



BIOPHILIC ARCHITECTURE AS A PREVENTIVE STRATEGY FOR YOUTH MENTAL HEALTH IN URBAN CENTERS

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ABSTRACT

Urban youth increasingly face mental health challenges due to academic pressure, sedentary lifestyles, limited access to safe public spaces, and the psychological impacts of dense urban environments. Conventional approaches to youth mental health, which are largely clinical or institutional, often fail to address preventive and environmental dimensions of well-being. In response, this paper examines the potential role of biophilic architecture as a non-clinical and preventive strategy to support youth mental health in urban contexts, particularly within sport and youth centers. This study employs a qualitative literature-based approach, synthesizing psychological theories, empirical studies, and architectural research related to biophilic design, adolescent mental health, and the built environment. The findings indicate that biophilic design elements such as natural lighting, ventilation, green and blue elements, spatial openness, and sensory-friendly environments are associated with stress reduction, improved mood, enhanced emotional regulation, and increased place attachment among adolescents. Sport and youth centers, when designed with biophilic principles, can function not only as physical activity hubs but also as restorative social infrastructures that support mental well-being. The paper identifies a research gap in youth-specific, urban-based studies that integrate biophilic design with real architectural typologies. By positioning biophilic architecture as a preventive mental health strategy, this study contributes to architectural discourse and youth studies, emphasizing the importance of everyday environments in fostering psychological resilience among urban youth, particularly in developing city contexts.

Keywords: *Biophilic architecture; Youth mental health; Urban youth centers; Preventive design; Sport facilities; Built environment*

1. INTRODUCTION

The mental health of young people in urban areas has become a crucial issue in the discourse of modern urban development. Urban environments, rife with academic pressures, social expectations, and a competitive lifestyle, also impact adolescents' psychological well-being. The intensity of activity, the density of space, and the fast pace of life contribute to increased symptoms of stress, anxiety, and mental fatigue. Several reports from the World Health Organization (WHO) and UNICEF have identified adolescents as an age group with a high level of vulnerability to mental health disorders, particularly in urban areas with limited open spaces, physical activity, and environmental quality conducive to well-being. This situation is further exacerbated by sedentary lifestyles, high use of digital devices, and limited safe spaces for social interaction and expression.

To date, efforts to address adolescent mental health issues have been dominated by formal approaches through educational institutions and clinical services. While crucial, these approaches have several limitations. School environments often prioritize academic achievement, leaving ongoing psychosocial

support unfocused. Furthermore, clinical mental health services tend to be reactive, costly, and still face social stigma. As a result, many adolescents do not receive early or preventative support, and psychological problems are often identified only after they have already reached a more complex stage.

In recent decades, interdisciplinary studies have begun to highlight the influence of the built environment on human mental well-being. An environmental psychology perspective views physical space as a factor that can influence an individual's emotional state, behavioral patterns, and psychological health. Aspects such as the quality of natural lighting, ventilation, the presence of natural elements, and the arrangement of social spaces have been shown to play a role in creating a sense of comfort and reducing stress levels. For adolescents, an emotionally supportive environment not only serves as a venue for activities but also plays a role in the formation of identity, social relationships, and psychological resilience.

In line with this thinking, biophilic architecture has developed as a design approach that offers mental health support through non-clinical means. Based on the concept of biophilia, which emphasizes the natural human tendency to connect with nature, this approach integrates natural elements into the built environment, both directly and symbolically. Various studies have shown that the presence of vegetation, natural lighting, water elements, and the use of nature-inspired patterns and materials have restorative effects, such as reducing stress and improving mood. Thus, biophilic architecture serves not only as an aesthetic strategy but also has the potential as a preventative approach to supporting mental health.

Although research on biophilic design and human well-being continues to grow, studies specifically exploring biophilic architecture as a preventative strategy for mental health in adolescents remain relatively limited. Most studies focus on workplaces, formal educational institutions, or healthcare facilities, while informal spaces such as youth centers in urban areas remain underexplored. This limitation presents opportunities for further research.

Based on these conditions, this study aims to examine the role of biophilic architecture in supporting adolescent mental health through the design of youth activity centers in urban areas. This study seeks to identify how biophilic architecture principles can be applied as a non-clinical preventive approach, while also serving as a conceptual basis for designing sport facilities and youth centers that are responsive to the psychological needs of young people in urban environments.

2. YOUTH MENTAL HEALTH IN URBAN CONTEXTS

The mental health of adolescents in urban areas is a serious concern in public health studies and urban design. The World Health Organization (WHO, 2021) confirms that more than half of mental health disorders emerge before the age of 14, with urban environmental factors being a significant risk factor. Rapid urbanization, population density, and changing lifestyles have created psychologically stressful conditions for young people. Therefore, an approach that considers both the physical and social environments is crucial in preventing mental health disorders in adolescents.

