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Biophilic Architecture in Health Facilities for The Management of Psychological Conditions of Asthma Patients

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ABSTRACT

The increasing air pollution in Indonesia has raised concerns among the public, accompanied by a rise in respiratory diseases. One such disease requiring special attention is asthma, with a prevalence of 7%. Asthma is a chronic condition that can be potentially fatal if not correctly managed, triggered by allergens and the psychological condition of the patient. Asthma management in Indonesia still requires improvement in terms of services and education, particularly in addressing the psychological aspects of the condition. Thus, a biophilic architecture approach is needed to enhance the management of psychological factors in asthma care. The research method involves qualitative and quantitative techniques with the following steps: (1) Synthesis of theory and observation of 10 hospitals with 14 biophilic architecture elements, (2) Collection of data on perceptions of implementing biophilic architecture elements in managing the psychological conditions of asthma patients with 41 respondents, (3) Identification of the management of psychological conditions of asthma patients with biophilic design, (4) Recommendations of biophilic design elements for the psychological healing of asthma patients. The results show that 12 out of 14 biophilic architecture elements are applied in the hospitals studied. Respondents' perceptions indicate that the psychological conditions of asthma patients that need to be managed are mainly dominated by overthinking, followed by anxiety, worry, and fear. Subsequently, biophilic design is derived from these findings to manage asthma patients' conditions by applying biophilic architecture elements in healthcare facilities. This research recommends the implementation of biophilic concepts in healthcare facility design to help manage the psychological conditions of asthma patients.

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Keywords: *Biophilic Architecture; Health Facilities; Psychological Conditions,*

1. Introduction

Weather change and increased air pollution in Jakarta, Indonesia, especially in 2023, raiseconcerns for public health, with the air pollution index reaching 166 on August 6, 2023. Thisincreases the risk of respiratory diseases such as asthma, whose prevalence is around 7% or around 18 million individuals in Indonesia in 2022 [1]. These data highlightthe urgency of understanding and effectively managing asthma, given its chronic nature and potential risk of death. As a disease that cannot be cured completely, proper treatment and prevention of trigger factors are key to improving the quality of life of asthmatics in Indonesia. It is important to note that asthma is not only

triggered by external allergens but also by psychological factors such as stress, which has been shown in several studies to be linked.

Currently, asthma management in Indonesia requires significant improvements, especially in health services and education. Many health services and hospitals in Indonesia focus more on physical medicine, while the psychological condition of people with asthma is also important. However, research shows a relationship between asthma and psychological conditions: anxiety [2, 3], worry [4, 5], overthinking [6], and fear [6]. In this context, biophilic architecture can be an alternative. This design emphasizes man's connection with nature to improve physical and mental well-being.

The application of biophilic design in asthma treatment facilities is expected to have a positive impact, supporting the physical and psychological healing process of patients. The biophilic concept has a positive effect on accelerating patient recovery, maintaining emotional stability, and reducing feelings of distress through psychological stimulation. The application of biophilic design in health facilities can create an environment that supports the healing process [7].

From the available data, it can be concluded that asthma management involves not only physical treatment but also attention to psychological aspects, which are equally important in managing the disease. Therefore, initiatives to create holistic health facilities that consider both physical and psychological elements are crucial in addressing chronic diseases such as asthma. The biophilic design concept emphasizes human connection to nature, which has been shown to have a positive impact on improving both physical and mental well-being. By applying biophilic design, healthcare facilities can create an environment that supports the comprehensive healing process of patients with asthma. This includes reducing stress levels and improving emotional stability. Therefore, the application of biophilic architecture in health facilities in Indonesia is expected to help manage asthmatics' psychological condition, positively impact the overall healing process, and improve the quality of life of asthmatics.

2. Material and Methods

2.1. Theoretical Studies

A. Asthma

Asthma is a complex, chronic respiratory disorder, triggered by an IgE response to antigens or pollutants [8, 9]. Risk factors include genetic inheritance, environment, smoking, and obesity. The disease affects the bronchi, causing narrowing of the airways, and has a significant global prevalence, impacting healthcare. One common type is bronchial asthma, a chronic condition characterized by intermittent attacks marked by spasms of the bronchial tubes, swelling of the bronchial walls, and increased mucus production. Symptoms include coughing, wheezing, shortness of breath, and chest contractions, especially in hospitals and emergency departments. The challenge of asthma management in Indonesia involves the limitations of research often conducted in schools or hospitals, thus affecting the representation of available data.

In the late 19th and early 20th centuries, asthma was often considered a psychological condition, referred to as "asthma nervosa," particularly in children. Treatment typically involves placement in institutions for an

extended period of time. Studies show that psychosocial stress in asthma patients is linked to poor disease control, low therapeutic adherence, response to less effective interventions, and physiological changes in the immune system [10, 11]. According to research by Marshal in the 19th century, the view regarding the etiology of asthma involved neurotic elements and nervous system irritability. Currently, evidence suggests that individuals who experience excessive stress have a higher risk of developing clinical asthma [12, 13]. Research by Bonnert (2023) combined two variables, namely the Asthma Symptom Fear Scale (FAS) and the Asthma Behavior Checklist (ABC). The process of selecting items from FAS involves a research group consisting of experts in asthma and cognitive behavioral therapy (CBT) [14]. The results of a study by Bonnert (2023) showed that the average FAS (Fear of Asthma Scale) score had a higher positive response, with a score above two on a scale of 0-4, ranging from 2.34 to 2.94. Grouping four psychological conditions that are often experienced by asthmatics, namely difficulty having fun because of worried about asthma and challenging to have fun because worried about asthma (worry), feeling asthma symptoms, becoming anxious (anxiety), always being aware of breathing(overthinking), and asthma symptoms cause fear (fear). The scores for each psychological condition among asthmatics are as follows: worry (2.34 and 2.52), anxiety (2.94), overthinking (2.41), and fear (2.61).

