Supplementary Material

Search String

(window OR balcon* OR loggia* OR terrace* OR "transition (2n) space*" OR entry* OR entrance* OR "outdoor space*" OR "private garden*")*

AND (residen OR hous* OR home* OR apartment*)*

AND (health OR well-being OR wellbeing OR mental OR social OR satisfaction OR preference OR perception*).*

Literature Review Table

Summary of the reviewed literature on HB components and their effects on health and well-being.

Windows
Window availability and characteristics
- The presence of windows makes a substantial difference to residents' well-being (R. Kaplan, 2001). - In general, people prefer an increase in the number and size of their home windows (Aslanoğlu et al., 2021); There is an association between the preferable number of windows in a space and the importance of window functions (e.g., view or good ventilation) to individuals in that space (Butler & Biner, 1989). - People prefer having skylights in the spaces of their homes; preferences vary across spaces according to different functions (Butler & Biner, 1989). - Cultural differences can influence preferences for windows functions (e.g., daylight access, thermal comfort, natural ventilation, privacy and view) (Abdelwahab et al., 2023). - There was increased time spent next to windows during the pandemic lockdown (Valizadeh & Iranmanesh, 2022). - People are willing to pay more to have a pleasant view (Wing Chau et al., 2004) and larger windows as a health-promoting parameter in the home (Chan et al., 2009). - There is limited research on window design attributes in residential settings (e.g., Hwang & Lee, 2018) which addresses preferences and functionality (e.g., Vakalis et al., 2019).
Connection to the outside
- People experience a great sense of well-being when their home facilitates and supports visual and sensory contact with the outside environment (Wågø, 2016). **View** - People desire visual contact with the outside, both to glean information about the weather and time, and also to look out through windows (Bishop et al., 2004; R. Kaplan, 2001). - During the pandemic, people reported that the view quality through windows as being the most valued features for a healthy and resilient home (Alonso et al., 2021; Horne et al., 2020; Jaimes Torres et al., 2021; Zarrabi et al., 2021). - Some studies have been conducted on the assessment of preferences, window view quality, and the impact of different elements visible from windows in urban areas (e.g., Koprivec et al., 2022; Ko et al., 2022; Kim et al., 2022; Mirza & Byrd, 2023).

- Window view quality can be enhanced by specific attributes, including horizontal stratification, distant features, a variety in elements, and dynamic qualities such as movement and changes in view content (Baxter, 2017; Lee, 2014; Cho et al., 2023; Kent & Schiavon, 2020).

Visual comfort

- Windows are an important determinant of residents' comfort in multi-unit residential buildings (Vakalis et al., 2019) in terms of daylight penetration and visual comfort (Xue, Mak, & Ai, 2016; Xue, Mak, Cheung, et al., 2016).
- In general, people prefer daylight over artificial light (Muñoz-González, et al. 2021).
- Daylight is in the center of a healthy home (Peters & Halleran, 2021); people recognized daylight and sun exposure as their most valued factors and preferred criteria among parameters which comprise a healthy home (Alhadedy & Gabr, 2022; Alonso et al., 2021; Zarrabi et al., 2021).
- In general, higher daylight and sunlight exposures in day-lit spaces contribute to better psychological health, happiness, mental ability, mood and emotional well-being, sleep quality, social behaviour, and physical health (Aries et al., 2015; Fernandez, 2022; Morales-Bravo & Navarrete-Hernandez, 2022; Shishegar et al., 2021; Shishegar & Boubekri, 2022; Spano et al., 2021; Veitch & Galasiu, 2012; Osibona et al., 2021). This was especially true for those spending the majority of their time at home (Javani et al., 2019).
- The health-promoting effects of daylight can be integrated in design choices by targeting various aspects of lighting; including the light spectrum, light levels, and the timing and duration of light exposure (Lee et al., 2022; Aslanoğlu et al., 2021).
- Health-promoting light levels, along with window view access are recognized as a biophilic factors in indoor spaces (Tabatabaeifard et al., 2023).
- Light levels in most homes (especially of older adults) often do not deliver adequately high light exposures for proper vision or well-being (Abidi & Rajagopalan, 2020; Veitch & Galasiu, 2012; Bakker et al., 2004).
- Little research has been conducted on the cultural aspects of visual comfort through windows (e.g., Elgadra & Fotios, 2023).

