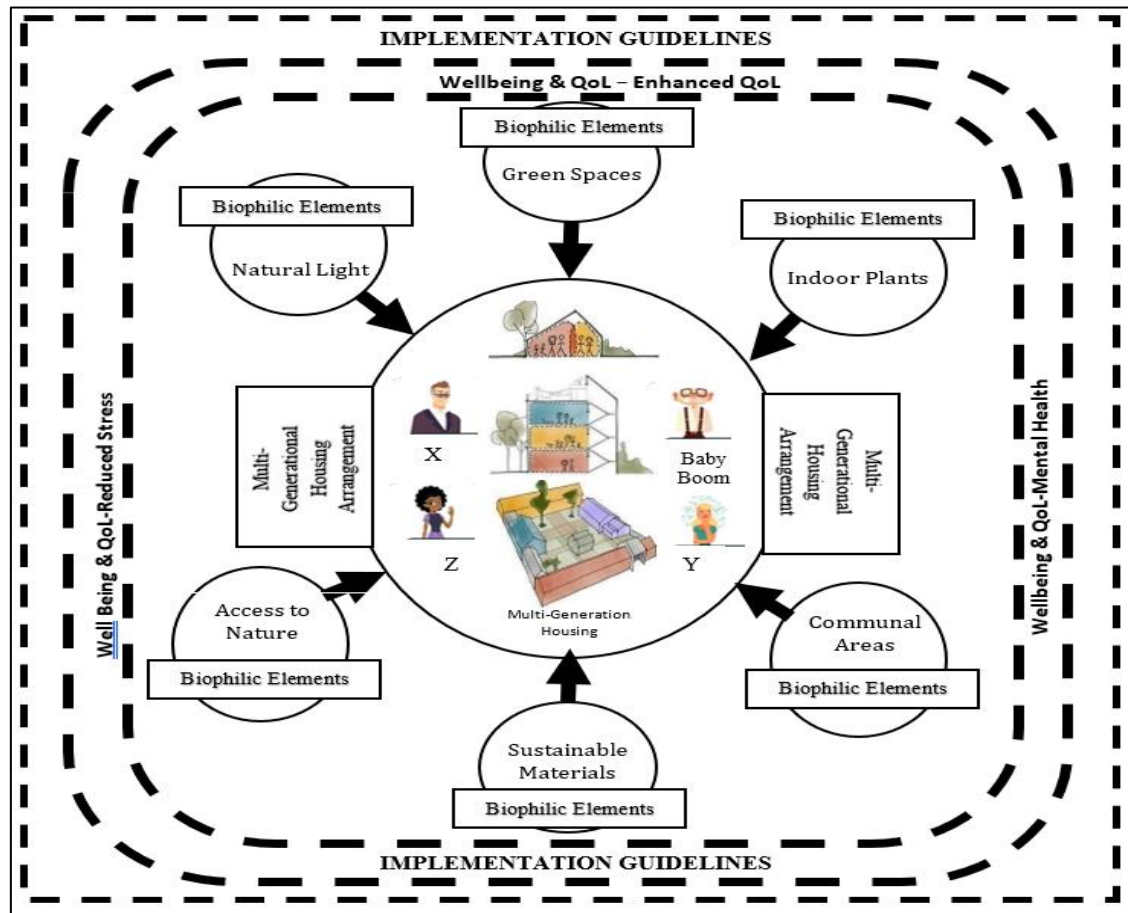


Fig. 7. Conceptual Framework

Source: Authors (2024)

CONCLUSION

Biophilic environment infusion in multi-generational housing settings – A connection between concept framework to biophilic environment supply design (influence to well-behavior and quality of life) -(Figure 6). The key findings from this study were that biophilic features —natural light, green outdoor spaces, indoor plants and views of nature in high and low demand, the positive effects on mental health between all generations.

It calls the three (3) elements of multi-generational housing arrangements a strata design, community design and single-house sharing design. Each contextualized framework offers its own set of opportunities for engagement of biophilia, intergenerational relationship development, and social interaction. Common green areas and vertical gardens can be used to promote community in strata designs for example. Single-house sharing arrangements can also be kind of nature retreats, and shared outdoors.