Meanwhile, the average ABC (Asthma Belief and Compliance Scale) has a less positive response, with scores below four on a scale of 0-7. The study highlights that individuals who have asthma tend to have a fear of symptoms or psychological aspects more than physical conditions. (Table 1).

Table 1. FAS and ABC data survey tested in 2020 of 188 respondents in Sweden

FAS	R^2	Item description	Mean	SD
1	0.61	Worry about asthma when leaving home	1.67	1.7
2	0.69	Often worry about asthma	**2.34**	1.6
3	0.48	Difficult having a good time due to worry about asthma	0.92	1.3
4	0.59	Worry about lung function	**2.52**	1.8
5	0.61	Sense asthma symptoms, become anxious	**2.94**	1.7
6	0.54	Constantly aware of breath	**2.41**	1.6
7	0.54	Often think asthma is a serious disease	2.11	1.7
8	0.55	Anxiety for asthma during the day when waking up	0.9	1.4
9	0.62	When in stress, anxious about asthma	2.06	1.8
10	0.57	Constantly aware of breath changes	1.71	1.6
11	0.52	Asthma symptoms cause fear	**2.61**	1.7

ABC-8	R^2	Item description	Mean	SD
1	0.48	Prefer not taking the stairs	3	1.9
2	0.46	Avoid hurrying	3.3	1.8
3	0.56	Avoid exercise	3.1	1.9

FAS	R^2	Item description	Mean	SD
4	0.71	Avoid becoming short of breath	3.5	2.1
5	0.76	Try to do things as calmly as I can	3.2	2
6	0.59	Plan my route to avoid walking	2.3	1.8
7	0.58	Rest before activities	3.1	2.1
8	0.75	Hold back not to exert myself	3.2	1.9

FAS: Response range 0–4 ("Totally disagree" – "Strongly agree").ABC: Response range 1–7 ("Never" – "Always").
R2 = square of standard loading on latent variableSource: Bonnet dkk, 2022

Based on the data in Table 1, it can be concluded that four psychological conditions are often experienced by people living with asthma, namely: worry, anxiety, overthinking, and fear. The majority of respondents stated that the worry aspect dominates, followed by anxiety and fear. Meanwhile, overthinking occupies the last position in the psychological hierarchy of people living with asthma. This finding confirms the importance of understanding and handling psychological aspects in asthma management, with a focus on handling anxiety and worry as the main priority. This phenomenon demonstrates that in asthma treatment and rehabilitation, the approach used not only focuses on physical healing but also emphasizes the importance of a psychological approach to patients [15]. The design of health facilities needs to support the psychological condition of patients to minimize worry, anxiety, overthinking, and fear.

B. Biophilic Architecture and Healthy Facility

Many studies have shown that interactions between humans and the environment can produce either positive or negative effects, depending on the condition of the space (e.g., green areas in dense urban areas), which in turn affect emotional, psychological, mental, behavioral, and physical health [16, 17].

Stress that includes worry, anxiety, overthinking, and fear in response to illness and environmental conditions is closely related to the patient's experience of suffering, illness, or pain, as well as lack of privacy, unwanted noise, dim lighting, and unpleasant hospital odors [18,19]. This condition can worsen worry, anxiety, overthinking, and fear of illness, which can cause adverse physiological effects, including a weakened immune system, inflammation, and allergies [20, 21].

Interaction with nature can reduce stress, worry, anxiety, overthinking, and fear [22]. The natural environment facilitates psychological healing and provides physiological and physical benefits [23]. Nature provides positive emotions, such as calmness and satisfaction, which effectively reduce adverse conditions, increase immunity, and enhance the individual's ability to cope with physical healing. [24] Therefore, integrating nature into healthcare environments is essential to support psychological conditions and provide physical healing effects. [22, 23]

The relationship between natural elements and humans, as explained in the Biophilia hypothesis such as the genetic relationship between humans and nature, is biologically present in human genes [24, 25]. Natural interventions in the biophilic principles of

architecture include "nature in space", "nature space", and "nature analogue", which integrate natural elements in design to enhance human psychological and physiological interactions with nature. [25, 26]

Biophilic design includes important principles such as the sustainability of natural elements, adaptation of the natural environment in the built environment, emotional engagement of users with the environment, creation of interactions between users and nature, and mutually beneficial relationships between nature and building structures. [25, 26, 27]. Some key elements in the application of this design include environmental features, natural forms and shapes, natural elements and processes, use of light and space, place-based relationships, and interactions between humans and nature [25, 26]. The influence of biophilic architecture on human psychology involves design concepts that integrate nature and the environment as an integral part of a building. Biophilic design is a design theory that studies the phenomenon that humans tend to interact with nature, which can positively impact human psychological and physical well-being (biophilia). The application of biophilic design in architecture can provide significant benefits in supporting the patient's health recovery process, maintaining emotional stability, and reducing user stress levels through psychological stimulation [7, 27]. The application of biophilic architecture in buildings such as hospitals, hotels, and psychiatric rehabilitation centers can positively encourage patient health recovery, maintain emotional stability, and reduce feelings of stress through psychological stimulation [7]. The application of biophilic design in hospitals not only provides psychological support and facilitates the patient's healing process but can also reduce the levels of stress and anxiety experienced by patients [27]. Biophilic design can support the patient's recovery process, as well as help reduce the levels of stress and anxiety experienced by them. Thus, the use of biophilic design in environments such as hospitals can contribute positively to patient well-being and healing, while encouraging a more harmonious relationship between humans and the natural environment. [22, 23].