Thermal comfort

- Offering sensory stimulation through a connection with the outdoors positively influences residents' natural adaptive mechanisms and fosters a sense of thermal pleasure (Emmanuel, 2017; de Dear & Brager, 2002).
- The ability to open windows to allow in air, smells, and sounds from the outside is crucial for residents' well-being (Wågø, 2016).
- People are willing to pay more for a housing unit with openings facilitating cross-ventilation (Chan et al., 2009); Natural ventilation through windows can enhance thermal comfort (de Dear & Brager, 2002).

Spatial perception

- The presence of windows and skylights reduces the feeling of enclosure in a space and makes it appear more spacious, which is desirable in living rooms and kitchens (Veitch & Galasiu, 2012).
- Window size is associated with the perceived spaciousness of a room (Fisher-Gewirtzman, 2017a)
- Daylight and air quality through windows increase the perceived adequacy of a given space (Cuerdo-Vilches et al., 2021; Mandel et al., 1980; Park et al., 2023).
- A larger outdoor view size leads to higher psychological satisfaction regarding the perception of space (Yeom et al., 2020).
- Window glazing with higher transmittance is correlated with greater perception of brightness, beauty and pleasantness in living rooms (Pineault & Dubois, 2008).

- Large windows, open scenes, and more daylight through windows reduce the perception of crowding and density (Baum & Davis, 1976; Gifford, 2007; Kearney, 2006; Schiffenbauer et al., 1977; Mandel et al., 1980; Park et al., 2023; Fisher-Gewirtzman 2017b).

Connection to nature

- Window view quality can be enhanced by natural elements (Cho et al., 2023).
- Natural window views are preferred over built views and can affect the perceived attractiveness of the home as well as satisfaction with the residence and neighborhood (R. Kaplan, 1985, 2001; Kearney, 2006; Schmid & Säumel, 2021).
- Passive connection with nature through windows can provide numerous opportunities for restoration, called "micro-restorative" experiences (R. Kaplan, 2001)
- The more natural elements in the window view, the higher the potential for cognitive restoration and increased emotional well-being (Braçe et al., 2020; Honold et al., 2016; Masoudinejad & Hartig, 2020; Olszewska-Guizzo et al., 2018; Tennessen & Cimprich, 1995; Yusli et al., 2021).
- Natural window views can promote the health and well-being of children living in apartment housing (Taylor et al., 2002), as well as the cognitive functioning of low-income children living in urban areas (Wells et al., 2000).
- Well-maintained, attractive, and diverse streetscape greenery is as relevant to mental well-being as the presence of a garden with a variety of plants (Shentova et al., 2022).
- In densely built residential areas, having more sky in the window views, more expanded views, and even viewing a green street are perceived as more restorative (Masoudinejad & Hartig, 2020); sky view parameters, weather conditions, and floor level can influence the perceived quality of views (Domjan et al., 2023; Kim et al., 2014).
- If far away views cannot be provided due to site constrains, nature (e.g., trees) should be integrated nearby to increase visual satisfaction (Kent & Schiavon, 2020).
- People are willing to pay more money for a natural view at home (Bishop et al., 2004; Chan et al., 2009; Hui et al., 2012; Hui & Liang, 2016; Jim & Chen, 2009).
- Green views from home provided protection against the negative consequences of lockdowns during COVID-19 (Horne et al., 2020; Lõhmus et al., 2021; Ugolini et al., 2021; Wang et al., 2020), as they were associated with increased levels of self-esteem, life satisfaction, and subjective happiness, as well as decreased levels of depression, anxiety, and loneliness (Soga et al., 2020).
- Natural views, a higher amount of greenery in the window view, and the frequency of nature exposure were associated with the overlook frequency, the window opening times, higher emotional well-being and fewer depressive and anxiety-related symptoms during the pandemic (Amerio et al., 2020b; Bi et al., 2022; Dzhambov et al., 2021; Leon et al., 2020; Liu et al., 2022; Pouso et al., 2021b; A. I. Ribeiro et al., 2021; Spano et al., 2021). This relationship was particularly pronounced for women (Kaplan Mintz et al., 2021; Shentova et al., 2022). Living in a small apartment with a poor view was linked to experiencing more depressive symptoms (Amerio et al., 2020).
- Natural window views, such as greenery and sea scenes, can moderate indoor comfort, in terms of thermal and noise perception (Jiang et al., 2022; Nang Li et al., 2012).