This study highlights health-related quality of life, which also includes physical, psychological and social well-being. The integration of biophilic design into multi-generational housing services can provide

the residents with quality of life by positively impacting physical and mental health, stress reduction, and create a sense of belonging. Even so, we should not neglect some limitations on the impact of biophilic design on quality of life. Cultural perceptions, personal preferences, and logistical complexities of integrating biophilic components into different urban types could play a role in the relative effects on residents' wellbeing (Figure 7). This study is significant because it provides a conceptual framework that serves as a practical guide for architects, urban planners, and policymakers. By addressing the specific needs of Malaysian residents, the framework facilitates the creation of harmonious and sustainable living environments that enhance health and well-being for all generations.

Future research should focus on empirical validation of the framework and exploring its applicability in various cultural settings. Implementing pilot projects and gathering resident feedback will be crucial in refining the framework and ensuring its effectiveness.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support of the College of Built Environment (CBE), Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia, for providing the research opportunity for this research.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted without any self-benefits or commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Che Muhamad Hanif carried out the research, wrote and revised the article, conceptualised the central research idea, and provided the theoretical framework. Hafiszah Ismail designed the research, supervised the research progress, anchored the review and revisions, and approved the article submission.

REFERENCES

- Attia, S., Farghaly, K., & Strickland, S. (2021). Sustainable material selection in biophilic design. *Journal of Cleaner Production*, 288, 125-187.
- Bauman, K. A., & Brown, R. D. (2021). Millennials and nature: Exploring generational differences in perceptions of biophilic design. *Journal of Environmental Psychology*, 76, 101-218.
- Bringslimark, T., Hartig, T., & Patil, G. G. (2020). The psychological benefits of indoor plants: A critical review. *Journal of Environmental Psychology*, 71, 101-225. <https://doi.org/10.1016/j.jenvp.2009.05.001>
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2022). The relationship between nature connectedness and well-being: A meta-analysis. *Journal of Environmental Psychology*, 78, 101-235. <https://doi.org/10.3389/fpsyg.2014.00976>

- Cattell, V., Dines, N., Gesler, W., & Curtis, S. (2020). Mingling, observing, and lingering: Everyday public spaces and their implications for well-being and social relations. *Health & Place*, 62, 102-287. <https://doi.org/10.1016/j.healthplace.2007.10.007>
- Chan, E. H. W., & Marafa, L. M. (2022). Community engagement in urban park planning: The role of cultural ecosystem services. *Journal of Environmental Planning and Management*, 65(2), 343-361.
- Chen, F., Liu, Y., & Yang, D. (2020). Preferences for biophilic design features in urban green spaces among Generation X and Millennials. *Sustainability*, 12(12), 4996.
- Choi, A. (2020). Daylighting and its impact on the quality of life in residential buildings. *Buildings*, 10(3), 56.
- Duchhart, I., Bolund, P., & Chen, S. (2020). Participatory design in urban green spaces: Lessons from community-based urban gardening. *Landscape and Urban Planning*, 200, 103-292.
- Feng, X., & Shi, S. (2021). Biophilic design: Enhancing mental health in urban environments. *Journal of Urban Health*, 98(5), 751-762.
- Gandhi, A.; Sucahyo, Y.G.; Ruldeviyani, Y. (2018) Investigating the Protection of Customers Personal Data in the Ridesharing Applications: A Desk Research in Indonesia. In Proceedings of the 15th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), Chiang Rai, Thailand, 18–21 July 2018; pp. 118–121
- Genc, Z. (2021). Generation Alpha: The children of the millennial parents. In *The New Generations* (pp. 109-127). Springer.
- Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2019). Nature and health. *Annual Review of Public Health*, 35, 207-228.
- Ismail, H., & Shaari, S. M. (2020). The location, house, or neighbourhood choice preferences among Malaysian housing generations. *Journal of Surveying, Construction and Property*, 11(2), 64-74.
- Ismail, H., Abidin, A. W. Z., Ling, N. L. F. J., Afif, A. S., & Siahaan, E. (2023). Factors Affecting Place Attachment and Types of Living Arrangement Preferences for Ageing in place of the Malaysian Generational Housing Consumers in Malaysia. *International Journal of Sustainable Construction Engineering and Technology*, 14(5), 185-195.
- Ismail, H., & Shaari, S. M. (2019). Housing decision: the choice between location, house and neighbourhood among Malaysian generations. In *MATEC Web of Conferences* (Vol. 266, p. 01026). EDP Sciences.
- Ismail, H., Halil, F. M., Abidin, A. W. Z., & Hasim, M. S. (2020). Ageing in Place or Late Life Move? The Malaysian elderly generation housing options. *Asian Journal of Behavioural Studies*, 5(18), 1-17.
- Ismail, H., Nordin, M. S. A., Halil, F. M., & Khalid, N. H. A. (2023). The Elderly Quality of Life (E-QoL) And Retirement Village Preferred Features by Malaysian Generations. *Planning Malaysia*, 21.
- Kent, M. (2021). The impact of daylight exposure on sleep patterns and mood in urban environments. *Journal of Environmental Psychology*, 74, 101-220.