2.1. Mental Health Challenges Among Urban Youth

Various studies have shown that adolescents in urban areas face higher levels of life stress than those in non-urban areas. UNICEF (2021) notes that academic demands, social expectations, and competitive pressures in urban environments correlate with increased levels of stress and anxiety in adolescents. Crowded, noisy, and minimally private urban environments also contribute to mental exhaustion and decreased emotional well-being.

In addition to psychosocial stress, sedentary lifestyles and screen dependence are increasingly dominant risk factors. The WHO (2020) reported that most adolescents in urban areas do not meet daily physical activity recommendations, while digital device usage continues to increase. Several epidemiological studies have shown that physical inactivity and excessive screen exposure are associated with an increased risk of depression, anxiety disorders, and sleep disturbances in adolescents (Twenge et al., 2018; WHO, 2020). This situation is exacerbated by the limited availability of safe and accessible public spaces for physical and social activities.

The limited availability of safe and inclusive spaces is also a major challenge in urban contexts. According to UN-Habitat (2020), many developing cities lack quality youth-friendly public spaces, leading young

people to spend time in virtual or informal spaces that are less conducive to psychological development. The absence of positive informal spaces has been linked to increased feelings of isolation, lower social cohesion, and vulnerability to risky behaviors in adolescents (WHO, 2021).

2.2. The Role of the Built Environment in Youth Well-Being

Studies in environmental psychology and health architecture consistently emphasize that the built environment directly impacts human psychological well-being. [7], through their Stress Recovery Theory, demonstrated that the characteristics of the physical environment, including lighting, vegetation, and the visual quality of a space, can influence stress levels and the psychological recovery process. This finding is reinforced by [2] Attention Restoration Theory, which states that environments that provide restorative experiences, particularly those containing natural elements, can enhance cognitive capacity and emotional regulation.

Social spaces in the built environment also serve as a protective factor for adolescent mental health. Research by Carmona et al. (2018) shows that inclusively designed public spaces that encourage social interaction can strengthen a sense of belonging and place attachment, both of which are associated with psychological well-being. For adolescents, spaces that allow for informal social interaction without institutional pressures contribute to identity development and emotional resilience.

In this context, the need for non-formal spaces for adolescents is becoming increasingly important. Youth centers, sport facilities, and non-institutional community spaces have been identified as potential channels for strategies to prevent mental health disorders (UNICEF, 2019). Unlike schools or clinical facilities, non-formal spaces provide flexibility, a sense of security, and freedom of expression, all of which support preventative mental health. Therefore, designing built environments that consider the psychological aspects of adolescents is not only socially relevant but also part of a space-based public health approach.

3. BIOPHILIC ARCHITECTURE AND PSYCHOLOGICAL FOUNDATIONS

The biophilic architecture approach is rooted in the understanding that the relationship between humans and nature is not simply an aesthetic preference, but a fundamental biological and psychological need. In the context of adolescent mental health in urban areas, this approach becomes increasingly relevant as a design strategy capable of responding to the pressures of the modern built environment. This chapter discusses the conceptual basis of biophilia, the psychological theories that support the effectiveness of biophilic design, and its application in the built environment.

3.1. Biophilia and Human–Nature Connection

The concept of biophilia was first introduced by Edward O. Wilson (1984), who defined it as the innate human tendency to seek connection with nature and other life forms. The Biophilia Hypothesis states that human affiliation with nature developed through an evolutionary process, with the natural environment playing a crucial role in human survival and well-being. Therefore, humans' positive response to nature is not merely cultural, but biological and universal.

Numerous cross-disciplinary studies have shown that exposure to natural elements such as vegetation, water, natural light, and open landscapes triggers positive psychological responses, including feelings of comfort, calm, and security. Kellert and Wilson (1993) assert that experiencing nature can improve emotional health, cognitive capacity, and psychological balance. In modern urban contexts, where interaction with nature is increasingly limited, this disconnection is often associated with increased stress and mental fatigue.

For adolescents, connection to nature plays a more significant role because their developmental stage is characterized by heightened sensitivity to the environment. Studies show that exposure to nature at a young age contributes to emotional regulation, reduced anxiety, and improved overall mental well-being. Thus, the principle of biophilia provides a strong theoretical foundation for integrating natural elements into built spaces as part of a mental health support strategy.

