CAN ARCHITECTURE HEAL? BIOPHILIC PRINCIPLES IN THE DESIGN OF HEALTHCARE SPACES

GİZEM GÜLTEKİN

Thesis for the Master's Program in Architecture

Graduate School
Izmir University of Economics
Izmir
2023

CAN ARCHITECTURE HEAL? BIOPHILIC PRINCIPLES IN THE DESIGN OF HEALTHCARE SPACES

GİZEM GÜLTEKİN

THESIS ADVISOR: Asst. Prof. Dr. Emre GÖNLÜGÜR

A Master's Thesis
Submitted to
the Graduate School of Izmir University of Economics
the Department of Architecture

Izmir
2023

ETHICAL DECLARATION

I hereby declare that I am the sole author of this thesis and that I have conducted my work in accordance with academic rules and ethical behaviour at every stage from the planning of the thesis to its defence. I confirm that I have cited all ideas, information and findings that are not specific to my study, as required by the code of ethical behaviour, and that all statements not cited are my own.

Name, Surname:

Date:

Signature:

ABSTRACT

CAN ARCHITECTURE HEAL? BIOPHILIC PRINCIPLES IN THE DESIGN OF HEALTHCARE SPACES

Gültekin, Gizem

Master's Program in Architecture

Advisor: Asst. Prof. Dr. Emre Gönlügür

April, 2023

The aim of this thesis is to investigate whether architecture can contribute to the healing process in healthcare spaces with the help of biophilic design principles. The biophilia hypothesis argues that nature should be included in the built environment.

A long-standing focus of architecture has been nature, especially in healthcare buildings where nature's healing power has become more apparent. With the onset of urbanization, people have become less engaged with nature and only focus on functional interests, ignoring the damage caused to the environment. While it is argued that interacting with nature is an impulse for humans, ignoring this interaction in recent built environment has caused many negative effects especially on user health and psychology.

This thesis examines the effectiveness of architecture in healing, focusing on

healthcare spaces that directly influence the users. Through a review of existing literature, it is indicated that healthcare settings should be evaluated human beings with a more holistic approach to contribute to well-being by giving more importance to the sense of belonging and interaction with nature. To address this, biophilic design principles, which appeals to user's innate affection of nature, were discussed whether can be used as an instrument to foster the therapeutic and welcoming environment. In order to support this discussion, the applicability of biophilic principles in the design of health spaces was examined with the support of the existing literature. In this study, examples of geographically diverse and recently constructed healthcare facilities were selected, which are presumed to have biophilic features. These examples were evaluated within the framework of biophilic principles presented by Kellert and Calabrese (2015). As a result, this study provides evidence that biophilic design principles could be useful in integrating nature into healthcare spaces, however, further evaluation is required to assess their impact on health and well-being.

Keywords: healing, history of healing, biophilia, principles of biophilia, human-nature relation, biophilic design, healing architecture

ÖZET

MİMARLIK İYİLEŞTİREBİLİR Mİ? SAĞLIK ALANLARININ TASARIMINDA BİYOFİLİK İLKELER

Gültekin, Gizem

Mimarlık Yüksek Lisans Programı

Tez Danışmanı: Dr. Öğr. Üyesi Emre Gönlügür

Nisan, 2023

Bu tezin amacı, mimarinin, biyofilik tasarım ilkeleri yardımıyla, sağlık mekanlarındaki iyileşme sürecine katkıda bulunup bulunamayacağını araştırmaktır. Biyofili hipotezi, doğanın yapılı çevreye dahil edilmesi gerektiğini savunur.

Doğa, uzun süredir mimarinin odak noktası olmuş ve özellikle sağlık yapılarında, doğanın iyileştirici gücünün daha belirgin hale gelmiştir. Ancak kentleşmenin başlamasıyla birlikte, insanlar doğa ile daha az etkileşimde bulunmuş ve çevreye verilen zararı göz ardı ederek yalnızca işlevsel çıkarlara odaklanmıştır. Doğa ile etkileşimin insan için bir dürtü olduğu savunulurken, günümüzdeki yapılı çevrelerde bu etkileşimin göz ardı edilmesi özellikle kullanıcı sağlığı ve psikolojisi üzerinde birçok olumsuz etkiye neden olmuştur.

Bu tez, kullanıcıları doğrudan etkileyen sağlık mekanlarına odaklanarak, mimarinin iyileştirmedeki etkinliğini incelemektedir. Mevcut literatür gözden geçirilerek, sağlık ortamlarının daha bütüncül bir yaklaşımla değerlendirilmesi, aidiyet duygusuna ve doğa ile etkileşime daha fazla önem verilerek iyilik haline

katkıda bulunulması gerektiği belirtilmiştir. Bunu ele almak için, kullanıcının doğuştan gelen doğa sevgisine hitap eden biyofilik tasarım ilkelerinin, terapötik ve davetkar ortamı teşvik etmek için bir araç olarak kullanılıp kullanılamayacağı tartışılmıştır. Bu tartışmayı desteklemek amacıyla, sağlık alanlarının tasarımında biyofilik ilkelerin uygulanabilirliği mevcut literatür desteği ile incelenmiştir. Bu çalışmada, biyofilik özelliklere sahip olduğu varsayılan, coğrafi olarak farklı ve yakın tarihte inşa edilmiş sağlık tesislerinden örnekler seçilmiştir. Bu örnekler, Kellert ve Calabrese (2015) tarafından sunulan biyofilik ilkeler çerçevesinde değerlendirilmiştir. Sonuç olarak, bu çalışma, biyofilik tasarım ilkelerinin doğayı sağlık hizmetleri alanlarına entegre etmede yararlı olabileceğine dair kanıtlar sunmaktadır, ancak sağlık ve esenlik üzerindeki etkilerini değerlendirmek için daha fazla inceleme yapılması gerekmektedir.

Anahtar Sözcükler: iyileşme, iyileşme mekanlarının tarihi, biyofili, biyofili ilkeleri, insan-doğa ilişkisi, biyofilik tasarım, iyileştiren mimarlık.

ACKNOWLEDGEMENT

I am extremely grateful to my advisor, Asst. Prof. Dr. Emre Gönlügür for his support and endless patience during my study. I am also thankful for sharing his knowledge with me and shedding light upon my study.

I would like to express my sincere thanks to my beloved family, for their endless support and encouragement.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1. Problem Statement

Today, healing spaces are considered as, the spaces that fail to inculcate the sense of belonging of users. The healthcare spaces focus mainly on quick treatment with technological equipment and preventive measures against infection without really addressing holistic healing. This leads to complex and unfamiliar environments, which giving users the feeling that they are disconnected from the flow of life. For this reason, the users feel stressed and tend to leave the clinical environment immediately.

The design of hospitals must meet stringent requirements to ensure patient safety and infection control and might limit the incorporation of natural elements that are crucial for healing environment. Healthcare spaces, make virtually no room for patients' needs for access to nature. Scientific studies show that, healthcare spaces that are inadequately designed to respond to psychological needs, might laten the patients' recovery, even if they are accommodating state of art equipment (Sternberg, 2009). Although healthcare spaces are prone to evoke feelings of illness, fear, and anxiety, the problem is compounded by the fact that users' psychological and physiological needs are not taken into an account in design. In order to ensure holistic recovery, physical and mental healing should be in the forefront of treatment.

However, recent studies show that the inclusion of biophilic design which expresses the human need to relate with nature within the built environment can lead to improved patient outcomes (Kellert, 2008). Despite the tendency to abandon nature, numerous records show that, establishing a relationship with nature in the built environment, is an important input for becoming more productive and healthier individuals.

The application of the architectural design principles of biophilia in healthcare spaces (such as hospitals) are critical in terms of the psychological and physical health of the user. Therefore, many academic experiments and researches have been carried out by different specialties. Briefly, these studies attest that there are various health benefits to increasing the productivity of healthcare professionals, reducing the dose of painkillers, accelerating the patient's recovery process, and shortening the length of stay (Ulrich, 1984).

This thesis seeks to address the lack of attention paid to the healing properties of design in healthcare settings and examine the potential benefits of biophilic design principles for improving patient outcomes and well-being. This thesis is an attempt to explore the healing environment in hospitals from a biophilic perspective.

Therefore, building on a comprehensive literature review, I will try to explain biophilic design in the context of healthcare spaces and include the insights of social ecology professor Stephen Kellert, who is one of the leading proponents of the biophilia hypothesis. Kellert led academic research and published extensively on the subject and developed a comprehensive framework for biophilic design. Working in collaboration with Elizabeth Calabrese, he further extended this framework and together they outlined certain biophilic design principles to guide designers working in the field. The thesis will examine and discuss a number of healthcare spaces based on the biophilic design principles developed by Kellert and Calabrese.

1.2. Significance of the Research

Today, with the developments of modern medicine, healthcare spaces were perceiving human as a machine and reducing the 'humanity' in clinical environments. As a result of this, there is negative connotation about healthcare services. In this sense, creating environments that will allow social and emotional bonding, might change those negative perceptions.

The Covid-19 pandemic reminded us the importance of the design of healthcare spaces and altered our understanding of what healing involves or requires. It is no longer sufficient to address healthcare simply as a matter of improving physical conditions; psychological well-being is also an important concern that needs to be taken into consideration. Healing should be thought of in a holistic manner and, in that respect, biophilic perspectives could provide us with valuable tools to address well-being

Biophilic design has an important role in health spaces due to its positive effects on human health and well-being. Rehabilitation centers, examination offices, clinics, hospitals for medical personnel, visitors and patients are characterized as places that cause excessive stress. In most of the existing healthcare facilities, the spaces are designed for the treatment of specific diseases by emphasizing the medical technology. But, how could these spaces have an impact on human psychology and

health is a matter of discussion in the background. Roger Ulrich, who is an architect works on environmental psychology, conduct an experiment about the impacts of built environment. The findings obtained from Ulrich's experiment show that nature is a very important helper in reducing the stress factor; it accelerates the recovery time from disease and fosters positive emotions. Biophilic design is based on the innate relationship with nature. But this relationship should not be taken as the use of natural elements in built environment. It is more holistic and comprehensive context, especially in the design of healthcare spaces. During this research, it was found that there are quite a few publications on biophilic design principles in healthcare spaces and its impact on health. For this reason, this study might be an input in terms of being an example for future studies.

1.3. Research Questions

The present research is motivated by the question whether and to what extent biophilic design approaches can contribute to healing. In addition to this main question, the following discussion pursues a number of secondary questions:

• How did healthcare spaces change throughout history and what sort of a relationship did they have with nature?

• What has been the contribution of architectural design to the healing function of healthcare spaces?

• What are the key biophilic design principles that can be adopted in healthcare spaces to promote healing and well-being?

Within the scope of this study, it has been tried to search for answers to the questions listed above. In accordance with the answers to the questions, as a result of the study, various suggestions were made to users, architects and designers.

1.4. Methodology

In this study, which aims to examine the effect of the use of biophilic design in health buildings on users, first of all, literature review has been made and relevant resources have been reached. Within the scope of the study, studies investigating biophilic design were examined using literature review method. Additionally, case-specific examples of built works from different geographical regions and healthcare requirements are evaluated. The effect of using biophilia in architecture on health

and well-being is discussed.