- Kwok, J., Lee, T. M. C., & Leung, K. (2021). The effect of environmental factors on older adults' mental health and well-being. *Journal of Aging Studies*, 57, 100-945.
- Liu, H., Duan, H., & Zhao, Y. (2022). The health benefits of urban green spaces for older adults: A systematic review. *Urban Forestry & Urban Greening*, 66, 127-242.
- Loder, A. (2022). Biophilic urbanism: A comparative study of the impacts of nature on human well-being in cities. *Urban Forestry & Urban Greening*, 66, 127-243.
- Lombardini, C., Coppola, L., & Viviani, M. (2020). Millennials and the built environment: Trends in preferences for housing and urban spaces. *Sustainability*, 12(15), 6092.
- Luttik, J., Sijtsma, F., & Arisz, T. (2022). Connecting nature and technology: The role of smart technologies in engaging children with urban nature. *Cities*, 123, 103-248.
- Menatti, L., & Casado da Rocha, A. (2021). Biophilic design and the well-being of elderly people: A case study. *Journal of Environmental Psychology*, 75, 101-221.
- Neale, R. & Fuller, R. (2020). Stress reduction and the biophilic quality of built environments: Evidence from the literature. *Journal of Environmental Psychology*, 69, 101-238.
- Newton, D., & Tucker, A. (2019). Preferences for nature contact among Generation X. *Environmental Design Research Association (EDRA)*, 50, 123-145.
- Munn, Z., Peters, M.D.J., Stern, C. (2018) Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol* 18, 143
- Pereira, G., Foster, S., & McCune, S. (2019). The impact of sustainable materials on residents' well-being: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 16(15), 2763.
- Raji, B., Tenpierik, M., & van den Dobbelsteen, A. (2021). The impact of indoor plants on the indoor environment and occupants' well-being. *Building and Environment*, 179, 106-992.
- Salama, A. M., Wiedmann, F., & Ibrahim, H. (2021). Inclusive design in urban environments: The case of Qatar. *International Journal of Architectural Research*, 15(3), 605-624.
- Ryan, C.O.; Browning, W.D. Biophilic design. *Sustain. Built Environ.* 2020, 43–85.
- Tan, Y., Wang, J., & Lin, Y. (2021). Biophilic design and quality of life in residential environments: A survey in China. *Sustainability*, 13(8), 4192.
- Van den Berg, M. M. H. E., Hartig, T., & Staats, H. (2022). Nature and stress recovery: A systematic review of the evidence. *Environmental Research Letters*, 17(4), 043-305.
- Vyas, A., & Satsangi, A. (2021). Designing for diversity: Multi-generational housing in urban areas. *Journal of Urban Design*, 26(5), 580-595.
- Wong, N. H., Tan, C. L., & Tan, P. Y. (2021). Integrated biophilic design for sustainable urban living. *Journal of Green Building*, 16(1), 203-222.

- Yuen, B., & Wong, F. (2020). Aging in place in multi-generational homes: The case of Singapore. *Cities*, 102, 102-287.
- Yuen, B., Yeh, A. G. O., Appold, S. J., & Zhai, F. (2018). High-density living in Asian cities: Challenges and opportunities. *Habitat International*, 82, 23-30.
- Zhang, Y., & Tang, Z. (2021). Viewing nature scenes reduces stress and improves cognitive performance: Evidence from an eye-tracking study. *Journal of Environmental Psychology*, 77, 101-248.
- Zhong, W., Schröder, T. and Bekkering, J. (2022). Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review', *Frontiers of Architectural Research*, 11(1), pp. 114–141. <https://doi.org/10.1016/j.foar.2021.07.006>
- Zhao, X., & Pan, W. (2022). Biophilic design and well-being in urban environments: A meta-analysis of empirical studies. *Environmental Science & Technology*, 56(7), 4897-4908.



© 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY-NC-ND 4.0) license (<http://creativecommons.org/licenses/by-nc-nd/4.0/deed.en>).