Connection to social life

- Viewing the street life through windows is more restorative than views limited to building facades; Windows on lower floors looking out to people and street life evoke restorative likelihood ratings similar to those views with the sky (Masoudinejad & Hartig, 2020).
- During the COVID-19 lockdown, some people perceived urban noises and sounds from the outdoors coming through windows and openings as a source of connection and a means to feel less alone, which was considered a positive experience (Torresin et al., 2021).

- More natural view from home can help individuals with lower social connections experience higher subjective well-being and a lower risk of depression (Cartwright et al., 2018).

Balconies

Balcony availability and characteristics

- The presence of private outdoor spaces/ balconies in multi-family housing promotes residents' satisfaction with the home, particularly of older adults (R. Kaplan, 1985; Talbot & Kaplan, 1991), and is vital to liveability in compact cities (Kotulla et al., 2019).
- People are willing to pay more for possession of a balcony at home (Chan et al., 2009; Wing Chau et al., 2004).
- Living in dwellings which lack outdoor spaces intensified the sense of being imprisoned and increased psychological distress (Hubbard et al., 2021; Millán-Jiménez et al., 2021; Rodríguez-González et al., 2020).
- Balconies were identified among the most valued spaces and were considered healthy factors of resilient housing during the pandemic (Alonso et al., 2021; Aydin & Sayar, 2021; Cuerdo-Vilches et al., 2020; Shamaileh, 2022; Valizadeh & Iranmanesh, 2022; Zarrabi et al., 2021; Pinheiro & Luís, 2020; Adeeb Fahmy Hanna, 2023).
- Balconies were used more frequently in the pandemic lockdown waves (Aydin & Sayar, 2021; Bassetti, 2020; Elzein & Elsemary, 2022; Gür, 2022; Khalil & Eissa, 2022; Mesa-Pedrazas et al., 2023; Ugolini et al., 2021), even regardless of culture and climate (Duarte et al., 2023).
- People who had balconies had less severe depressive symptoms than those without balconies (Tleuken et al. 2021).
- During the pandemic, lacking a balcony, or having a small and unfit balcony, was found to contribute to negative effects of the lockdowns, such as experiencing loneliness, depression, and a higher amount of negative emotionality (Adeeb Fahmy Hanna, 2023).
- Lack of a balcony was a strong reason for dissatisfaction with housing and a motivator for relocation (Kleeman & Foster, 2023; Kley & Dovbishchuk, 2021).
- There are few studies on common activities taking place in balconies as well as the associated cultural norms (e.g., Aronis, 2009; Kennedy et al., 2015; Khalil & Eissa, 2022; Kisnarini et al., 2018; Mladenović et al., 2017; Smektała & Baborska-Narożny, 2022), and what people prefer to do there (e.g., Cuerdo-Vilches et al., 2020; Gür, 2022).
- Few studies have recently been conducted on the features of balconies that facilitate their use, such as their size, lighting, the adjacent spaces, safety, privacy and adaptability (Bettaieb & Alsabban, 2021; Kennedy et al., 2015; Molaei et al., 2022; Nam & Cho, 2021; Peters & Masoudinejad, 2022; Yang Ouyang et al., 2023).
- The concept of an "adaptable balcony" has been proposed in the context of multifamily housing, referring to convertible balconies which can enhance spatial flexibility and improve residents' functional use of their dwellings; Several typologies of adaptable balconies are identified (Peters & Masoudinejad, 2022).