1.5. Structure of Thesis

Although biophilic design may seem conceptually new, it has always found a place with different approaches in the practice of the built environment. The need for shelter, arising from the need for protection of human beings, can be regarded as first turning point to nature. This starting point, created culture with the development of knowledge and technology, which has never been completely disconnected from nature. In this context, it is stated that nature takes part in an instinctive way, and applied in built environment directly or indirectly, as a design element. In fact, the relationship between architecture and nature has been established unconsciously throughout history. When looking at old settlements and structures, the bond between nature and structure is always strong from the Asclepieion. Because architecture has developed at the expense of local culture and materials. However, modern architecture has found a universal language by moving away from the traditional building systems with the effect of globalization. Buildings became widespread in all around the world with the addition of glass, steel and concrete. In addition, the development of technology increased urbanization and industrialization in the 19th century. As a result of human-made arrangement of landscape and architecture in the natural environment, started to damaging nature.

From the beginning of twentieth century, the damage given to nature started to causing problems. The disconnection between nature and human, which should be established instinctively, has brought along various human health and environmental health problems. Answers tried to be found for the problems that have arisen with the breaking of the bond between nature and human. Many researches have been started to solve the problems in the built environment and as a result, many design approaches have emerged such as organic architecture, green design, ecological design, biomimicry, and regenerative design, aimed at establishing a bond between the built environment and nature. Biophilic design is an approach proposed by Kellert (2006) that aims to reflect love of nature on a conscious level. With the realization of this tension between nature and human in the early 20th century, studies have been started to improve environmental problems and ecosystem under the guidance of science. It is observed that designs removed from nature have

negative effects on human health with creating stressors. However, many researches show that anger and aggression decreased in natural environments and increased in urban environments. So, the global health problems of the 21st century can be addressed with the approaches that taking into account the needing of interaction with nature and realizing healing influence of nature instead of neglecting it. In this perspective, biophilic design may creating environments that supporting healing and well-being.

In this study, the potential benefits of using biophilic design principles in healthcare spaces are examined. In this context, the study consists of four parts.

In the first part of the study, information is given about the subject of the research, the definition/area of the problem, the importance of the research, the research questions, the methodology and the structure of the thesis.

In the second part, the definition of healing, the concept of healing spaces, the human and nature connection are mentioned to better understanding of healing spaces with the examination of history and nature. It is tried to understand, how healthcare facilities have changed until today and how nature took its place during the change.

In the third part of the study, biophilic design were examined in the context of healing. Biophilic design definitions, values and parameters were mentioned to create a holistic framework and integrating it into built environment. And lastly, a couple of healthcare facilities were examined in the context of biophilic design principles and influence of healing process.

CHAPTER 2: THE HEALING ROLE OF ARCHITECTURE

2.1. Understanding Healing

The word healing has different meanings in different timelines but as a general definition, according to Oxford dictionary, it is 'the process of becoming or making somebody/something healthy again; the process of getting better after an emotional shock'. In the traditional healing system, it is believed that if there is a discomfort in body, mind or spirit might be leading to unhealthy conditions and become ill and it is the common sense it is the interconnectedness of mind-body-soul in healing and healing is a holistic approach (Lichtenstein, Berger and Cheng, 2017). Another definition of healing is ''regaining the conditions and functions of healthy situation before the onset of the disease" (Huiting, 2013). The concept of recovery has been studied in many respects in the psychiatry department, which is characterized as a special area of the health field. According to another view, recovery includes contributing to society, living independently and learning to overcome obstacles (Erikson, 2013). According to Brown (2013), the concept of healing, who suffering from mental illnesses, is expressed as being able to live the healing process by creating a meaningful life in time periods hence, individual recovery is a personal, time-consuming and variable experiences based on responsibility, meaning, identity and hope (2013). Firth et al., claim about integrated healing,

''Healing is a holistic, transformative process of repair and recovery in mind, body, and spirit resulting in positive change, finding meaning, and movement towards self-realization of wholeness, regardless of the presence or absence of disease'' (Firth et al., 2015, p.46)

and bring about the probability of healing even when cure is unthinkable. Sternberg's definition of healing, consist of the reflections of nature and sensations of the outside world

"There is a turning point in the course of healing when you go from the dark side to the light, when your interest in the world revives and when despair gives way to hope. As you lie in bed, you suddenly notice the dappled sunlight on the

blinds and no longer turn your head and shield your eyes. You become aware of birdsong outside the window and the soothing whir of the ventilation system down the hall. You no longer dread the effort needed to get up, but take your first cautious steps, like a child, to explore the newfound space around you. The smell of food does not bring on waves of nausea or revulsion, but triggers hunger and a desire to eat. The bed sheets feel cool and soothing—their touch no longer sends shivers through you, like chalk-squeak on a blackboard. Instead of shrinking from others, you welcome the chit-chat of the nurse who enters the room. This is the point when the destructive forces of illness give way to healing" (Sternberg, 2009, p.1).

Sternberg (2009) states that specialists and nurses are aware of that the healing process initials with immediate attention of external stimulus. At this point, question comes up, if our enclosed space could make us feel better or have any outcome? For better answers to that questions, effects of our surrounding should be discussed. By the various different definitions of health, it is understood that being healthy situation is a comprehensive process with different possibilities. In this chapter, I explain and perceive the concept of healing so that I can observe the potential situations that can be effective in case of being healthy. Pondering on the concept of healing in the historical process may provide an opportunity for spatial understandings.

2.2. Historical Development of Healing Spaces

The concept of healing covers, social, physical and spiritual integrity. Healing spaces considered as the process of creating intense spaces that can support medical practices, accelerate the healing process and help prevent diseases. The hope, excitement and other positive emotions that design can give to the human soul can be seen as the basis of the philosophy of health, which is based on the individual state of "well-being" (Jiang, 2022). A healing space does not have to be necessarily enclosed vast space, it could be in many variable scales even it could be an open space as long as provide a holistic (physical and psychological) manner of recovery. Ages ago, nature was deep-seated element in healing process however, by the starting of twentieth century, substantially lost its connection but today, it is tried to be re-established. (Marcus and Sachs, 2013).

Throughout the healthcare design history, source of disease did not consistently regulate. The professionals aimed to produce healthy environment while designing however, sometimes the results didn't turn out as they expected (Kisacky, 2017). By showing some selections from history, I discuss the impact of nature on healthcare spaces and the change in the human-nature relationship over time.

Healing places have a long history, one of the first healing place was dates back the 300BC, Asclepieion, placed in ancient Greece and this place includes cleansing ritual with natural spring water, a library, theater, etc… Those were the built as temples committed to the god of healing Asclepius. Asclepieion was considered unique places which understand human needs and raised to next level (Signoretta, Moughtin and Moughtin,2009). The location of Asclepieion merely important and was frequently constructed in valleys which closed to springs and greenery (Van den Berg, 2005). The prominent part of Asclepieion was the abaton where the patients sleep and dream, it is believed that in their sleep, they can talk with the health god and sleeping is healing (Gesler,2003). It can be observed that the presence of nature was a fundamental feature at those time. Also, there was a need for establish a connection between healing and faith. Before the medieval period, healing structures, can be associated with a religious place where patients were waiting for death rather than healing.

In the Middle Ages, medical care was also related with the religious associations of the time like monastery infirmities and physical illnesses are rarely known so the bodily treatment was made by traditional healing methods (Van den Berg, 2005). Kisacky claims that, in many of medieval and renaissance hospitals, recovery was both physically and spiritually so, while patients in their beds they were able to hear religious events and each ward were connected to chapels (2017). In that monastery infirmities, there were many facilities for promoting healing process, the essential one was the garden. Roman military healthcare facilities were another first known hospitals which natural lighting and ventilation provided to the separated wards for averting infection even if the germ theory was not manifested (Marcus and Sachs, 2013).

In the eighteenth century, pavilion type hospital came out as a basis of modern hospital building. It is composed of several connected buildings and aimed to reduce infections spreading by air (Kisacky, 2017). Marcus and Sachs (2013) said

that, there were an emphasis on birth and death data and discrete observations of patients in hospitals this leads to new healthcare designs which give importance to hygiene and cross-ventilation the reason behind was the belief of infections transmitting by rotten waste or miasmas in the air. Marcus and Sachs (2013) described;

"Pavilion-style hospitals comprised two- and three-story buildings linked by a continuous colonnade, and narrow wards with large windows that enhanced ventilation. Between the wards were courtyards and gardens, which began to be reconsidered as important components of the healing environment." (Marcus and Sachs, 2013, p.8).

Early example of pavilion type was St Thomas' Hospital with large windows and veranda by the river for patience where they can interact with nature (Van den Berg, 2005).

It can be said that, as time goes by the observations on patience, the presence of nature elements became critical in design process to enhance healing process. On the other hand, early of the eighteenth and nineteenth centuries, Kisacky argues that heath became a holistic phenomenon including residents' circumstances and, in this respect, architecture gained an important role of the well-being (2017). Therefore, if they wanted to heal, first they need to improve the building. In this regard, Florance Nightingale (1820-1910), who was another pioneer in hospital history with her unique experiences of war, suggested that high mortality rates could be reduced by taking care of hospitals' sanitation. She pointed out design and care quality and her prior principle was 'not to harm to sick person' (Nagasawa,2019). Nightingale's principles served as the handbook in hospital design until the modern era and demonstrated that architecture should be functional and inspiring (Murphy and Mansfield, 2017). Kisacky (2017) claims that since the improvement of germ theory, most of the medical professionals were surely agreed with the idea of 'sickness spread by depraved environments' and at this point of view, hospitals were unhealthy by its nature. Besides, those were threatening places because of the risk of infection for the guests, patients, employees and their expanding circle. At that time, the risk of infection in the hospitals was so common that there was a category called 'hospital

disease' and this situation leads to hospital fear (Kisacky, 2017). Because of the medical terminology and uncertainty surrounding hospitals, people are increasingly avoiding these places out of fear of infections, which has made hospitals even more intimidating than they already were. In the nineteenth century healthcare practitioners, suggested architectural renovations and hygienic reconstructions for the hospitals to avert disease or reduce the outbreak. But here, hygiene needs to be explained; basically, it means promote health and includes the actions in that promoting (Kisacky, 2017). However, in the contemporary world, because of the germ theory, hygiene evoked by means of personal and social cleanliness.

The sanitation movement of the nineteenth century, contained a set of principles adopted around the world. Royal Victoria Hospital established in 1893, which is located in Montreal, can be regarded as an accomplished version of this movement and can be seen as a good example of the pavilion plan (Figure 1). This hospital, designed by Saxon Snell and growing steadily since its establishment, was one of the buildings that followed the technology and represents the approaches to hospital design of those times (Sternberg, 2009). According to Adams (2008), Royal Victoria Hospital expresses the latest trends in hospital design and is the most prominent example of the changing hospital design approach during the first world war. According to the prevailing belief at that time, the isolation method was applied to prevent the spread of infectious diseases, so, we came across with H-shaped masses which provides ultimate isolation at that time. In this hospital, the architect Snell designed with a mindset of the healing of the patients and led to a clear observation of the characteristic features of the pavilion plan. In order to reduce the level of contagion, Royal Victoria consists of round-shaped wards, which was for to prevent dust accumulation, that are separated from each other and connected by small transitional areas. Elevators and fire protection systems were installed, which can be called new developments in the technical field.