Browning and Ryan, 2020, explain the Principles of biophilic architecture in 3 Categories of 14 Patterns of Biophilic Design, namely: (1) Nature in Space (Visual Connection with Nature, Non-Visual Connection with Nature, Non-Rhythmic Sensory Stimuli, Access to Thermal and Airflow Variability, Presence of Water, Dynamic and Diffuse Light); (2) Natural Analogies (Biomorphic Forms and Patterns, Material Connection with Nature. Complexity & Order); (3) Nature of the Space (Prospect, Refuge, Mystery, Risk/ Peril).[28]. The principles are a reference for biophilic design. Then Ismail, 2024 explains the psychological experience felt by the effects of the principles of biophilic architecture [29]. Details can be seen on the table. 2.

Table 2. Principles of biophilic architecture

3 Categories of 14 Patterns of Biophilic Design (Browning and Ryan, 2020) [28]			Experience (Ismail, 2024)[29]
Category	**Patterns**	**Explanation**	
Nature in Space related to the integration of natural elements within spaces, such as indoor gardens, green walls, and the use of natural materials.	**Visual Connection with Nature**	Understanding of natural elements, living systems, and natural processes.	Stimulating and soothing.
	Non-Visual Connection with Nature	Nature sensations: sound, touch, scent, and taste, creating positive experiences.	Easily recognizable and comforting.
	Non-Rhythmic Sensory Stimuli	Non-rhythmic natural signals, statistical analysis, and unpredictability.	Encouraging participation and providing energy.
	Access to Thermal and Airflow Variability	Gentle modification of air temperature, humidity, airflow, and natural-like surfaces.	Energetic and refreshing.
	Presence of Water	Enhancing place experience through observation, listening, or tactile interaction with water.	Providing inspiration and serenity simultaneously.
	Dynamic and Diffuse Light	Using variations in light intensity and shadow changes to create natural conditions.	Something filled with drama and intrigue yet balanced with a sense of calmness.
	Connection with Natural System	Understanding of natural processes, particularly seasonal changes and time indicators in a healthy ecosystem.	Triggering beautiful memories, provoking deep thoughts, while creating a calming and relaxed atmosphere.
Natural Analogies Referring to the use of natural forms, patterns, and textures in design, including but not limited to mimicking plant shapes or natural patterns	**Biomorphic Forms and Patterns**	Forms, patterns, textures, or numerical arrangements that mimic nature.	Something rich in valuable elements, providing warmth, and radiating authenticity or genuineness.
	Material Connection with Nature	Natural materials and elements reflecting local ecology or geology, creating a unique sense of place.	Something rich in valuable elements, providing warmth, and radiating authenticity or genuineness.
	Complexity & Order	Abundant sensory information with a natural-like spatial hierarchy.	A situation or environment open to ideas and expression, providing a sense of safety while remaining controlled or orderly.
Nature of the Space Emphasizing the creation of environments that provide a natural experience through elements such asnatural lighting, scenic views, and fresh air.	**Prospect**	Unobstructed long-distance views for surveillance and planning purposes.	A situation or environment open to ideas and expression, providing a sense of safety while remaining controlled or orderly.
	Refuge	A sheltering place from the environment or primary activities, protected behind and above	A mixed feeling of excitement, anticipation, or tension awaiting something expected.
	Mystery	A promise of further information, involving partially obscured views or other sensory inputs, encourages deeper environmental exploration.	A mixed feeling of excitement, anticipation, or tension awaiting something expected.
	Risk/Peril	Identified threats accompanied by reliable protection measures.	Delight with an element of risk, adding tension or uncertainty.

Source: Browning and Ryan, 2020; Ismail, 2021

2.2. METHODS

This research uses qualitative and quantitative approaches with structured methodological stages. The results of this study will be the basis for the author in designing solutions at the stage of completing the final project.

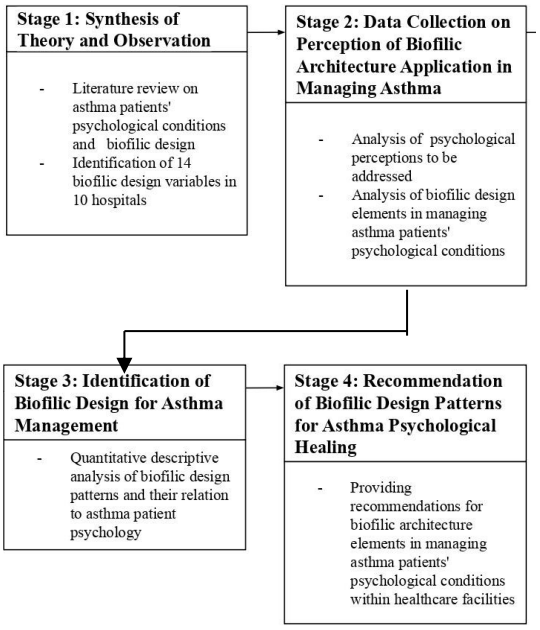


Figure 1. Stages of research methods

i. Stage 1 Synthesis of theory and observation: literature review of psychological conditions of patients that cause asthma, as well as biophilic design that can reduce psychological conditions. At this stage also identified and observed the application of 14 biophilic variables in 10 hospitals.
ii. Stage 2 Data collection on perception of biophilic architecture application in managing Asthma: collection of perception data from 41 respondents, namely the dominant psychological perception of asthma sufferers. Furthermore, the perception of the implementation of biophilic design elements on the psychological conditions of asthma patients.
iii. Stage 3: Identification of Biophilic Design for Asthma Management: Quantitative analysis of descriptions of hospital design with a biophilic approach that can support the psychological conditions of asthma patients.
iv. Stage 4 Recommendation of biophilic design patterns for asthma psychological healing: in the form of recommendations for the application of biophilic to hospital design elements.