Connection to the outside

- Outdoor spaces accessible from home bring benefit to residents regarding health and positive emotions (Cheshmehzangi, 2021; Millán-Jiménez et al., 2021; Pouso et al., 2021b).
- Balconies enhance residents' satisfaction by offering a space to escape the routine life of the home without leaving it (James, 2007).
- Balconies are valued for qualities such as transparency, daylight, and a pleasant view (Wågø et al., 2016).

Visual comfort

- The type of balcony and their enclosure type (such as open, glazed, and eliminated), affect the degree to which they contribute to visual and psychological comfort (C. Ribeiro et al., 2020).
- Balconies can serve as a buffer space, reducing undesirable penetration of sunlight and decreasing visual glare (Kim & Kim, 2010; C. Ribeiro et al., 2020; Xue, Mak, Cheung, et al., 2016).
- Balconies may cause adverse effects on daylight penetration and luminous comfort (Peters et al., 2020; Wilson et al., 2000).
- Limited studies exist on the impact of balcony design parameters (like size, geometry, location, and typology) on daylight within apartment units (e.g., Dolníková et al., 2021; Peters et al., 2020; Yang Ouyang et al., 2023; Jakubiec et al., 2023).

Thermal comfort

- The presence of a balcony, its green features, and associated fresh air movement, can affect residents' comfort through an indirect influence on their feelings and behaviours (Xue, 2016; de Dear & Brager, 2002).
- Being able to open balcony doors to let in outside air, smells, and sounds is essential for maintaining residents' well-being (Wågø, 2016).
- Balconies enhance comfort and provide sensory stimulation, unlike monotonous mechanical systems: When residents can control their indoor climate by opening balcony doors, they often feel more satisfied with their thermal environment and indoor air quality (de Dear & Brager, 2002; Wågø, 2016).

Spatial perception

- Balconies can influence the experience of spaciousness and liveability perception, especially in high-density apartments (Kennedy et al., 2015; Kotulla et al, 2019).
- The availability of a balcony can mitigate the feeling of crowding and increase residents' satisfaction with room size, although it may not be used frequently (Park et al., 2023).
- There are contradictory findings regarding the effects of balconies on perceived privacy and security: Balconies can negatively impact privacy, leading residents to use shades even at the cost of losing natural light (Xue, Mak, Cheung, et al., 2016); The provision of a balcony does not aggravate residents' concerns about security even in low-floor apartments where security is a major concern (Wing Chau et al., 2004).

Connection to nature

- People prefer to have access to nearby nature (R. Kaplan, 1985).
- Access to an immediate green space at home has positive effects on the healthiness of residents' lifestyles (Odum, 2015), older adults' satisfaction with life, satisfaction with their residence, and their concentration (Talbot & Kaplan, 1991; Ottosson & Grahn, 2005), as well as children's emotional well-being and self-discipline (Taylor et al., 2002).
- The ability of balconies to foster a connection with nature is especially important in high-density cities (Kennedy et al., 2015; Kotulla et al., 2019).
- Provision of open green spaces for each apartment significantly helps improve residents' mental and physical well-being, while also providing adequate natural ventilation and lighting (Waheeb & Hemeida, 2022).
- During the pandemic, balconies were identified as potential biophilic elements in apartment housing which could be used to provide residents with frequent active contact with nature (Akbari et al., 2021; Leon et al., 2020; Zwierzchowska et al., 2021).

- Due to the restorative potential of nature exposure and its use as a protective mechanism against the negative effects of the COVID-19 lockdowns on mental health, green balconies were significantly valued during the pandemic, when frequencies of visits to public green spaces declined (Ugolini et al., 2021).
- Residents' satisfaction, emotional and mental health has been associated with green balconies to an even greater extent than with windows (Mladenović et al., 2017), particularly during the stressful period of the pandemic (Alhadedy & Gabr, 2022; Dzhambov et al., 2021; Kaplan Mintz et al., 2021; Leon et al., 2020; A. I. Ribeiro et al., 2021).
- Balconies can be beneficial for facilitating micro-gardening in multi-family housing, contributing to a more pleasant life, enhancing aesthetic quality of the home, protecting against mental health-related consequences of home confinement, and promoting positive physical, mental, and social health outcomes, as well as contributing to greater public well-being (Mladenović et al., 2017; Theodorou et al., 2021; Zwierzchowska et al., 2021; Soga et al., 2017; de Bell et al., 2020; Yeo et al., 2020).
- Private gardens, green views and gardening were associated with a less negative or even a positive change in the well-being of urban residents during the pandemic, with plant diversity and garden size being the most important predictors of well-being (Shentova et al., 2022).
- Having a garden on the balcony promoted resilience and a green lifestyle during the pandemic (Wang et al., 2023).
- Throughout the pandemic, plant production contributed both aesthetically and functionally to balcony design and proved effective for people's physical and mental health (Bayazit Solak & Kisakurek, 2023).