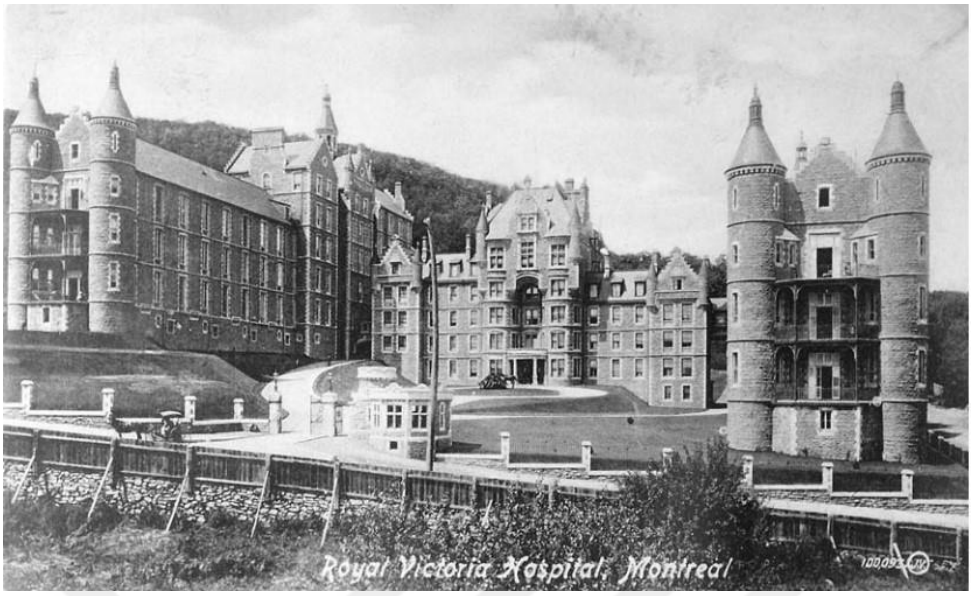

Figure 1. Royal Victoria Hospital in Montreal (Source: Adams, 2008).

In the pavilion type, where ventilation is typically assigned as an essential parameter, Royal Victoria stands out with its ward design with high ceilings and a window placed at the head of each patient bed, and at the same time trying to make maximum use of daylight (Kisacky, 2017). Those big windows, allows the sunlight to reinforce healing process and provides cross ventilation to reduce the spread of infections (Sternberg, 2009). Another prevailing feature of open ward system (Figure 2) was the decentralized nursing stations. With this feature, nurses had a broader view and could observe patients better which is seen as a must for modern healthcare process and those stations sparked off a better caregiving to the patients (Adams, 2008). In addition, as mentioned earlier, the Royal Victoria was on an ever-expanding course and new wings were being added. The newly added wings had terraces and looked towards the forest for patients aiming relate to nature. All these were the harbingers of modernization (Sternberg, 2009).

According to Adams (2008), in the case of the Royal Victoria Hospital, architecture and medicine have been brought together and an attempt is being made to achieve a balance between them. The pavilion-type plan led by this hospital and continued to be used for a long time. Still remains in the discussion of modern healthcare architecture.

Figure 2. Women’s ward in Royal Victoria Hospital (Source: Adams, 2008).

Pavilion type hospitals advocated for blocking the hospital illnesses and infections but it failed because of overcrowded wards (Kisacky, 2017). Pavilion type started to disappear for the reason of land shortage, infection control and efficiency issues and replaced by multi-storied pavilion type buildings. This can be shown as evidence that hospitals are moving from horizontal placement to vertical placement.

In addition to the issues mentioned above the modern medical progress, surgical and medicine developments had reduced the amount of garden and natural elements (Marcus and Sachs, 2013). Although green area was favorable element in hospital design, it was not easy to conduct, hence, hospitals had to be built close to patients and in central neighborhoods except for long-term facilities for example sanatoriums (Van den Berg, 2005). As a result of the relocation of hospitals from their outskirts into the city center, users have been able to obtain easier transportation. However, high-rise hospitals that are spread over a large area create a structurally unacceptable image that does not blend into the urban texture and changes the city's flow.

In twentieth century, medical practicians were sure that, the reason of contiguous disease were microorganisms and illnesses spread by physical contact. Centuries of scientific research proved the correctness of this idea and precautions have reduced the incidence of infectious diseases but not completely vanished (Kisacky, 2017). As another important development of this century in the field of

healthcare facilities, architects embraced the Modern Movement by collaborating with artists, and the healthcare settings built at that time tried to integrate modernist inspirations with concrete, steel and glass materials (Hoskin and Haggard, 1999). Similarly, Adams (2008) claims that hospitals built since the 20th century have brought historical features to the outside with traditional materials and technological features to the interior in order to keep up with the medical and modernist developments. Kisacky argues that, hospitals started to seen crucial institutions by 1945, however in the rural places, access to these necessary buildings was very limited. This situation caused a huge construction boost after The World War II. And expectedly, war time developments were altered society and architecture (Kisacky, 2017).

To briefly summarize the recent history, early in the 19th century, healthcare facilities were places that provided care for the sick and injured individuals and were built in green areas. However, in the twentieth century, long-lasting changes took place and healing spaces turned into complex structures that spread to wider urban environments (Willis, Goad and Logan, 2018). In addition, a number of regulations have been introduced in order to ensure that the twenty first century hospitals are placed on a logical basis by the authorities, while their holistic therapeutic feature has remained in the background. However, developing of medicine and emergence of regulations had not prevented the spread of infectious diseases, but developments in medicine and architecture have led to more precise judgments about the occurrence of diseases. Also, environmental therapy ideas were changed comparing to nineteenth century, at that time, it was a recovery method but in the twentieth century, it started to seem more emotionally effective (Kisacky, 2017). As Adams (2008) points out healthcare facilities in the twenty-first century must not only provide health care to sick and injured individuals, but also offer a healing environment that can support healing from the inside out. Furthermore, Kisacky (2017) argues that architecture needs to move forward with a more comprehensive vision of healing. Kisacky writes that:

"*The hospital is both a medical factory and a healing environment. … In more concrete terms, the history of hospital buildings is more than a history of changing details, materials, forms, and technologies in service of an increasingly*

limited physiological definition of health; it is a chronicle of aspirations and disappointments as to the role architecture might play in a more inclusive conception of health." (Kisacky, 2017, p.344).

This statement requires rethinking of health issues in the concept of architecture. The issue of enhancing healing through design has been highlighted by Adams, who stressed that hospitals are becoming more welcoming rather than hard-lined places equipped with high technology. Sternberg (2009) claims in his book "Healing Spaces: The Science of Place and Well-Being", our surroundings have an influence on our bodies. He advocates that our senses can stimulate the immune system that helps us to heal and he adds space could accelerate our healing process. In his book, Sternberg states that, Nightingale's patient-centered ideas, which defends the discourse of the natural environment has a positive impact on supporting healing, influenced modernist architects such as Alvar Aalto. In addition to that, Sternberg highlights Alvar Aalto's Paimio Sanatorium as an instance where architecture plays a critical role in providing restorative healing spaces that promote holistic healing.

Aside from sanatoriums, health spaces have traditionally focused on hygiene and equipment, and the relationship between health and nature has had a secondary role throughout history. In the nineteenth century, the Royal Victoria Hospital, with its organization, was considered one of the most iconic healthcare structures of those times and the pavilion prototype. In the twentieth century, this title was taken by Alvar Aalto's Paimio Sanatorium (Willis, Goad and Logan, 2018).

Paimio Sanatorium which designed by Fin architect Alvar Aalto in 1933 (Figure 3). It was originally built as a tuberculosis sanatorium which providing cure for this deadly disease and it was a turning point for Aalto's career (Heikinheimo, 2016). According to Heikinheimo (2016), in the twentieth century, the sensory and emotional needs were neglected in healthcare spaces but this sanatorium was the exception.

Figure 3. Paimio Sanatorium by Alvar Aalto (Source: archeyes.com, 2020).

Although Aalto is one of the leading architects of the modern era, it can be thought that he was inspired by Ancient Greece temples that underlined the healing power of nature, in the design of this sanatorium (Agnihotri, 2022). It was important for all sanatoriums to be built on rural landscape. It must be admitted that isolation was one of the driving forces to cherishing the natural landscape. (Sternberg, 2009). At those times it is believed that sun heals the tuberculosis and Aalto provided terraces for sunbathing and designed to take maximum advantage of sun (Heikinheimo, 2016). Location selection were very important in order to create an effective therapeutic environment in sanatoriums. Accordingly, Aalto was very delicate about site selection and located the sanatorium in isolated natural settlement (Figure 4), (Sternberg, 2009).

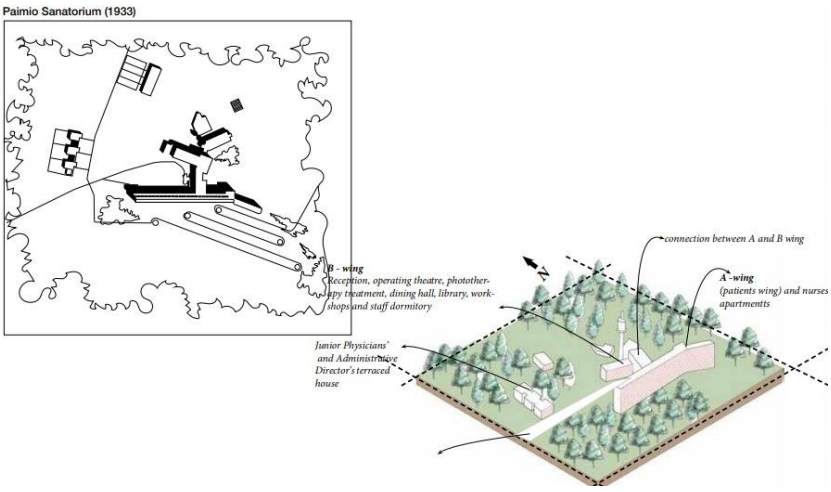

Figure 4. Axonometric view of Paimio Sanatorium (Source: Mishio, 2021).

Patients were spending a lot of time in the sanatorium for their ongoing treatment, so Alvar Aalto designed walkways with water elements to encourage patients to move, and asked that their beds be taken outside for getting fresh air and natural light (Heikinheimo, 2016). Aalto was also caring about creating silent and peaceful place for patients. Additionally, soundproof materials are used in the patient rooms to block the negative effects of noise. (Heikinheimo, 2016). Unlike the grey stone-like materials which were used in Royal Victoria Hospital, there were series of organic forms and various color palettes in the design of this sanatorium (Figure 5) and it is aimed to create brightened and welcoming space for the tuberculosis patients.

Figure 5. The use of color and organic forms in Paimio Sanatorium (Source: archeyes.com, 2020).

At that time in history, the design concept of healthcare buildings supported efficiency and creating a sanitary environment, but Aalto brought a new perception to modern healthcare structures based on human experience and psychology (Plummer, 2018). It can be observed that, Alvar Aalto's design initiatives included not only visual but also have therapeutic effects. The Paimio Sanatorium was built especially for to treat tuberculosis and was developed by architects in collaboration

with doctors. According to Sternberg (2009), this sanatorium led the way in integrating nature into health structures and revealed that well-thought architecture can lead to healing.

Briefly, while nature has a strong effect on healing and well-being process, with the modernization and development of medical technology, healthcare facilities begun to pushed aside nature and abandoned its healing effect. From the Asclepius, nature was essential for healing spaces and landscape and sunlight were important tools in recovery. However, by the late twentieth century, hospitals equipped with highest technology and somehow welfare of patients was neglected (Sternberg, 2009). According to Sternberg (2009), scientists have already identified that our environmental perceptions contribute to healing. In this point of view, it is necessary to reconsider how the natural environment is effective and necessary at a time when nature is considered as a small design detail. Since ancient times, nature has been harmonious with architecture. In particular, the use of nature in health facilities has been observable since ancient times. Considering that the study focuses on health spaces, examples of architecture used in conjunction with nature as well as how these spaces have evolved throughout history are presented. In this context, to better understand nature's healing power in architecture, the relationship between human, architecture and nature will be explained in more detail in the next section.