3. Results and Discussions

Application of 14 Biophilic Design Elements in Hospital Case Studies

Observations of 10 hospitals showed that there are 12 biophilic elements: visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimulation, thermal variability and airflow, presence of water, dynamic light and diffuse, connection with natural systems, biomorphic forms and patterns, material relationship with nature, complexity, and order, opportunity, and hiding. The use of large windows and the placement of indoor plants to improve connectedness with nature are the most widely applied design elements. Full details of the application of the 14 biophilic elements in hospital design can be found in the appendix (table 4).

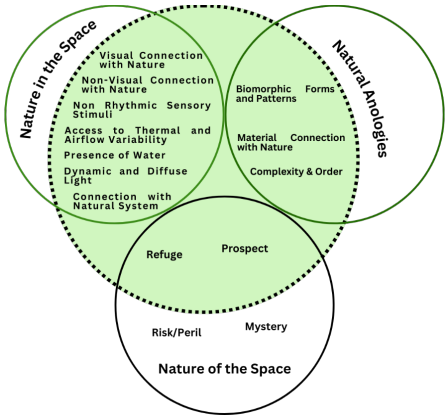


Figure 2. Venn diagram of biophilic elements applied to hospitals
Source: Analysis of theory synthesis, 2024

Description of the Implementation of Biophilic Design Element Theory in Hospitals

Description of biophilic design elements [12, 14] in hospitals, as follows:

1. *Visual Connection with Nature*

The application of natural elements in the hospital environment can be improved through two approaches, namely by using large windows overlooking natural landscapes, utilizing natural materials and textures, and displaying nature paintings. This approach can be applied directly to multiple rooms, such as waiting areas, inpatient rooms, and communal spaces. By visually exposing the elements of nature, optimized space design not only builds a connection with nature, but also contributes positively to comfort, reduces stress levels, and improves mood. This not only benefits patients but also medical staff, who support patients' holistic well-being as an integral part of the care approach. Medical staff, who support patients' holistic well-being as an integral part of the care approach.

Figure 3. Application of visual connection with nature at Strawberry Hill Behavioral Health Hospital
Source : Strawberry Hill Behavioral Health Hospital, 2019

2. *Non-Visual Connection with Nature*

The application of this element carries two main approaches, namely auditory stimuli and the use of odor stimuli. The focus of optimization should be placed on areas that are frequently accessed by patients during the treatment process, especially in the inpatient room. The application of auditory stimuli, such as the sounds of nature, has proven effective in creating an environment that supports the well-being of patients and hospital visitors. Natural sounds, such as gurgling water or birds singing, can have a calming effect and reduce stress levels. In addition, this element also involves the use of soothing odor stimuli, such as aroma therapy, as well as texture adjustments on surfaces accessible to the patient. Given the variability of individual responses to stimuli, this approach takes into account diversity in the design of hospital environments. By providing positive stimuli, the application of this element can effectively reduce the stress levels of patients and visitors, creating a more positive treatment experience in the hospital.

Figure 4. Application of non-visual connection with nature at Khoo Teck Puat Hospital
Source : Khoo Teck Puat Hospital, 2010

3. *Non-Rhythmic Sensory Stimuli*

The application of this element in building design, which involves the connection of humans with nature through elements such as observation of cloud movement or the sensation of weather changes through building openings, can enhance sensory experiences in a hospital environment. Sensory diversity, including gentle winds and natural scents, positively affects concentration and reduces fatigue levels. The importance of considering building designs that facilitate accidental access to natural elements is reflected in the presence of windows that allow occupants to see weather changes or feel gentle winds, providing natural sensory variations that can contribute to mental and emotional well-being.

Figure 5. Application of non-rhythmic sensory stimulation with nature at New Stanford Hospital
Source : New Stanford Hospital, 2019

4. *Access to Thermal and Airflow Variability*

The application of this element emphasizes ventilation management within the hospital, which can be more effective if applied to rooms that have freedom in their design. This is because there are rooms that have special functions and must comply with high hygiene standards and strict temperature and humidity requirements. The importance of considering the needs of patients, especially those who may have sensitivity to certain air or temperature, emphasizes that ventilation and temperature settings should be able to be adjusted according to individual preferences and needs. The use of natural ventilation is a solution to maximize air exchange in hospital rooms. Designs that support natural air circulation, such as the use of openable windows, allow natural ventilation to efficiently regulate temperature and humidity. This not only creates a comfortable environment for patients and medical staff but also supports the healing process by guaranteeing optimal environmental conditions.

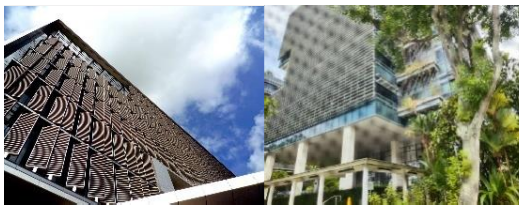


Figure 6. Application of thermal variability & airflow with nature at Khoo Teck Puat Hospital
Source : Khoo Teck Puat Hospital, 2010

5. *Presence of Water*

The application of this element can be realized by introducing the water element into the hospital environment. Water use can involve the physical presence of water, such as a fountain or small pond, as well as abstractly through textures, sounds, or images. The goal of this practice is to create a calming environment, reduce stress levels, and bring a positive atmosphere within the hospital. The provision of physical water elements, such as fountains or small pools, can provide a relaxing and cool effect that can potentially help patients and visitors feel more comfortable. In addition, this approach may also involve abstract use of water-related elements, such as gurgling water sounds or images of water scenes, to create a calming effect and support the healing process.

Figure 7. Application of thermal variability & airflow with nature at Kurashiki Central Hospital
Source : Kurashiki Central Hospital, 2023

6. *Dynamic and Diffuse Light*

The application of this element can be realized by creating large openings or windows in each room to maximize the entry of sunlight. Natural sunlight has health benefits, especially in supporting the production of vitamin D in the human body. The use of this element should be applied to almost all rooms, except in rooms that require special lighting and have a very high degree of spread, such as operating rooms. The use of natural light with variations in intensity and color can have a positive impact, such as increased concentration, support for circadian rhythms, and improved mood. A bright, glowing room can create a more pleasant environment, provide a sense of comfort, and potentially improve patients' quality of life and hospital experience.