3.2. Psychological Theories Supporting Biophilic Design

The effectiveness of biophilic design in supporting mental health is reinforced by various psychological theories, one of which is *Stress Recovery Theory* proposed by [7]. This theory states that exposure to natural environments can accelerate recovery from psychological stress by triggering positive emotional responses and reducing stress-related physiological activity. Ulrich's research showed that individuals exposed to

natural scenery experienced faster reductions in blood pressure, heart rate, and emotional tension than those in monotonous, artificial environments.

Besides that, *Attention Restoration Theory* (ART) developed by [2] explains that natural environments have restorative qualities that can restore attentional capacity depleted by intensive cognitive activity. Environments with natural elements offer a restorative experience. "soft fascination", a stimulus that captures attention without demanding excessive focus, thus allowing for mental recovery. This theory is particularly relevant in the context of urban adolescents facing cognitive fatigue due to academic pressure and excessive exposure to digital technology.

Further research in environmental psychology has also highlighted the link between environmental preferences and emotional regulation. Research shows that humans tend to prefer environments that resemble natural patterns, such as orderly visual complexity, diversity, and a balance between openness and protection. Environments with these characteristics have been shown to increase feelings of safety, reduce anxiety, and support emotional stability. These findings strengthen the argument that biophilic design works not only on a visual level but also influences deeper psychological processes.

4. EMPIRICAL EVIDENCE FROM PREVIOUS STUDIES

Several empirical studies have shown that exposure to environments with biophilic elements significantly contributes to reduced stress levels. [7] found that individuals exposed to natural landscapes experienced faster stress recovery compared to those in artificial environments without natural elements. This finding is supported by a meta-analysis conducted by Bratman et al. (2019), which concluded that interaction with nature is associated with decreased cortisol activity and increased positive affective states.

In addition to reducing stress, improved mood is also a consistent finding in biophilic design studies. Research by Browning et al. (2014) and Kellert (2018) shows that the presence of vegetation, natural lighting, and water elements in a space can increase feelings of calm, comfort, and optimism. In the context of adolescents, a study by Van den Berg et al. (2016) showed that exposure to green space correlates with higher levels of emotional well-being and reduced symptoms of anxiety and depression.

Adolescents' preference for natural elements has also been documented in various studies. A study by Chawla (2015) showed that adolescents tend to prefer spaces with natural characteristics, such as the presence of trees, green spaces, and water features, over spaces that are entirely artificial. This preference is not only aesthetic, but also related to perceptions of comfort, safety, and opportunities for informal social interaction. These findings strengthen the argument that biophilic design has particular relevance for the adolescent age group.

4.1. Adolescents' Psychological Response to Biophilic Environments

Adolescents' psychological responses to biophilic environments are influenced by how they perceive space. Environments that feature natural elements tend to be perceived as more welcoming, open, and non-threatening. According to research by Hartig et al. (2014), positive perceptions of environmental quality are directly related to increased psychological well-being and emotional well-being. For adolescents, positive spatial perceptions are crucial in shaping their daily social and emotional experiences.

Furthermore, sense of security and place attachment (*place attachment*) is also an important aspect of the relationship between biophilic design and adolescent mental health. A study by Scannell and Gifford (2010) showed that attachment to a place contributes to emotional stability and a sense of belonging. Biophilic environments, through the presence of natural elements and the human qualities of spaces, can strengthen the emotional bond between adolescents and the spaces they use. This attachment serves as a protective factor against stress and feelings of isolation, which are often experienced by adolescents in urban areas.

In addition, biophilic environments also play a role in supporting emotional regulation and cognitive focus. *Attention Restoration Theory* [2], environments containing natural elements can restore attention capacity depleted by intensive cognitive activity. Further research shows that adolescents with access to green spaces or natural environments exhibit improved concentration, better emotional control, and decreased impulsivity (Taylor & Kuo, 2009). These findings confirm that biophilic environments impact not only emotions but also adolescents' cognitive functioning.

4.2. Limitations and Research Gaps in Existing Studies

Although empirical evidence regarding the benefits of biophilic design on mental health is growing, several limitations remain in existing research. First, most studies are general in nature and do not specifically target the adolescent age group. Many studies combine different age groups or focus on adult populations, thus not fully addressing the unique psychological characteristics of adolescents.

Second, the research context is still dominated by specific environments such as workplaces, formal schools, or healthcare facilities. Studies that specifically discuss the application of biophilic design in the context of youth activity centers (*youth centers*) in urban areas is still very limited. However, non-formal spaces play a crucial role as a medium for social interaction and mental health support for adolescents outside the educational and clinical systems.

Third, there are still limitations in integrating psychological findings with concrete architectural design applications. Many studies focus on analyzing psychological perceptions or responses without directly linking them to concrete spatial design strategies. This gap highlights the need for research that bridges theory, empirical evidence, and architectural design practice, particularly in the design of sport facilities and youth centers based on biophilic architecture.