2.3. Human, Nature & Architecture Interaction: An Overview

Throughout history, human beings, have a natural interaction with their surroundings and the elements of creating their living spaces. Since the early settlements, architecture has been influenced by nature, and the desire to be close to nature has long been a priority. Also, the nature - architecture relationship has been studied for ages, with some of the earliest records of it being found in ancient Greek and Roman texts. For example, Vitruvius, who wrote the major architectural work to survive from the first century, deals with this binding relation. Nature has been a sign of privilege since the Renaissance, not only through greenery and water, but also through organic forms, and nature has been depicted on stone-like structures (Zhong, Schroöder and Bekkering, 2021). Since then, many prominent works of modern architecture demonstrate an intertwined approach with nature, and nature became not only a visual feature but also a valuable component.

Kellert (2018) claims that during the history, human beings have been exposed to nature in their daily life, and as a result, they developed adaptive responses bodily and spiritually to the environmental forces so that they can react to threats and survive. There are many defenders of this discourse. In nineteenth century, the theory of evolution developed by Charles Darwin, defines human as a member of the ecological environment and an outcome of natural evolution. This theory has completely eliminated the privileged position of mankind against nature by undermining its superiority over nature. According to Frumkin (2001), the evolution theory defends that it is possible to mention about firmly established attach between nature and human. Similarly, Ulrich (1993) defends natural selection and the positive effects of human interaction with nature and he states that it is restoring positive effects, increasing cognitive level. Kellert and Calabrese (2015) stated that human intelligence, mind and body evolved in a non- artificial biocentric world. For this reason, human feels an inner connection to nature in order to continue their life, and it is almost impossible to think about the mental and physical well-being without natural environment (Kellert and Calabrese, 2015). Researches indicate that our past has contributed to our preference for green and spacious environments over stacking of buildings and abandoned landscapes (Gullone, 2000).

However, starting of twentieth century is expressed as a period in which the conflict between man and nature becomes violent, cultural, economic and social crises intensify, and global ecological problems become widespread (Ojama, 2015). With the development of modern industry, technology and health system, new concepts have emerged and changed people's flow of life (Westin, 1970). As the consequence of that developments our lifespan has been prolonged and the uncontrolled increasing of population has started to consume more and cause serious damage to the natural sources. Furthermore, society became technologically oriented and started to spend their time in indoor spaces which closed off to nature (Kellert, 2018). According to Wilson (1986), addiction of technology leads to disappearance of human beings' desire to interact with nature and by the time goes, modern people realized the damage given and feel longing for nature. Kellert (2018) claims that the outcomes of this situation realized towards the end of the twentieth century. Thereby, answers began to be sought on the sustainability of life and the protection of the natural environment. Many research conducted to find the answers. As a result of

mentioned researches, the ecological view come up which advocates balance with human and nature and criticizes mechanized world (Kellert, 2008).

These researches and studies have mostly focused on creating spaces that are more sustainable, recovering nature and getting closed to nature (Kellert and Calabrese, 2015). Especially by looking at the findings reached in the field of psychology, it can be said that nature is a very important helper in reducing stress and becoming more productive. As Kaplan, environmental psychologist who specialized in effect of nature on health, has written "Nature matters to people. Big trees and small trees, glistening water, chirping birds, budding bushes, colorful flowers—these are important ingredients in a good life." (Kaplan, 1983; Frumkin, 2001 p.234). Kellert (2008) claims that the reason behind is, human beings discover themselves in nature and see as a part of it. After all the researches and discourses, the positive effects of contact with nature on human health were revealed. In this respect, the weakened bounding with nature, began to be rethought and reshaped.

The view that interacting with nature provides variable physiological and psychological benefits to human health has been defended for a long time. In a study conducted by Browning, Ryan and Clancy (2014) it is detailed how interacting with nature positively affects human peace and health. In this study, the effects of natural factors on human have been gathered under three main topics: physiological, psychological and cognitive (Browning, Ryan and Clancy, 2014). Cognitively, routine interaction with nature support mental renewal, provide being more productive and physiologically, it is believed that regulating blood pressure and lower stress. Lastly in a psychological approach, nature experience recovers emotional disorders with reduction of anger, fear, anxiety level (Browning, Ryan and Clancy, 2014).

One of the defenders of this view was Roger Ulrich, architect specialized in environment psychology. He conducted many researches about the effects of nature on human well-being. Ulrich conducted one of these experiments by connecting 160 participants to measuring machines and observing how nature affected the rate of stress relief (Ulrich et al.,1998; Gullone, 2000). According to the results of another study he conducted, in terms of stress relief, nature scenes are preferred more than cities, regardless of the participant's cultural background. These studies converge on that stressed people feel better when there is direct or indirect exposition to nature

(Ulrich, 1979; Weinberger et al., 2021).

In nineteenth century, mortality records were examined in United States and resulted in higher rates seen in urban areas comparing to rural (Van den Berg, 2005). In fact, people's perception of the city was that it was polluted and adversely affecting health; dense urbanization the increased spread of infectious diseases and use of coal worsen air pollution. (Sternberg, 2009). This situation created an awareness and demonstrated that the notion of human- nature relations should be considered on a broader perspective. The healing effect of nature can be examined in urban context. In this respect, Kellert draws attention how nature is implemented at the urban level in his article. He writes that "The prevailing paradigm of urban development is neither necessary nor sustainable and constitutes more a design deficiency than an intrinsic and inevitable flaw of modern life" (Kellert, 2006, p.9).

Together with urbanization, which causes distant from nature, the relationship between dwellers and the city has begun to be discussed. Rohde and Kendle carried out a literature review about the effects of greenery urban environment and examined psychological well-being of people. This research resulted in it affects human health in a positive way. As an example, natural surroundings reduce stress and eliminate barriers between social classes by encouraging socialization, evoking a sense of adventure and triggering self-confidence (Rohde and Kendle, 1994).

Similarly, Beatley, argues the positive and negative effects of urbanization on human health. He suggested that instead of neglecting nature, it should be cherished in well planned urban designs with city parks, gardens and etc. (Beatley, 2010). Researches show that existence of green urban areas have a greater influence than we expected. According to a study conducted in Denmark in 2007, green elements in urban environment evokes the feeling of getting outside and being more physically active, less stressed and lower the potential of obesity (Beatley,2010). To mention one of the psychological effects of being close to nature, regarding to the study of Taylor Homes in Chicago, it is found in the attention test, the residents of the apartments close to the greenery had better findings than the residents of the apartments towards to arid surrounding (Sternberg, 2009). Moreover, greenery in neighborhoods has the secondary benefit of reducing air pollution and improving air quality. Besides, we don't have to be exposed directly to the green to see its positive effects on our well-being, it could be indirect relation. Marcus and Sachs (2013)

indicate that pleasing sound and smell, feeling of sun and fresh air can be helpful sensory experiences.

It is founded that nature sounds like bird chirping or flow of water can be restorative in spite of this, urban sounds such as ambulance or heavy traffic noise effecting negatively. Designing sustainable urban environment and close interaction with nature can lead up to build meaningful lives. Kellert suggested that we should not be content with avoiding things that will harm nature, we should do more to heal it and we should build a context for significant exchange with our surrounding (Van den Berg, 2005). Bringing together cities and nature will not only improve the environment, but will also improve the health of its inhabitants. With this vision, Beatley (2010) believes that in urban design, nature should be inspired for creating sustainable and walkable cities.

However, current built environments are unable to satisfy the need for interaction with nature, despite being vital to our psychological well-being. Since there is dominant approach in design which sees the nature as an obstacle or unnecessary detail (Kellert and Calabrese, 2015). There is no doubt that nature is a broad concept and susceptible to interpretation and confusion (Zhong, Schroöder and Bekkering, 2021). There is a debate regarding exactly how much can be achieved by adding green elements to buildings to establish a relationship between human, nature, and architecture. According to biologist and natural scientist Edward O. Wilson, in order to be healthy and productive individuals, we need to be in constant contact with nature and reclaims the phenomenon of biophilia as “emotional affiliation of human beings to other living organisms” (Kellert, 2018). In this context, biophilia can be considered as a method for dealing with the incorporation of nature into the built environment.

The term biophilia, was first mentioned by psychologist Erich Fromm, defined as the love towards living creatures and life (Fromm, 1964). Fromm suggested that the mutual relationship and connection between human and nature is inherent in a biological way. Despite of the definitions made by Wilson and Fromm are close to each other, Fromm mostly evaluated the mutual interaction between people, and Wilson focused on the mental, emotional and physical intimacy towards life and nature (Kellert, 2008). Kellert defines biophilia as a tendency to hold onto natural processes in a similar way to Wilson (Kellert, 2008).

Findings are growing which demonstrates the reality of biophilia and the advantages of exposed to nature direct or indirectly (Beatley, 2010). Some early studies tell us about the healing power of nature. On this broad subject, Roger Ulrich did a landmark study in 1984 which indicates how could a window perform act upon healing and he was the first to measure patients were affected by their environment during the recovery (Sternberg, 2009). He selected forty-six patient which undergone gall bladder surgery with ultimate care of they were on equal conditions and even their nurses were the same but only the bed positioning was different, some of them were facing towards to nature, some of them were facing the wall. Ulrich recorded bodily responses such as medication amount, pulse rate, dosage of painkillers etc. for deeper understanding of humans' physiological relationship with nature. The findings reveal that, it is faster and easier to get rid of stress in a natural environment compared to an urban environment and the patients who were in contact with nature were discharged from hospital faster and received fewer negative critics from nurses. Ulrich's experiment has once again strengthened the connection between architecture, nature and health. (Sternberg, 2009). According to Beatley (2010), Ulrich's findings were not surprising and could be a driving force for changing the design of medical facilities to include healing gardens, natural daylight and other green features. Similarly, Frumkin (2001) advocates that healing effects of the built environment continue to be investigated and as more information comes in, it is necessary to act on the results. Maybe these developments can strengthen patient care and if it will contribute to the healing process, we can make patients spend time in green areas, we can build hospitals in natural landscape.

The book, "Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life", at the helm of Kellert and published in 2008, provides an interdisciplinary study of how to conduct the interaction of human and nature in the built environment and how to apply the biophilic design approach in practice (Kellert, Heerwagen and Mador, 2008). In his book, he underlined the problem of our age which integrating nature to the built environment (Kellert, 2018). Similarly, Sternberg (2009) remarked the necessity of understanding that our natural environment affects our emotions and that these emotions have an impact on recovery hence, the recovery of patients is an issue that needs to be considered in building design.

Nature has recently been the subject of discussion and rediscovery with an expectation of making a contribution to health and resilience (Zhong, Schroöder and Bekkering, 2021). It has been widely accepted that nature has a calming effect on people, and that this calming effect can be beneficial to those who suffer from illness or injury. Therefore, incorporating nature into health facilities has been seen as a way to enhance the healing process. In this respect, biophilic design has potential that will help modern cities that are and isolated from nature to connect with nature again (Kellert and Calabrese, 2015). Biophilic design is a multi-layered issue that needs to be considered at all scales, not just the building scale (Beatley, 2010).