Figure 8. Application of dynamic & diffuse light at Royal Papworth Hospital
Source : Royal Papworth Hospital, 2020

7. Connection *with Natural System*

The application of this element can be realized by creating openings that interact directly with natural elements, but it should be noted that the application of this element is limited to spaces of a communal nature. This approach has a positive impact on the patient's psychology as it creates a harmonious and refreshing environmental experience. By creating openings that facilitate interaction with nature, communal spaces can become more open to natural elements such as sunlight, scenery, or fresh air. This creates a pleasant atmosphere and provides a positive experience for the patients in the room.

Figure 9. Application of connection with natural systems at Gheskio Tuberculosis Hospital
Source : Gheskio Tuberculosis Hospital, 2015

8. Biomorphic *Forms and Patterns*

The application of this element can be realized by using nature-inspired forms, such as leaf patterns or cell structures. The use of nature-inspired aesthetic patterns not only provides visual appeal but can also spark a sense of engagement with nature. The application of this element can be carried out throughout the hospital, creating a more natural and friendly environment. The positive impact of using nature-inspired elements can be felt by the psychology of patients, medical staff, and visitors.

Figure 10. Application of forms and biomorphic elements at Strawberry Hill Behavioral Health Hospital
Source : Strawberry Hill Behavioral Health Hospital, 2019

9. *Material Connection with Nature*

The application of interior design elements using natural materials such as wood, stone, or cork can create a natural feel and connection with nature. This technique involves imitating natural textures, such as bark or moss, by utilizing sustainable and environmentally friendly materials. The integration of natural materials such as wood or stone can give a natural impression to interior design. It is important to pay attention to the applicable room requirements and regulations, especially within the scope of hospitals, so that the application of this element remains appropriate and safe. Some adjustments may be required to meet the specific needs and requirements of the room.

Figure 11. Application of thermal variability & airflow with Nature at Khoo Teck Puat Hospital
Source : Khoo Teck Puat Hospital, 2010

10. Complexity & *Order*

The application of natural design elements involves the incorporation of elements of complexity and diversity of nature in the design. It can stimulate the brain and enhance the user experience by utilizing nature-inspired colors, textures, and shapes. The use of these design elements not only provides pleasing visual variety but also increases user engagement. It is recommended to implement this element in communal spaces, but it is necessary to take care that the design is not too crowded, especially in environments such as hospitals, to avoid negative impacts on patients.

Figure 12. Application of complexity & order at Kurashiki Central Hospital
Source : Kurashiki Central Hospital, 2023

11. *Prospect*

The application of this element involves creating an area with sufficient visibility, spaciousness, and open towards nature. The goal is to provide visual access to a wide view, enhance comfort, and create a positive experience for patients and medical staff. Areas with natural views can provide an open, natural, and calming atmosphere. The presence of large windows or open areas can create the impression of a large space and connect with the surrounding environment. Thus, the resulting atmosphere supports the healing process and provides a positive experience for all who interact with the room.

Figure 13. Application of opportunity at New Stanford Hospital
Source : New Stanford Hospital, 2019

12. *Refuge*

The application of this element involves providing safe and secure areas, such as terraces or gazebos, as resting areas for medical staff and healing areas for patients. An additional advantage involves providing privacy space for patients as needed. Safe and secure open areas can serve as comfortable resting places for medical staff, help refresh them between tasks and positively affect their well-being. This step can support the optimal performance of medical staff by providing the best service.

Figure 14. Application of hiding at Kurashiki Central Hospital
Source : Kurashiki Central Hospital, 2023

13. *Mystery*

The application of this element involves the recognition of unexpected patterns in design, such as winding paths or mysterious natural elements, to increase curiosity and desire to explore. However, in a hospital context, this approach may not be necessary or even less recommended. Hospitals are supposed to create an impression of serenity and safety for patients, visitors, and medical staff. The introduction of unexpected elements, winding paths, or mysterious elements can increase the impression of spookiness and confusion, which may hurt the use of such space in the hospital environment.

14. Risk/Hazard (*Risk/Peril*)

The application of this element involves creating designs that mimic natural challenges, such as the use of water patterns or moving bridges, to provide a safe, stimulating, and courageous challenge experience. While this approach may add value in some contexts, it should be noted that its application is not necessary in hospitals. Conversely, designs that mimic the challenges of nature can worsen the patient's state and are less in line with the atmosphere of tranquility and healing desired in a hospital environment. In the context of healthcare, the primary focus should be on creating spaces that support patient healing and well-being.

Psychological Conditions of Asthmatics in Indonesia

In this study, a cross-sectional data collection method was applied to 41 participants suffering

from asthma and related anxiety, with an age range of 18–70 years. The findings showed that 34.1% of participants expressed the need for increased attention to the psychological condition of asthmatics, especially overthinking, to support asthma cure in Indonesia. Furthermore, the results of the questionnaire showed that in the second order, as many as 26.8% of respondents identified anxiety as an aspect that requires serious attention in the management of asthma.

Analysis of fear of asthma symptoms shows that in Indonesia, overthinking ranks first in the hierarchy, followed by anxiety, worry, and finally fear. A comparison of these findings with Swedish studies shows a difference, where anxiety occupies the top position, followed by worry and fear, while overthinking is in the last position [14]. Overthinking, or overthinking, is a state in which a person tends to overthink a situation or problem. Individuals who experience overthinking may be trapped in repetitive thought cycles, have difficulty stopping negative thinking, or find it difficult to make decisions. Anxiety is a feeling of discomfort, worry, or fear about events that may occur in the future. Although anxiety is a natural response to certain situations, when it reaches excessive levels and interferes with daily life, it can be considered an anxiety disorder. Worry is a form of thinking associated with feelings of anxiety or fear of possible future events, often involving negative thinking about possible adverse outcomes. Fear is an emotional response to a real or believable threat, it can arise in response to a particular situation, object, or event.