Connection to social life

- During the pandemic, people used their balconies more frequently as new places for public and social spaces where they could watch or even communicate with people outside (Aydin & Sayar, 2021; Bassetti, 2020; Beşir Ertaş et al., 2023; Elzein & Elsemary, 2022; Gür, 2022; Camacho, 2021; Grigoriadou 2021).
- In some cities, activities performed on balconies, such as playing music, provided the means for social solidarity during COVID-19 lockdowns and were a powerful form of societal resilience (Calvo & Bejarano, 2020).
- Little research has been conducted on balconies as urban liminal space, making them essential for social communication between the private and public realms (e.g., Aronis, 2022), as well as on their different characteristics and roles in the social and cultural life of the city (e.g., Aronis, 2009).
- Few studies have been conducted on the social outcomes of gardening on balconies (e.g., Y. Wang et al., 2023).

Entrance/Transitional spaces

Characteristics

- Few studies have explored the activities that take place in transitional spaces, and identified design characteristics of entrance areas and forecourts in apartments (e.g., Al-Yozbakee & Al. Sanjary, 2022; Bay, 2010; Bay, 2004; Wang & Bay, 2008).
- Residents of apartments with forecourts have reported these spaces as their most desirable areas, compared to other indoor and outdoor spaces (Bay, 2000).
- During the pandemic, the home entrance space was recognized as being the least pleasant, due to its association with disinfection (Cuerdo-Vilches et al., 2020).
- During the pandemic, people's preferences for entrance spaces included: transitional hierarchy, adequate ventilation and air purification systems, and enough space for changing clothes, storage, cleaning food dirt, sanitizing shopping packages, and washing hands before entering the home (Cuerdo-Vilches et al., 2020; Gür, 2022; Putra, 2021).

Connection to the Outside
- Transitional spaces can facilitate psychophysiological adaptation to thermal conditions, particularly among older adults; the ideal model for designing a transition space is to utilize a semi-open external corridor with the temperature/humidity constantly increasing/decreasing from outdoors, through the transition space, into the indoors (Jiao et al., 2023). - The transition zone between the indoors and outdoors should be carefully considered to support residents' well-being, including accommodating different activities, ensuring privacy, and improving thermal comfort (Wågø, 2016).

Connection to Nature
- Limited research has been conducted on the potential of gardening in semi-open corridors and forecourts of apartments and its effects on health (e.g., Bay, 2010; Bay, 2004).

Connection to Social Life
- Few studies in apartment housing consider that the corridor is a manifestation of security and safety, socializing, cultural needs and habits, personalization and territory identification (e.g., Lianto et al., 2017). - A significant amount of residents' social interaction has been observed in the transitional spaces of high-rise housing (Huang, 2006). - Forecourts and semi-open corridors can cause a visual connectivity between residents in their entrance porch spaces, creating a friendly atmosphere, contributing to high levels of social interaction, and a strong sense of identity and security (Bay, 2010; Bay, 2004). - Gardening in semi-open corridors and forecourts was associated with increased exposure to neighbours, sense of community, belonging and security (Bay, 2010; Bay, 2004). - Some criteria have been identified for enhancing social interaction in semi-public transitional spaces of high-rise apartments, such as visibility and openness, design attributes of nodes, having the possibility for multiple activities, and personalization (Huang, 2006; Siew Bee & Poh Im, 2016). - Design strategies that connect people to the surrounding street life can help moderate the psychological and social impacts of high-rise housings (Kalantari & Shepley, 2021).

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