CHAPTER 3: BIOPHILIA AS AN INSTRUMENT OF HEALING

3.1. Biophilic Design: Incorporating Nature

The notion and practice of biophilic design stem from the biophilia hypothesis, which reflects an innate desire on the part of humans to live in harmony with nature. The previous section discussed biophilia as a tendency to be connected with nature and natural processes (Kellert, 2005). To maintain a meaningful implication of biophilia, Stephen Kellert claimed "biophilic design" in 2005. Biophilic design, was questioned how the concept of biophilia will be applied in architecture which emphasizes the necessity of continuing instinctive human commitment to nature and the living things (Kellert, 2005). As a result of rapid modernization, human beings, surrounded by spaces that contradict their biological codes (Gullone, 2000). Biophilic design can be served as an environmental improvement, given the negative effects urbanization has on human psychology and physiology (Borten and Barbiero, 2020). The biophilic design, aims to create a good living space on the built environment and improve the mental and physical well-being by rebuilding the relationship between nature and human in the urban space (Kellert and Calabrese, 2015). Also, it is worthy to note that, in Kellert's view, sustainability is an essential component of biophilia. He mentioned that combining these two notions will contribute to the built environment and help provide livable, curing spaces by enhancing the quality of life (Kellert, 2008).

As Kellert indicated, the purpose of biophilic design approach is to create new living spaces on behalf of human beings. It was developed to maintain human-nature energy on earth, according to Louv (2008) biophilic design is based on production, not consumption. Before defining the basic elements and qualities of the biophilic design approaches, it should be emphasized that the biophilic design does not only mean adding natural factors to the built environment, it means applying it in an effective way to satisfy the need of human nature connection. Effective biophilic design practice requires the knowledge of the earth and its natural processes to contribute to human health and well-being. (Kellert, 2008). For achieving the effective and meaningful biophilic design, Kellert defined eight biophilic values and stated that these values will guide the designers. The mentioned values will be explained in the following section. Following that, the biophilic principles, which Kellert and Calabrese (2015) derived from these values, will be explained. The

following sections provide a clear framework for biophilic design, as well as a discussion of how applying these principles to healthcare spaces might benefit human health.

3.2. Values of Biophilic Design

Today, researches on the practicality of biophilic designs in various regions of the world are continued and design examples are increasing every day. During the application, researches on biophilic design features are carried out in order to provide common language, unity and guidance. Kellert's (2018) discussion of biophilic values is fundamental to provide common language. Regarding the impact of biophilia on health and well-being, he identifies eight values. In biophilic design, values are derived from the biophilia approach, and they may differ based on culture and background, but all have the goal of enhancing human health and well-being. (Kellert, 2018).

Kellert summarizes biophilic values in eight key points.

"Affection" emphasizes a solid foundation and an appreciation for nature. Another value, "Attraction" can be defined as the ability to recognize beauty of nature, which is inherent in people's genetic codes. "Aversion" is the tendency of staying away from threats in nature which causing fear and anxiety. "Control" is associated with the desire to dominate nature. "Exploitation" refers to another value of biophilia as the inclination of making use of nature as a material resource. "Intellect" refers to take advantage of nature to change perspectives, while "Symbolism" refers to the use of natural images to improve the ability to think abstractly. Last, "Spirituality" is the aspiration to experience nature to find meaning in life (Kellert, 2018).

Whether or not Kellert's biophilic values are adaptive depends on repetitive nature experiences. It should be clarified that every experience of nature does not mean it is biophilic. There can be valuable and worthless contacts. Architectural and landscape designs that lead to a valuable contact with nature appeal to evolved tendencies to engage with the natural world rather than experiences having a temporary effect (Kellert and Calabrese, 2005). In addition, each biophilic value represents a tendency to connect with nature that can potentially contribute to human health, productivity and well-being (Kellert, 2018). Briefly, functional biophilic

design should include engaging experiences based on learning and development. Nonetheless, it should connect ecologically with nature, while creating a coherent and reinforced environment for individuals.

3.3. Application of Biophilic Design

In the modern era, experiencing nature is perceived as a challenge in the cityscape. It is challenging to integrate biophilic design tenets in built environment and requires a broad perception of its experiences. A number of publications are released by scientists and designers that identify the qualities that contribute most to the effectiveness of the built and natural environment. It is crucial that the findings be reflected in practice, to create a restorative environment (Tekin et al., 2023). According to Tekin et al., the goal can be achieved by analyzing the demographic characteristics of the built environment as well as the intended use of the building. Therefore, I will explore the relationship between nature and the built environment by referring to two prominent studies belonging to Kellert and Calabrese (2015) and Browning, Ryan and Clancy (2014).

To begin with, Browning, Ryan and Clancy's study will be discussed which emphasizes the biophilic design parameters in three different parts and provide a framework in order to better implementation biophilic design. Following that, I will cover biophilic design principles which Kellert and Calabrese presented.

3.3.1 Parameters of Biophilic Design

Browning, Ryan and Clancy classify the principles of biophilia under three main headings: nature in space, nature of space and natural analogues (Browning, Ryan and Clancy, 2014). The mentioned biophilic design principles focus on cognitive, physiological and psychological benefits. The word "pattern" is used by Browning, Ryan and Clancy to articulate a standard terminology, within the framework of biophilic design principles. Thus, biophilia maximizes the level of interdisciplinary accessibility by creating a common language, that is widely known and accepted. The main purpose of describing the Browning, Ryan and Clancy's patterns, is to describe the clear relationship between natural and built environments and how people respond to these environments. (Browning, Ryan and Clancy, 2014). I briefly explain three prominent headings of biophilic design patterns.

Nature in space studies the temporary, physical and direct presence of nature in a place. The pattern of nature in space includes smells, sounds, breezes and other natural factors as well as animal, water and plant life in the built environment. According to Browning, Ryan and Clancy (2014), nature in space can be explained; "Visual and non-visual connection with nature, non-rhythmic sensory stimuli, access to thermal and airflow, contacting with natural systems, water, dynamic lit" (Browning, Ryan and Clancy, 2014). The patterns can be exampled as, a window with a sea or garden view, green walls, courtyards, vegetation which refers to the visual connection with nature. Also includes tactile and auditory stimuli, sea scent, bird sounds, water sound etc. elements can be given as examples. Those links have been found to improve attention, reduce aggression, lower heart rate and blood pressure, and reduce stress (Browning, Ryan and Clancy, 2014).

Natural Analogues includes the indirect and organic connotations of nature with patterns, colors and shapes etc. manifesting itself in the form of works of art, natural materials and ornamentation in built environment. Natural analogues include three biophilic design parameters which are biomorphic forms, interaction of materials, complexity and order. (Browning, Ryan and Clancy, 2014). Biomorphic forms are represented by the symbolic transfer of geometric, texture, shape or patterns which can be found in the natural environment to design. Also, the use of natural materials and visual inclusion of fractal geometry encountered in nature can be exemplified of natural analogues (Browning, Ryan and Clancy, 2014).

Nature of space encompasses spatial configurations which procuring cause of psychological and physiological responses. The nature of the space includes four biophilic design parameters; prospect, refuge, mystery and peril (Browning, Ryan and Clancy, 2014). The prospect parameter satisfies the need of control and reducing insecurity while increasing comfort; Skylights or windows, glass partitions, open plan areas are can be examples (Browning, Ryan and Clancy, 2014).

The abovementioned biophilic design principles can be considered as providing guidance rather than dictating a formula and by defining the parameters it is aimed to underline the connection between nature and built environment. The gathered evidences show that, implementation of these parameters have mounting positive impacts on health by decreasing the level of stress hormone and regulating blood pressure (Van den Berg, 2005).

3.3.2 Biophilic Design Principles: An Overview

Human feel a need to be a part of the ecological system, which is composed of integrated pieces that support each other. The concept of biophilic design is intended to satisfy the experience of nature to create a healthy environment for people within contemporary architecture. In this respect, Kellert and Calabrese (2015) presented the principles of biophilic design to create a foundation of meaningful design which supporting human productivity and well-being. Yet, those principles need to be permanently implemented to achieve effective design (Kellert and Calabrese, 2015).

According to the first principle, biophilic design should contribute to overall well-being and foster productivity. The isolated experience of nature can lose its appeal in the built environment. In the second principle, it emphasizes not harming nature and it is aimed at avoiding negative effects by developing human interaction with natural systems in the built environment. It is argued that the third principle of biophilic design is to integrate nature in an authentic manner rather than making it artificial and disconnected from reality. The other principle is that biophilic design should take place on different scales, including transitional areas. Keeping the design language similar, the interior should reflect the exterior. Lastly, promising biophilic design should promote emotional bonding with the environment. Lack of attachment could be the reason for neglecting nature and result in disappearing of sense of belonging (Kellert and Calabrese, 2015).

In summary, nature is always striving to maintain sustainability through ignoring negative effects and enhancing the human experience in built environments. In doing so, the biophilic design provides long-term benefits to both humans and nature. For example, it contributes to the conservation and enhancement of biodiversity in nature, as well as to the productivity and self-esteem of humans. Precisely, biophilic design contributes to physical and mental well-being in a broad spectrum ranging from providing productivity to reduction of anxiety, reducing fatigue and increasing motivation and repelling aggression and strengthening communication skills. We could perceive biophilic design experience through our sensory abilities such as sight, smell, sound and etc. Kellert and Calabrese reveal three headlines for experiencing nature to establish a holistic understanding of

biophilic design. These are the direct experience of nature, the indirect experience of nature, and the experience of space and place (Kellert and Calabrese, 2015). The detailed framework is shown below (Figure 6). Since this study is primarily concerned with biophilic design in healthcare spaces and its applications, key principles have been chosen that prominent for healthcare spaces. In the determination of these principles, references were taken from two sources that conducted a detailed literature review (Zhong, Schröder and Bekkering, 2021; Tekin et al., 2023).

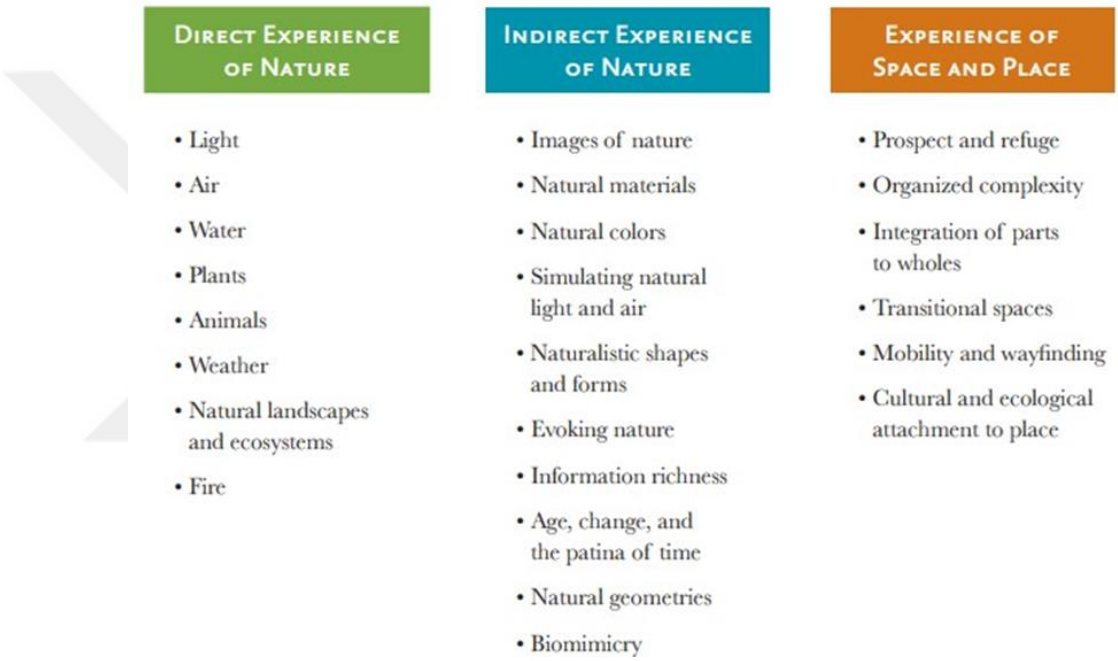

Figure 6. Attributes of biophilic design experience (Source: Kellert and Calabrese, 2015).