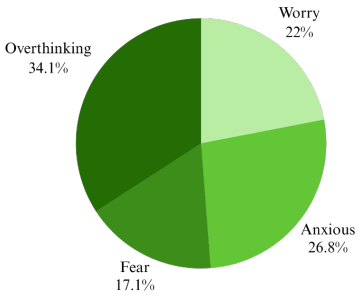


Figure 15. Diagram of the results of the fear questionnaire on the scale of asthma symptoms in Indonesia

Biophilic Elements as Management of Psychological Conditions of Asthmatics

From the survey results, it was revealed that 34.1% of asthmatics experience psychological conditions of overthinking. To address overthinking in people with asthma, design elements involving visual connections with nature, non-rhythmic sensory stimulation, thermal variability & airflow, connections with natural systems, material connections with nature, and opportunities can be applied. This strategy is implemented by providing large windows displaying natural scenery, integrating natural sounds without unpredictable rhythms, and implementing passive heating and cooling strategies. This approach not only successfully reduces the symptoms of overthinking but also creates a calming and relaxing atmosphere for people with asthma.

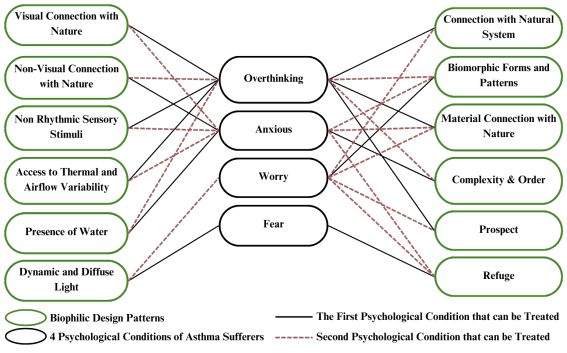
Of people with asthma, about 26.8% experience psychological conditions of anxiety. Anxiety sufferers can cope with such symptoms through the application of design elements, such as a non-visual connection with nature, the presence of water, and complexity & order. This approach can be implemented through the integration of natural scents or fragrances, the use of indoor water features such as fountains or ponds, as well as the application of fractal elements that mimic natural geometry. The

integration of natural scents or fragrances can provide a sensory experience that calms and relieves anxiety. Indoor water features, such as fountains or pools, create a calming atmosphere and help distract from anxiety. Paying attention to non-visual aspects in space design for people with asthma with anxiety not only improves their psychological well-being but also supports efforts to manage health conditions holistically.

As many as 22% of asthmatics experience psychological worry. To overcome the psychological condition of worry in asthmatics, an interesting concept that can be applied is to use of biomorphic shapes and patterns. The integration of organic forms that resemble natural beauty, along with the use of patterns inspired by biological structures such as veins or cells, can be an effective strategy for reducing worry. Organic forms that mimic the beauty of nature provide attention-grabbing visual stimuli, create a comfortable environment, and stimulate meditative or reflective thinking, helping to distract from worries felt by asthmatics, as well as creating a calming atmosphere. It is important to recognize that environmental design with a biomorphic approach not only gives an aesthetic effect but also has a positive psychological impact.

As many as 17.1% of asthmatics experience a psychological condition of fear. To overcome the psychological condition of fear in asthmatics, the concept of using dynamic & diffuse light and hiding is an excellent idea. Dynamic lighting systems that mimic changes in natural light can create an environment that moves over time, providing a sense of warmth and tranquility to asthmatics who may experience fear. The use of diffusion lighting, in addition to reducing glare, also creates a soft and even atmosphere. This combination can help ease fear by creating a calming and safe environment. The concept of hiding, which creates an atmosphere or attitude that favors deep reflection, loving, embracing, and has protective properties, can also provide the necessary emotional support. Through the integration of these elements in the environment surrounding asthmatics, it is expected to have a positive influence on their psychological well-being. Hopefully, these strategies will help create a comfortable space and provide protection, helping to overcome any fears that may arise.

This research shows that the application of biophilic architectural principles, involving elements such as visual connection with nature, non-rhythmic sensory stimulation, thermal variability and airflow, non-visual connection with nature, presence of water, complexity and order, biomorphic forms and elements, dynamic and diffuse light, opportunities, as well as hiding, can significantly manage psychological conditions such as overthinking, anxious, worry, and fear in asthmatics. Environmental design that pays attention to the balance between physical and psychological aspects can create a calming space, help reduce psychological symptoms and support the holistic well-being of people with asthma. The biophilic architectural approach in environmental design is not just a solution, but rather an integral solution to understanding and managing the psychological impact on people with asthma. It offers an atmosphere that promotes well-being and provides emotional protection through integration with nature and biomorphic principles.



psychological conditions with biophilic design elements

Source: Data analysis results, 2022

Design Recommendations Based on Perception

The survey results on views on indoor biophilic implementation showed that from several different sample groups, there was a consensus that the application of 12 biophilic elements could manage the psychological condition of individuals suffering from asthma, according to perceptions from data from 41 respondents. Full details of the figure can be found in the appendix to Table 4.