5. BIOPHILIC DESIGN AS A PREVENTIVE MENTAL HEALTH STRATEGY IN URBAN YOUTH CENTERS

Preventive approaches to mental health are increasingly important in addressing the increasing psychological distress among adolescents in urban areas. Recent research in architecture and environmental psychology shows that the built environment has a direct influence on the emotional and cognitive well-being of users, particularly adolescents who are vulnerable to stress and depression [4]. In this context, biophilic design is understood as a non-clinical approach that has the potential to passively support mental health through spatial quality, sensory experiences, and connection to natural elements.

5.1. Youth Centers as Preventive Social Infrastructure

Youth centers serve as informal community spaces that provide a safe, inclusive, and flexible environment for youth to engage in activities and social interactions. This non-clinical environment allows youth to engage without academic or medical pressures, making it more effective in building mental well-being through preventative measures. UNICEF (2019) states that voluntary, non-hierarchical community spaces contribute positively to emotional resilience and a sense of belonging in adolescents.

The findings of [4] reinforce the idea that the quality of the built environment can serve as an *environmental buffer* against psychological stress. Spaces with biophilic characteristics can reduce symptoms of mild depression through calming and restorative spatial experiences. Thus, youth centers can be positioned as preventative social infrastructure that bridges the social, physical, and mental recovery needs of adolescents in urban environments.

5.2. Design Principles for Biophilic Youth Centers

Biophilic design principles have been shown to have a significant impact on adolescents' psychological well-being. One of the key principles is spatial openness (*spatial openness*), which allows for extensive visual connections, flexibility in space use, and a perception of control over the environment. [4] found that spaces with good visual openness are associated with reduced stress levels and increased emotional comfort in adolescent users.

Natural lighting and cross-ventilation are also biophilic elements that directly impact mental health. Exposure to natural light is associated with emotional stability, improved mood, and reduced mental fatigue, while natural ventilation creates a more vibrant and adaptive spatial experience [4]. These elements help strengthen users' connection to the outdoor environment, which is crucial in dense urban settings.

The integration of green and blue elements, such as vegetation and water features, acts as a restorative stimulus that supports attention recovery and emotional regulation. A study by [4] showed that visual and physical access to natural elements correlated with a reduction in mild depressive symptoms in adolescents. Therefore, the implementation of gardens, green courtyards, or reflective water elements in youth centers can be an effective passive design strategy.

Additionally, sensory comfort is a crucial aspect of biophilic youth center design. Environments with excessive sensory stimulation can potentially trigger mental fatigue. Sensory-friendly spaces (*sensory-friendly spaces*) with acoustic control, soft lighting, and natural materials have been shown to support adolescent sense of security and emotional regulation [4]. The provision of social interaction spaces balanced with protective spaces (*refuge areas*) allows teenagers to choose a space experience according to their emotional state.

5.3. Relevance to Urban Sport and Youth Facilities

The integration of sport facilities into youth centers strengthens their role as a preventative mental health strategy. Physical activity is generally known to contribute to stress reduction and improved psychological well-being in adolescents (WHO, 2020). However, [4] emphasize that the benefits of physical activity can be maximized when supported by a restorative built environment.

Sport environments designed with biophilic principles, such as natural lighting, visual connections to green spaces, and smooth spatial transitions can balance the intensity of physical activity with the need for mental recovery. In the context of urban sport and youth facilities, biophilic design serves as a balancing layer that supports both physical and mental health. This approach positions architecture as an active element in preventative strategies for adolescent mental health in urban areas

6. DISCUSSION

This chapter discusses the synthesis of theoretical and empirical findings regarding the influence of biophilic design on adolescent mental health (Focus A) and its implications as a preventive strategy in the design of youth centers and urban sport facilities (Focus B). This discussion positions architecture not merely as a container for activities, but as an active medium that bridges the needs of mental health, physical activity, and social space for young people in urban areas.

6.1. Biophilic Design as a Bridge Between Mental Health, Physical Activity, and Social Space

The results of the study in the previous chapter indicate that biophilic design has the ability to connect three main dimensions of adolescent well-being: mental health, physical activity, and social interaction. Biophilic elements such as natural lighting, vegetation, visual openness, and sensory-friendly spatial qualities have been shown to contribute to stress reduction, improved mood, and cognitive recovery in adolescents [4]. In the context of youth centers and sport facilities, these elements serve as a supporting layer that enriches the spatial experience, so that physical activity not only impacts physical health but also emotional balance.