Tekin et al. (2023) point out that general frameworks for biophilic design are insufficient, and that establishing principles based on content, such as what the building will be used for, cultural and climatic factors, will lead to more positive outcomes. Tekin et al. (2023) examined the effect of biophilic design on users in healthcare spaces. Thermal comfort, sufficient light, fresh air, a feeling of security, and an inviting space are the factors that patients and staff value most. Aside from these features, privacy, the presence of natural elements like greenery and water, and easy access to transportation are also important. In this context, selected criteria in the headline of direct experience of nature are “air, light, water, plant and landscape and ecosystem”. In the indirect experience of nature selected criteria are “natural

materials, natural colors, naturalistic shapes and forms". In the subject of experience of space and place "prospect and refuge, transitional spaces, mobility and wayfinding and cultural and ecological attachment to place" can be shown as highlighted features in the field of healthcare design (Kellert and Calabrese, 2015). The prominent criteria will be explained below (Table 1).

Table 1. Selected biophilic principles derived from Keller and Calabrese, 2015.

Selected Principles		
Direct Experience of nature	Indirect Experience of Nature	Experience of Space and Place
Light	Natural materials	Prospect and refuge
Air	Natural colors	Transitional spaces
Plants	Naturalistic shapes and forms	Mobility and wayfinding
Natural landscapes and ecosystems		Cultural and ecological attachment to place

The direct experience of nature can be explained as tangible interaction with natural context such as plants, natural light and fresh air, water, landscape in urbanized areas (Kellert and Calabrese, 2015). It allows us to connect distinctive features of natural habitat such as clean air and daylight by just sitting nearby the river or trees yet, direct experience can be regarded as a starter to build a meaningful relation with nature in urban environment (Kellert, 2018). Also, outside view can be regarded as a direct experience. Evolutionary, people have the inclination of savannah-like scenery with huge trees rather than artificial landscapes (Kellert and Calabrese, 2015). As many researches were emphasized, on user psychology there can be stimulating and soothing effects of direct connection with the nature with the elements of plants, daylight and etc… But as Kellert (2018) mentioned in principles of biophilia, those elements can only effective with the continuity, an isolated green wall or fountain replaced in entrance can be regarded as relatively unsatisfactory.

The indirect experience of nature, can be defined as communicating with nature, by the metaphor or representation of nature, resembling the actual contact with the real nature (Kellert and Calabrese, 2015). Natural materials and textures, organic forms, round and spherical surfaces, which can inherently be found in nature,

are the relevant examples of this experience (Kellert, 2018). Designs inspired by natural irregular forms, awaken our desire to attach with nature. Indirect experience of nature, support the create welcoming environment.

The experience of space and place, shows the spatial features of the natural environment that have a positive impact on the health and well-being (Kellert and Calabrese, 2015). In this respect, biophilic design features address human perspectives of nature. Among its examples; broad vision and refuge, cultural and ecological attachment, wayfinding, transitional space etc. (Kellert and Calabrese, 2015).

Kellert and Calabrese represented 24 parameters of biophilic design which detailed in Figure 6. Since this paper examines biophilia in a healthcare framework, the relevant attributes of biophilic design, which are subtitles of biophilic experience will be briefly described below.

Light is one of the parameters of biophilic design as discussed by Kellert and Calabrese. Daylight can be utilized by including elements such as skylights and windows into design decisions (Kellert and Calabrese, 2015). Natural light experience supporting people to understand the solstices and seasons, and so making it easier to comply with nature and navigate. In addition, the light spreading on objects and nature creates variable shadows which intensifies the sense of movement and adding depth to the clinical environment (Kellert and Calabrese, 2015). Also, this feature has an effect on productivity (Browning, Ryan and Clancy, 2014). Excess daylight, however, can be both a distraction for occupants and detrimental to the building's efficiency if not calculated properly (Browning, Ryan and Clancy, 2014; Zhong, Schröder and Bekkering, 2021).

Natural ventilation experience in the built environment, which supports human productivity, is provided by humidity and air pressure, and these factors can be applied with simple methods such as window opening or with engineer strategies. As a result, it supports mental health and leads people to become more prosperous individuals (Kellert and Calabrese, 2015). But uncontrolled ventilation can be result in dust accumulation and high humidity level (Shi et al, 2018; Zhong, Schröder and Bekkering, 2021).

Water is essential for humans; hearing and seeing water may produce a calming effect on people. It has been proven by different studies that places with

water are more preferred and these places reveal positive emotional reactions on people (Kellert, 2018). Exposure to the properties of water lowers blood pressure and heart rate, improves psychology and perception sensitivity, improves memory and concentration, and reduces stress and creates satisfaction. Changing design strategies by including fountains, aquariums, can satisfy the desire for contact with water (Kellert and Calabrese, 2015). In addition, it can serve as a means of highlighting the natural water elements in a land selection. It is an issue that needs to be handled delicately when adding to the design. If water is not reusable, it causes environmental issues (Browning, Ryan and Clancy, 2014; Zhong, Schröder and Bekkering, 2021). There is also a possibility that some people may develop an aversion to biophobia and noise (Ulrich, 1993).

Plants constitute a prominent design element of biophilic design practices. The plant texture included in the design is regarded an example of the direct experience of nature in the built environment. Plants provide mental and psychological comfort to people, as well as contributing to the increase of efficiency and performance (Kellert and Calabrese, 2015). The use of green elements can be an example of biophilic designs with their form, texture and colors (Kellert, and Calabrese, 2015). Integrity is important for the effective implementation of biophilic design. Therefore, the phenomenon of biophilia, which is tried to be achieved with a single plant, is generally remains inconclusive. At the same time, over-planting, which is seen as the only way of application of biophilia and alienated greenery which contrasting with design is also likely to fail (Kellert, 2018). Although its restorative power is generally accepted, even with a low probability, indoor plants have been reported to cause allergies and infections (Moslehian et al., 2023).

Landscape and ecosystem refer to a direct experience of nature and help create more harmonious and ecologically integrated spaces (Kellert and Calabrese, 2015). Users feel more like a part of the nature and being part of a whole has a psychologically relaxing effect. Nonetheless, a large area of land integration that appears artificial can cause people to leave their safe zone and feel disoriented (Kellert, 2018; Zhong, Schröder and Bekkering, 2021).

Natural materials effect humans indirectly. In the built environment, there are many uses for furniture and fabrics, for example leather, cotton, clay wood, etc. In addition to creating an inviting atmosphere, it is also effective in creating a sense of

belonging (Kellert, 2018). Despite the developing of craftsman, many features of natural materials are too special and distinctive to be copied by artificial materials (Kellert and Calabrese, 2015).

Natural color can be evaluated as a supportive tool for mobility and wayfinding, as well as facilitating visual accessibility (Kellert and Calabrese, 2015). Therefore, people tend to become attached to the natural world's bright colors, rainbows, shimmering water, blue clouds, and other colorful features (Kellert, Heerwagen and Mador, 2008). According to Kellert (2018), effective biophilic design by means of color should support earth tones of soil, rock particles and plants. However, the use of bright colors should be applied carefully because of the stress-inducing effects (Kellert, 2018; Zhong, Schröder and Bekkering, 2021). Also, color is subjective and may produce aversion.

Natural shapes and forms, refers adding nature-inspired forms to the built environment that evokes memories of living organisms that triggers a powerful simulation of nature. These forms, which can be applied indoors and outdoors, have the potential to transform calm space into the dynamic quality of a living space (Kellert and Calabrese, 2015). Although organic architectural applications have been very popular lately, they can cause disconnection in design of modern architecture, which is usually advanced with sharp lines, this situation creates the potential to reduce organic forms to a sculpture (Kellert, 2018). Also, excessive use of these shapes can be overwhelming (Browning, Ryan and Clancy, 2014).

Transitional spaces, which help experience the space, can be integrated into the design with methods such as corridors and courtyards (Kellert and Calabrese, 2015). The feeling of belonging is created when we understand the connection between spaces. Furthermore, transition areas placed at critical points facilitate both staff and patient flow (Tekin et al., 2023). There is already a sense of unfamiliarity in healthcare settings. That's why designs that cause confusion can result in fear of getting lost.

According to Kellert and Calabrese (2015) the human species is adapted to thrive in environments where they can dominate the environment and feel safe and secure. Prospect expresses a wide field of view and dominance and contributes to anticipate potential dangers, whereas refuge refers to the act of providing protection. In healthcare design, the user can achieve this evolutionary requirement by creating

enclosed, externally connected spaces. This experience of space, which relieves the anxiety and fatigue, can be obtained by adding such as windows, balconies (Browning, Ryan and Clancy, 2014). It should be noted that keeping these two extreme characteristics balanced and maintained is essential (Zhong, Schröder and Bekkering, 2021).

Especially in complex and large-scale places such as hospitals, mobility and wayfinding gains importance in the context of the experience of space. A legible place often evokes trust in the user. It is especially easy to move about in healthcare settings with well-defined entrances that connect the interior to the exterior, and with items such as staircases and elevators that facilitate vertical circulation (Kellert and Calabrese. 2015). Also, it is possible to be face with durability and planning difficulties (Zhong, Schröder and Bekkering, 2021).

Cultural attachment is a way of experiencing space. Proximity to familiar places reflects a tendency to establish territorial control, which can be enriched by cultural and ecological methods. Culturally integrated designs foster the bonding and the meaning that an environment has a distinct human identity. It promotes ecological connections to the ground, emotional attachment to a region, awareness of the local landscape and characteristic meteorological conditions (Kellert and Calabrese, 2015). The misleading use of cultural elements in the built environment can have adverse psychological effects and might contribute to disinformation (Zhong, Schröder and Bekkering, 2021).

These biophilic principles experienced by our sensory abilities and when it is perceived, various physical, emotional and cognitive reactions are triggered in human beings (Kellert and Calabrese, 2015). These can be a guidance for a successful application to the designer who wants to integrate nature into the built environment (Kellert, 2018). There is a growing body of evidence that these principles, which contain a number of natural elements, can be used as factors that can help speed the recovery process, especially in healthcare structures, as they support the creation of a more restorative environment for individuals within the built environment. In the following sections, the restorative effects of these principles will be discussed in more detail, and examples of buildings that show how these principles can be incorporated into the design of health facilities will be presented to illustrate how they can be successfully integrated.

CHAPTER 4: HEALING ARCHITECTURE THROUGH BIOPHILIC DESIGN

4.1. Complications of Modern Hospital

Throughout history, the perception of disease and health has evolved and healthcare designs have been affected in particular with the advancement of technology and medicine. Since ancient times, the primary focus of healing has been prevention of infection, which changed the course of healing along with hospital design with the germ theory. This theory argues that contagious diseases spread through germs and these germs must be blocked (Sternberg, 2009). Specialists searched for solutions and suggested precautions that changed healthcare design. Hospitals kept up with the developments, and came to embrace, pavilion type planning which was considered as the first step of modernization. Pavilion type hospitals popularized and spread the sanitation movement thought the world (Hoskin and Haggard, 1999). Although we see today the provision of hygiene in hospitals as a very normal and basic requirement, this movement has greatly reduced hospital diseases and changed people's scary perception of hospitals (Sternberg, 2009).