Table 3. Biophilic elements in managing the psychological condition of asthmatics from the perception of 41 respondents

	Overthinking	Anxious	Worry	Fear
Visual Connection with Nature	A.1.1 (46.3%)			
Non-Visual Connection with Nature		A.2.1 (41.5%)		
Non Rhythmic Sensory Stimuli	A.3.2 (41.5%)			
Access to Thermal and Airflow Variability	A.4.5 (46.3%)			
Presence of Water		A.5.1 (75.6%)		
Dynamic and Diffuse Light				A.6.1 (53.7%)
Connection with Natural System	A.7.1 (68.3%)			
Biomorphic Forms and Patterns			A.8.2 (43.9%)	
Material Connection with Nature	A.9.5 (53.7%)			
Complexity & Order		A.10.2 (41.5%)		
Prospect	A.11.1 (26.8%)			
Refuge				A.12.5 (34.1%)

From the data in Table 3, it can be concluded that each biophilic element can manage the psychological condition of asthmatics. Suffering who experience excessive anxiety can be overcome by applying design elements involving visual connections with nature, non-rhythmic sensory stimulation, thermal variability &; airflow, connections with natural systems, material connections with nature, and opportunities. Sufferers who experience anxiety can overcome these symptoms through the application of design elements, such as non-visual connections with nature, the presence of water, and complexity & order. Patients who experience psychological conditions worry that they can be overcome by applying biophilic elements in the form of biomorphic shapes and patterns. To overcome the psychological condition of fear in asthmatics can be overcome by applying biophilic design elements, dynamic & diffuse light, and hiding.

5. Conclusion

Treatment of asthma involves not only physiological aspects but also demands attention to psychological aspects. The results of the analysis of the scale of fear of asthma symptoms in Sweden and Indonesia showed a different hierarchy of order, influenced by differences in respondents' perception of conditions. Therefore, the quality of the hospital space and design are aspects that need special attention. From the identification and analysis of the application of 14 biophilic elements according to Browning in 5 general hospitals and 5 lung specialty hospitals, it can be concluded that 12 of the 14 elements can be integrated in hospitals. Each element of biophilic design has a specific role to play in managing the psychological state of people with asthma, including overthinking, anxiety, worry, and fear. Space design with elements of visual connection with nature, non-rhythmic sensory stimulation, thermal variability &;

airflow, material connection with nature, and opportunities has the potential to be effective in reducing the psychological state of overthinking in asthmatics. Asthmatics with psychological conditions of anxiety can benefit from a non-visual connection with nature, the presence of water, and complexity and order. Biomorphic shapes and patterns become an interesting strategy to overcome the psychological condition of concern in people with asthma. The approach with dynamic and diffuse light and hiding is also considered very good in overcoming the psychological condition of fear in asthmatics. As a proposal for future research, it is necessary to involve broader boundaries of respondents' perceptions. It is hoped that this approach can be applied to other health facility buildings, such as clinics, rehabilitation centers, and the like. Indonesia. Further research can also be supported by elderly interviews regarding elderly satisfaction factors with housing.

References

[1]. Hapsari N. E. "Jakarta is the Most Polluted City in the World, Here's the Impact on Citizen Health." *REPUBLIKA*. 2023.

[2]. Brew BK, Lundholm C, Viktorin A, Lichtenstein P, Larsson H, Almqvist C. "Longitudinal depression or anxiety in mothers and offspring asthma: a Swedish population-based study." Int J Epidemiol. . ;47(1):166 174. doi:10.1093/ije/dyx208. 2018.

[3]. Lehto K, Pedersen NL, Almqvist C, Lu Y, Brew BK. "Asthma and affective traits in adults: a genetically informative study." Eur Respir J. ;53(5):1802142.doi:10.1183/13993003.02142-2018. 2019

[4]. Sastre J, Crespo A, Fernandez-Sanchez A, Rial M, Plaza V,. "Investigators of the CONCORD Study Group. Anxiety, depression, and asthma control: changes after standardized treatment." J Allergy Clin Immunol Pract. ;6(6):1953–1959. doi:10.1016/j.jaip.2018.02.002. .2018.

[5]. Grzeskowiak LE, Smith B, Roy A, Schubert KO, Baune BT, Dekker GA, Clifton VL. "Impact of a history of maternal depression and anxiety on asthma control during pregnancy." J Asthma. ;54(7):706–713. doi :10.1080/02770903.2016.1258080. 2017.

[6]. Stoeckel MC, Esser RW, Gamer M, Büchel C, von Leupoldt A. "Brain responses during the anticipation of dyspnea." Neural Plast. ;2016:6434987. doi:10.1155/2016/6434987. 2016.

[7]. Raden Roro Monica Synthia Permata Dewi, Y. K. A. R. "Identify the Application of Biophilic Design in Hospital Interiors." *INTRA JOURNAL*, *6*. 2018.

[8]. Spahn, J. D., Brightling, C. E., O'byrne, P. M., Simpson, L. J., Molfino, N. A., Ambrose, C. S., Martin, N., & Hallstrand, T. S. . Effect of Biologic Therapies on Airway Hyper responsiveness and Allergic Response: A Systematic Literature Review. In *Journal of Asthma and Allergy* (Vol. 16, pp. 755–774). Dove Medical Press Ltd. 2023. https://doi.org/10.2147/JAA.S410592.

[9]. Hennegrave F, Rouzic OL, Fry S, Behal H, Chenivesse C, Wallaert B. "Factors associated with daily life physical activity in patients with asthma." Health Sci Rep. ;1(10):e84. doi:10.1002/hsr2.84. 2018.

[10]. Xiong, T., Bai, X., Wei, X., Wang, L., Li, F., Shi, H., & Shi, Y. "Exercise Rehabilitation and Chronic Respiratory Diseases: Effects, Mechanisms, and Therapeutic Benefits." In *International Journal of COPD* (Vol. 18, pp. 1251–1266). Dove Medical Press Ltd. https://doi.org/10.2147/COPD.S408325. 2023.