Sport activities taking place in biophilic environments have the potential for greater psychological benefits than conventional, enclosed, and poorly designed sport spaces. The presence of natural elements and visual connection to the outdoors create a smoother transition between intense activity and recovery, supporting adolescents' emotional regulation. Thus, biophilic design acts as a bridge between the need for physical stimulation and the need for mental recovery within a single, integrated spatial system.

6.2. Biophilic Architecture as a Preventive Mental Health Approach

Research findings indicate that biophilic architecture has strong relevance as a preventive approach to mental health, particularly for adolescents. Unlike curative and reactive clinical approaches, biophilic design works passively and sustainably through everyday spatial experiences. Built environments that provide a sense of safety, sensory comfort, and opportunities for healthy social interactions contribute to a reduced risk of chronic stress and mild depressive symptoms [4].

In the context of youth centers, this approach expands architecture's role from simply providing facilities to fostering mental well-being. Non-formal, biophilically designed spaces allow youth to access psychological support without stigma, as the healing process occurs naturally through activities, interactions, and spatial experiences. This strengthens the argument that architecture can function as part of a community-based mental health prevention system.

6.3. Relevance in Developing Urban Contexts

The application of biophilic design as a preventive strategy has particular relevance in the context of developing cities like Medan. Urban areas in developing countries generally face challenges such as limited mental health facilities, high population density, and a lack of safe and inclusive public spaces for youth. In

these circumstances, youth centers and sport facilities designed with biophilic principles can serve as a relatively efficient and sustainable alternative to environmentally-based interventions.

The Medan context, particularly in urban areas with high levels of activity and complex environmental pressures, demonstrates the need for spaces that balance urban dynamics with the psychological well-being of the younger generation. Biophilic architecture offers an adaptive approach to these conditions by utilizing natural elements, the local climate, and the characteristics of open spaces as restorative resources. Thus, biophilic design is not only theoretically relevant but also contextually relevant as a design strategy capable of addressing the social, health, and environmental needs of developing cities.

6.4. Implications for Architectural Design

This discussion confirms that the integration of biophilic design in youth centers and sport facilities has direct implications for architectural design practice. Architects and planners need to view sport and community spaces as holistic systems that incorporate physical activity, social interaction, and mental recovery. This approach encourages a paradigm shift from purely functional design to one that prioritizes human well-being.

By consistently adopting biophilic principles, public facilities in urban areas can function as social infrastructure that supports preventative mental health. In the long term, this approach has the potential to strengthen the psychological resilience of adolescents, improve the quality of life for urban communities, and contribute to healthier and more sustainable urban development.

7. CONCLUSION

This study examines the role of biophilic architecture in supporting adolescent mental health in urban areas, focusing on sport facilities and youth centers as non-clinical and preventative spaces. Through a synthesis of environmental psychology theory, empirical studies, and architectural discourse, this study demonstrates that the application of biophilic principles such as natural lighting, natural ventilation, green and blue elements, spatial openness, and sensory-friendly spaces has the potential to positively impact emotional regulation, stress reduction, and the overall psychological well-being of adolescents.

Conceptually, this paper contributes to the development of architectural and youth studies by positioning biophilic design as an environmental strategy that complements social and institutional approaches to youth mental health issues. Unlike previous studies that primarily examined the application of biophilic design in workplaces or healthcare facilities, this research broadens the context of the study to non-formal spaces oriented towards the youth generation. By positioning youth centers as social infrastructure, this research emphasizes that architecture plays an active role in shaping the emotional and social experiences of youth in urban environments.

From a design perspective, research findings indicate that the integration of physical activity, social interaction, and the quality of the built environment is key in designing sport and youth centers that promote mental well-being. Sport environments designed with biophilic principles not only support physical performance but also provide a balanced psychological recovery space. This approach encourages a design paradigm shift from merely fulfilling functions to human-centered design (*human-centered design*).

In the context of a developing city like Medan, the application of biophilic architecture has significant relevance as an adaptive and sustainable design strategy. Limited access to formal mental health services and the scarcity of safe and inclusive public spaces make biophilic-based sport and youth centers a potential alternative environment-based intervention. This approach positions architecture as part of a mental health prevention system integrated with the daily lives of adolescents in urban areas.

As a further research direction, more specific empirical studies are needed on the psychological responses of adolescents in various cultural and urban contexts. Longitudinal research and post-occupancy evaluations of biophilic youth and sport center facilities are also needed to measure the long-term impacts on the mental health and behavior of users. Furthermore, cross-disciplinary collaboration between architecture, psychology, and urban studies is expected to strengthen biophilic architecture's position as a credible preventive approach to supporting the well-being of young people in urban environments

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