While hospitals have undergone some changes in interior functioning and design, the organization of settlement has also changed. the very first hospital-like structure, Asclepieions were built rural areas with high altitude where away from noise, heat and pollution (Sternberg, 2009). Now, hospitals with sharply drawn borders and disconnected from the urban fabric, cause patients to become lonely and away from nature. But location is the prominent determinant for a meaningful interaction with nature should be examined by designer (Hoskin and Haggard, 1999). According to many researches, integration of nature was essential for well-being and promoting recovery.

The aggressive progress of technology in twentieth century, modern hospitals, which are heavily equipped with technological elements such as x-ray devices and electrocardiograms, created machine-like places. Also, hospitals gradually expanded physically to meet the requirements of technology which is causing aroused feeling of getting lost in the space. Being in huge buildings where the latest works of technology are located, became an anxiety-inducing experience for patients, which already suffering from impaired hormonal balance (Sternberg,

2009). According to Sternberg, in modern medicine the patient-oriented perception has changed and replaced by a machine-oriented understanding, and patients are expected to keep up with it. Actions to prevent infection, such as the use of metal surfaces and the restriction of patient visits and use of healthcare equipment, causing a disturbing environment which is noisy and people are isolated (Sternberg, 2009). Many studies show that the mentioned features may slow down the healing process by creating stressful healing spaces because it is known that stress can damage our immune system as Sternberg writes:

"Research has shown that stress is harmful to health. It slows healing, predisposes the body to more severe and more frequent infections, and compounds the effects of illness. A hospital environment, whose goal is to heal, should do what it can to eliminate stress" (Sternberg, 2009, p.227).

One of these researches conducted by psychologist-immunologist research team in Pittsburgh and examined possible roles of stress on the role of stress in the scope of vaccines. They compared the students who got the flu vaccine during the exam period with those who were vaccinated during the holiday period, and as a result, it was observed that the vaccinations during the holiday period produced more antibodies. Another research conducted by immunologist Glaser. Although he was skeptical that emotions affect the immune system, in his first experiment, he observed that the spouses of died Alzheimer's patients had weakened immune cells known as natural killer cells (Sternberg, 2010). In this respect, examining the stress creating factors in hospitals became a vital issue.

Ulrich addressed noise the main cause of stress in hospitals (Sternberg, 2009; Ulrich, 1991). It was noted that noise has reached its highest level during shift changes of nurses and doctors and during the relocating of x-ray-like large equipment. These noise creating actions caused decreasing of sleep quality among patients and healthcare providers. According to the research conducted by MacKenzie and Galbrun (2007), it is revealed that noise in hospital wards, creating the potential of decelerated healing process. in the study examining the noise levels in the intensive care units of Edinburgh hospitals, a significant number of noise sources were identified. However, the lowest noise level was measured in the intensive care unit where the acoustic ceiling was applied (MacKenzie and Galbrun, 2007).

In modern hospitals, single rooms and restricted patient visits are some of the precautions that are taken to prevent the spread of infection. However, these measures led to the isolation of patients. In addition, the spatial area allocated to diagnostic and treatment equipment has led to a decrease in greenery that supports socialization (Sternberg, 2009).

All of these situations have caused stress on patients, resulting in a weakening of their immune system and thus slowing recovery. As a consequence, it has created a more vulnerable state against infections. Experts have found many studies to reduce negative situations in the hospital.

4.2. Collecting Evidence on Healthcare Design

Studies have been initiated by the leadership of Roger Ulrich, to eliminate the negative effects on patients caused by modernization and the development of medical technology. While the results of Ulrich's research on scenic windows were influential, he was aware that it needed further investigation and devoted his career to improving the hospital environment. This situation reaccelerated evidence-based design (EBD) which aiming to figure out the architectural influence on physical or psychological health (Sternberg, 2009). It is advocated that evidence-base design is a process-oriented discourse, in the book "Evidence-Based Design for Multiple Building Types" and it is defined as:

"Evidence-based design is the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project" (Hamilton and Watkins, 2008, p.9).

Although evidence-based design is a relatively new discourse, it can be said that it is effective in the quality of health services with its increasing findings. The notion of evidence-based design has become a current issue for healthcare architecture with noticeable impact in built and it is considered as a new skill set to the designers (Pilosof and Grobman 2021).

An increasing number of studies have proven that well-designed physical environments reduce stress, contribute to recovery and provide a more productive

environment for healthcare professionals. Phiri and Chen advocate that, rather than focusing on 'beautiful design', the main target of evidence-based design is helping the healing process with creating a peaceful and quiet environment by the use of natural elements (Phiri and Chen, 2014). While examining the benefits of evidence-based design on patient care, Ulrich and Zimring have mentioned three main topics; patient safety, environmental stressors, and ecological health (Sternberg, 2009).

Patient safety underlines to prevent the hospital diseases and accidents and to provide efficient patient care (Sternberg, 2009). Evidences show that, hospital injuries were occurring mostly in bathrooms or in the corridors that leading to the toilet (Phiri and Chen, 2014). Phiri and Chen suggesting well-planned patient rooms and corridors with holding bars and flooring with non-slippery materials to minimize the injuries. It is confirmed that hospital diseases are caused by the spreading infection which is mostly transferred with physical contact. Phiri and Chen state that it can be dealt with by creating a hygienic environment. At the same time the decentralized organization of nurse station could increase visual control and ensure the safety of patients. (Phiri and Chen, 2014).

According to studies, noise is the major stressor in hospital which heavily equipped with machines (Sternberg, 2009). Environmental stressors can be reduced by separating circulation areas from patient treatment areas and using soundproof materials for a peaceful recovery environment (Phiri and Chen, 2014). According to a study which conducted in a Swedish Hospital, it is observed that, the use of sound-absorbing ceiling elements significantly reduced noise, and the test results of the patients were better. Also, the study showed that, sound blocking measures improved the sleep quality of patients and ensured employee satisfaction (Sternberg, 2009).

It is possible to consider the inclusion of green areas, which supports mental health of the patients and accelerate their recovery, as "ecological health" (Sternberg, 2009). According to Sternberg, measures to reduce the risk of disease, such as single rooms and visitor restriction, has isolated patients. Therapeutic gardens, sunlight and natural landscapes used to take a break from the stressful hospital environment and enhance socialization (Phiri and Chen, 2014). Phiri and Chen (2014) states that, using biophilic principles fosters healing because human beings susceptive to natural process and patterns. Nature is always in motion and encourages to move and reminds us of resilience and regeneration and these reminders are important matters

for patients to re-connecting life.

Evidence-based design can be viewed as a foundational approach to design that promotes patient well-being and recovery. The Ulrich experiment, which accelerated biophilic design research, established an intense relationship between nature and human beings, and formed a tenor for evidence-based design. Evidence-based design concepts were divided into three titles as patient safety, environmental stressors, and ecological health. The importance of biophilic design principles was mentioned, especially in the context of ecological health for reducing the stress level of patients and healthcare providers.

With the help of evidence-based design, it has been observed that hospital environments can cause physiological responses. Hence, suggestions have been developed to reduce possible consequences of hospital environment that effects patients and healthcare professionals. Evidence-based design can be used as a tool to design hospitals that support healing and provide physical and mental well-being, and can be used for providing motivation for architects and investors.

4.3. Restorative Effects of Biophilic Design

Healthcare structure planning and designing processes are based on shaping functional and environmental relationships. If healthcare facilities operate effectively, but lack of organization leads to psychological effects of high blood pressure, delusion, and patient anxiety. It has been scientifically proven that psychological indicators delay the healing process (Phiri and Chen, 2014). At the design stage of health structures that support the healing process, the social, mental, and spiritual needs of users should be taken into consideration as well as the physical needs.

Although health is defined in different ways by many experts, it generally refers to a state of holistic well-being. Therefore, it requires detailed thinking in the design of healthcare spaces. It has been determined that direct communicating with nature, being in harmony with daylight, fresh air and greenery can support the condition of being healthy. At the same time, by contributing to psychological health with the integration of nature in stressful environments created by clinical environments, it has been discussed that patients and visitors can feel better and contribute to healthcare professionals being more productive and happier individuals.

According to studies, direct experience of nature contributes to postoperative recovery by reducing stress and anxiety (Ulrich, 1984). Also, it has been stated that biophilic design elements such as plants, sunlight, air and water provide spatial richness to indoor spaces. Users motivate themselves to heal more by observing life's flow (Sternberg, 2009). In addition, it is stated that it facilitates access to the outside world for employees and they get rid of the overwhelming effect of the clinical environment faster. It is underlined that this situation will be effective in terms of performance and attention for employees (Hung and Chang, 2021). In addition, it is important to mention that the principles of direct experience of nature contribute to a building's thermal comfort as well as its visual appeal in terms of aesthetics (Wijesooriya and Brambilla, 2021).

Among the indirect experiences of nature, natural materials, colors, and organic forms can be listed relating to healthcare environments. It has been observed that the proper use of color has a mood-enhancing effect on staff and patients. This leads to increased work efficiency and a decrease in stress hormones (Hung and Chang, 2021). Natural materials and organic forms, on the other hand, create a sense of belonging among employees and create an inviting environment for patients (Tekin et al., 2023).

The selected principles of experience space and place can be listed as, prospect and refuge, cultural and ecological attachment, transition spaces, mobility and wayfinding. Researches show that those principles can increase socialization and promote a feeling of security for patients and employees if they are implemented in a meaningful way (Tekin et al., 2023). For patients who already have difficulty moving, design interventions such as increased mobility and navigation applications seem to increase comfort. Also, sheltered areas embedded in the design contribute to privacy, which is both important for patients and staff. In addition, use of local materials and ecologic solution which support the cultural attachment to the place, also attract the visual attention. It is common for healthcare workers to work long hours, resulting in a lack of attention and stress. These feelings can lead to wrong decisions or low motivation. The design perception of health spaces that promotes biophilia can offer mental healing as well as physical healing to both patients and employees (Youtube, 2019).

To sum up, adding biophilic design principles into healing environment leads

to reduction of stress and anxiety, regulated blood pressure and creating sensory stimuli (Sternberg, 2009; Hung and Chang, 2021; Tekin et al., 2023). It can be derived that patients or healthcare users can benefit from biophilia, which can be described as "instinctive tendency to connect with nature". In this respect, Kellert and Calabrese (2015) suggested a framework for implementing effective biophilic design into built environments which were detailed in previous chapters. It seems that, these principles may contribute to healing process. In this study, it is discussed how healthcare facilities can interact with nature. In the following part, examples of healthcare spaces with biophilic features are examined through the lens of biophilia and with the outlined principles.

4.4. Incorporating Nature into Healthcare Spaces

It has been discussed that communication with nature has important effects on human health and can contribute to healing if used effectively in the light of the principles and values of biophilic design. In order to reach a meaningful application of biophilic design, Kellert and Calabrese (2015) presented several design principles. These principles are gathered under three main headlines for experiencing nature; direct experience of nature, indirect experience of nature and lastly experience of space and place.

Briefly, direct experience of nature referring the tangible interaction with the environment such as plants, natural light, water, landscape in urbanized areas (Kellert and Calabrese, 2005). The indirect experience of nature, refers to communicating with nature in a resembling manner, by the metaphor or representation of nature (Kellert and Calabrese, 2015). Nature-inspired forms and materials, paintings can be regarded as elements of this experience. The experience of space and place, demonstrates the spatial features that have the potential to foster health and well-being in the built environment with the features of mobility, broad vision, sheltering and etc. (Kellert and Calabrese, 2015).