[11]. Fang, W., Zhang, Y., Li, S., Liu, A., Jiang, Y., Chen, D., Li, B., Yao, C., Chen, R., & Shi, F. "Effects of air pollutant exposure on exacerbation severity in asthma patients with or without reversible airflow obstruction." *Journal of Asthma and Allergy*, *14*, 1117– 1127. 2021.https://doi.org/10.2147/JAA.S328652.

[12]. Marshall, G. D. "Psychological stress, immunity, and asthma: developing a paradigm for effective therapy and prevention." In *Current Opinion in Behavioral Sciences* (Vol. 28, pp. 14–19). Elsevier Ltd. 2019. https://doi.org/10.1016/j.cobeha.2019.01.006.

[13]. Rönnebjerg, L., Axelsson, M., Kankaanranta, H., Backman, H., Rådinger, M., Lundbäck, B., & Ekerljung, L. "Severe asthma in a general population study: Prevalence and clinical characteristics." Journal of Asthma and Allergy, 14, 1106–1115.2021. https://doi.org/10.2147/JAA.S327659.

[14]. Bonnert, M., Roelstraete, B., Bergstrom, S.

E., Bjureberg, J., Andersson, E., & Almqvist, C. "The *Fear* of Asthma Symptoms Scale and the Asthma Behavior Checklist: preliminary validity of two novel patient reported outcome measures." *Journal of Asthma*, *60*(8), 1558–1565. 2023. https://doi.org/10.1080/02770903.2022.2160343.

[15]. Stubbs, M. A., Clark, V. L., Cheung, M. M. Y., Smith, L., Saini, B., Yorke, J., Majellano, E. C., Gibson, P. G., & McDonald, V. M. "The Experience of Living with Severe Asthma, Depression and Anxiety: A Qualitative Art-Based Study." *Journal of Asthma and Allergy*, *14*, 1527–1537. 2021. https://doi.org/10.2147/JAA.S328104

[16]. Felgueiras, F., Cunha, L., Mourão, Z., Moreira, A., Gabriel, M.F. "A systematic review of environmental intervention studies in offices with beneficial effects on workers' health, well-being and productivity." Atmos Pollut Res 2022, 13, 101513, https://doi.org/10.1016/j.apr.2022.101513.

[17]. Jimenez,M.P, DeVille, N.V., Elliott, E,G., Schiff, J.E., Wilt. G.E., Hart, J.E., James, P,. "Associations between nature exposure and health: a review of the evidence." Int J Environ Res Publ Health 2021, 18:4790, https://doi.org/10.3390/ijerph18094790.

[18]. Al Khatib, I., Samara, F., Ndiaye, M. "A systematic review of the impact of therapeutical biophilic design on health and well being of patients and care providers in healthcare services settings." Front built environ 2024, 10, 1467692, https://doi.org/10.3389/fbuil.2024.1467692.

[19]. Norouzianpour, H. "Architectural interventions to mitigate occupational stress among office workers." Enquiry The ARCC J Architectural Res 2020, 17:21–40, https://doi.org/10.17831/enq:arcc.v16i2.1069.

[20]. Alotiby, A. "Immunology of stress: a review article." J Clin Med 2024, 13:6394, https://doi.org/10.3390/jcm13216394.

[21]. Ishikawa, Y., Furuyashiki, T. "The impact of stress on immune systems and its relevance to mental illness." Neurosci Res 2022, 175:16–24, https://doi.org/10.1016/j.neures.2021.09.005.

[22]. Ulrich, R.S. "In Behavior and the natural environment. In Aesthetic and affective response to natural environment." Boston, MA: Springer US; 1983:85–125.

[23]. Shuda, Q., Bougoulias, M.E., Kass, R. "Effect of nature exposure on perceived and physiologic stress: a systematic review." Compl Ther Med 2020, 53, 102514, https://doi.org/10.1016/j.ctim.2020.102514.

[24]. Wilson, E.O., Kellert, S. "The biophilia hypothesis." Island Press; 1993.

[25]. Kellert, S.R., Heerwagen, J, Mador, M. "Biophilic design: the theory, science and practice of bringing buildings to life." Wiley; 2011.

[26]. Kellert, S., & Calabrese, E. "The practice of biophilic design." London: Terrapin Bright LLC. 2015.

[27]. Zhong, W., Schröder, T., & Bekkering, J. "Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review." In *Frontiers of Architectural Research* (Vol. 11, Issue 1, pp. 114–141). Higher Education Press Limited Company. 2022. https://doi.org/10.1016/j.foar.2021.07.006

[28]. Browning, Wiliam.D., Ryan, Catherine, O. "Nature Inside: A biophilic design guide." RIBA Publishing Portland, Place, London, WIB, IAD, 2020

[29]. Ismail, Muhammad Azzam. , Huizi, Deng., Raha, Sulaiman. "Enhancing children's health and well-being through biophilic design in Chinese kindergartens: A systematic literature review." Social Sciences & Humanities Open 10.2024.

[30]. Strawberry Hill Behavioral Health Hospital, 2019. (n.d). From retrieved https://www.cannondesign.com/work/the-university-of-kansas-health-strawberry-hill-behavioral-health-hospital

[31]. Khoo Teck Puat Hospital, 2010. (n.d). From retrieved https://www.cpgconsultants.com.sg/projects/khoo-teck-puat-hospital-singapore/\

[32]. New Stanford Hospital, 2019. (n.d). From retrieved https://healthcaresnapshots.com/projects/8014/new-stanford-hospital/

[33]. Kurashiki Central Hospital, 2023. (n.d). From retrieved https://www.kchnet.or.jp/en/

[34]. Royal Papworth Hospital, 2020. (n.d). From retrieved https://royalpapworth.nhs.uk/ Gheskio Tuberculosis Hospital, 2015. (n.d). From retrieved

[35]. https://www.archdaily.com/937709/gheskio-tuberculosis-hospital-mass-design-group