In order to discuss these experiences in the context of healthcare spaces, the parameters that categorized under the three explained points are mentioned referring to works that have been completed in the last decade or so. Examples of Maggie’s Center in Yorkshire, Khoo Teck Puat Hospital, Royal Children Hospital, Butaro Hospital and Friendship Hospital, which are thought to have biophilic elements, are

discussed in terms of the selected parameters which is shown in Table 3.1. The examples are geographically diverse and include buildings from Bangladesh to Australia and range from hospices for terminally ill patients to children's hospital. Architecturally speaking, these works are designed with a concern to establish connections with their immediate natural environment. The presentation of the selected parameters of the aforementioned biophilic design will be discussed through examples and supported by visuals. It is aimed to recognize biophilic approaches in the design of health spaces and to set an example for future designs in terms of better interaction with nature.

First of all, the general design approach of Maggie's centers will be discussed briefly. Then, an example of one of these approaches, Maggie's Yorkshire, will be examined in light of selected criteria. Maggie's Centers, these centers have been specially designed for patients suffering from cancer and their families, and has made many design decisions to support both health and well-being of the users. After the first headquarters of Maggie's Center, which was opened in Edinburgh in 1996, continue to spread around the world and as far as more than 30 branches have been opened (Pilosof and Grobman 2021). Maggie's Cancer Care Center is an internationally established healthcare institution with the integration of indoor and outdoor spaces and healthcare that supports medical treatment. It was founded by Maggie Keswick and Charles Jenks in 1995 and was designed by various architects in different regions of the world for the same purpose. This aim is to provide an alternative treatment center for cancer patients who are going through difficult processes (Annemans et al., 2012). Medical care for cancer is a delicate field because it affects all aspects of life physically and psychologically, resulting in intense emotions such as fear and anxiety. (Tekin et al., 2022). For this reason, all kinds of treatment places are valuable for patients and their relatives who struggle with the fear of death. According to the study which involving 474 patients, it is found that creating calming and warm environment is crucial for Meggie's Cancer Care Centers (Tekin et al., 2022). To create this desired environment, a brief has been published informing the architects about the design requirements. While this brief provides an individual healing environment, it also supports social communication. This brief includes a list of required areas and recommendation for designers to design an environment that is welcoming while providing privacy (Annemans et al., 2012).

According to Tekin et al. (2022), when the design decisions which referring to biophilia parameters implemented, it has been found that patients generally feel more comfortable and welcoming. Another research about Maggie Cancer Care Center, conducted by Pilosof and Grobman (2021) which aim is to support the integration of Evidence-Based Design approach in healthcare architecture The results of the research show that it is highly advantageous to implement evidence-based design in providing healthy environment to patients in order to increase awareness of the impact of biophilic design on the well-being (Pilosof and Grobman 2021).

This clinic which located in United Kingdom, was designed by Heatherwick studio in 2020 and covers an area of 462 square meters (Archdaily, 2021). I will discuss the selected parameters in Maggie's Yorkshire, under the main points represented by Kellert and Calabrese.

Direct experience of nature: In the design of this center great importance is given to *natural light* which emphasized in Maggie's Brief (2015). In Maggie's Yorkshire it was supported by items such as open plan and large windows and a clerestory (Archello, 2022). Exposure of daylight increases patients' commitment to life and joy. The reason why nature is always in motion somehow and to see the cycle of day lead to feel alive (Tekin et, al. 2022). Parameter of plant in built environment, considered as prominent issue in biophilic design (Kellert and Calabrese, 2015). In Maggie's Yorkshire, there are different features that meet the plant parameter, such as potted plants and roof gardens. Especially with the potted plants giving the homily feeling and attachment to the patients (Figure 7,8). In the research of Tekin et al, 2022, many patients claimed that, plants and gardens increasing the effect of healing. The reason behind can be, greenery stimulating the sensory experience of sight, touch and smell at the same time. Another issue is thermal comfort which is essential for cancer patients who tend to be cold in general (Tekin et al., 2022). For this reason, ventilation, air conditioning, door and window openings are important. In this center we can observe many operable windows and ventilation system. The shape and positioning of the building are especially designed to provide air circulation (Youtube, 2022). Maggie's Yorkshire refers to the direct experience of nature by the features such as the plants, roof garden, windows, clerestory that supporting natural light and air. However, landscape and ecosystem parameter not adequately meet. When viewed from the window, only the clinic's

small garden stand out since the clinic is surrounded by buildings. It is also observed that there is a lack of integration of water parameter in the design which is also important feature of direct experience.

Figure 7. Outdoor greenery, Maggie's Center Yorkshire (Source: archdaily.com, 2021).

Figure 8. Indoor plants, Maggie's Center Yorkshire (Source: archello.com, 2022).

Indirect experience of nature: In the design of Maggie's Centers, furnishing, the use of natural materials and organic forms were considerably important compared to other healthcare settings to create a welcoming environment (Tekin et al., 2022).

Most of these centers, the use of wood, natural fabric and texture is common in design. In addition to adding coziness to the environment, textured materials are widely used in Maggie's Yorkshire. The use of porous limestone, cement floor finishing and wood created a space that enhancing inviting environment (Youtube, 2021). Using rounded processed timber stands out as an element that is particularly reminiscent of nature. Also, green colors are stands for reminders of nature which are used in furnishing which positioned to encourage social interaction (Figure 9,10). Likewise, we can see the dominance of curvilinear forms especially in pillars. Those properties referring the indirect experience of nature represented by Kellert and Calabrese (2015). The assessment of the clinic indicated that all criterion determined in this study for indirect nature experience was satisfied.

Figure 9. The use of natural materials and forms in Maggie's Center Yorkshire (Source: architonic.com, 2020).

Figure 10. The use of natural materials and colors Maggie's Center Yorkshire (Source: arcdaily.com, 2021).

The experience of space and place: In a spatial manner, plan layout is vital for successful design. In the layout of Maggie's Yorkshire plan, open plan approach is used which fosters the broad vision (Figure 11). Also, it increases patient safety which is one of the headings of evidence-based biophilic design (Tekin et al.,2022). The prospect and refuge criteria provided by windows with vistas while integration of private rooms. In this clinic, all the adjacent areas are connected to the garden through a welcoming open space, providing guests with an easy way to move (Archello, 2022). Also well-defined entrance increasing the mobility. Open plan layout (Figure 12) also enhancing socialization and reduce the classical hospital-like appearance with the lack of long corridors and complexity. This favored by designers and patients and may be helpful for experience of space with cultural interaction (Tekin et al., 2022). Open floor plans have been praised by architects, patients, and visitors, but some have suggested they reduce privacy and the sense of enclosed space. This situation may lessen the experience of space and place in the context of refuge and prospect according to discourse of Kellert and Calabrese (2015).

Figure 11. Visual connection in Maggie's Center in Yorskhire (Source: archello.com, 2022).

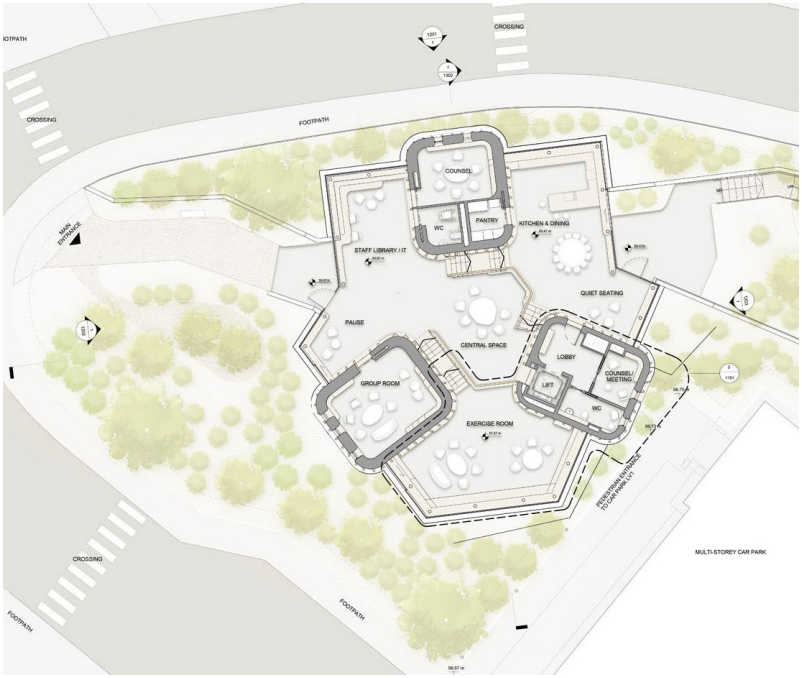

Figure 12. Open-plan layout of Maggie's Center Yorkshire (Source: heatherwick.com, 2023).

One of the characteristics of these centers is there is no front desk in entrance

and this provides an impressive entrance area and enhances the spatial experience (Annemans et al., 2012). According to Annemans et al. (2012), the absence of an authorized person at the front desk emphasizing the equality among individuals and providing patients more inclusive environment and speeding up communication with other patients. According to Tekin et al. (2022), absence of front desk may empower the patterns of prospect and refuge and transitional space which defined by Kellert and Calabrese. Local plants used in garden design increased cultural attachment to the place (Youtube, 2022). However, lack of wayfinding features can be inspected which may resulted in the feeling of lost and creating stress. The transition spaces between the different phases are also not defined. In all case, Maggie's Yorkshire enhancing the experience of space and place and be the spark of patients to interact with each other and so associated with homely feeling.

Regarding to the comments of users and patients, it seems that Maggie's Cancer Care Centers are considered as most effective center. The results of the study showed that designing healing environments requires spatial experience, commitment, and creativity (Annemans et al., 2012). Bringing a new approach to the concept of cancer care, Maggie's Centers primarily aims to support the patient emotionally and socially (Pilosof and Grobman, 2021). In these care centers, the only purpose is not only to cure the disease, but also to give them a feeling of home by using natural elements, and to revive their pleasant memories (Tekin et al., 2022).

Maggie's Yorkshire also following the attempts of all centers. Although the direct and indirect experience criteria of nature are evidently applied at this clinic, deficiencies have been observed regarding the experience of space and place. The design approach of Maggie's Center in Yorkshire can be considered as biophilic by incorporating and praising nature in its designs.

Khoo Teck Puat Hospital, which was built in Singapore and opened in 2010, has a tropical climate dominated by humidity and rain, is one of the examples that highly incorporates nature into the design. It is stated that through design interventions, aimed to move away from the unfamiliar and sterile environment of the hospital (Designsingapore.org). This hospital is considered to be the first green hospital in its region (Modi and Parmar, 2020). Therefore, patients and healthcare professionals can interact with the natural landscape at every opportunity, since it was designed to harness the healing power of nature. (Modi and Parmar, 2020).

Khoo Teck Puat will be examined due to its biophilic criteria.

Direct experience of nature: It can be observed that, glass walls, balconies and courtyards were integrated into design. At the same time, the skylight used on the ground floor allowed daylight to spread throughout the interior. These features, including the shape of the building mass, were created to support natural ventilation and lighting (Designsingapore.org). In garden design, it aims to contribute to healing by creating areas that are thought to be good for the users' psychology with an emphasis on vitality and continuous growth. The vegetation was installed by the roof garden, courtyard and planted pots (Designsingapore.org). Also, with its healing gardens aiming to reduce the stress level of the patients and established a therapeutic healing environment (Figure 13). The hospital is distinguished by its greenery, some of which is free to the public use (Designsingapore.org).

Figure 13. The use of green elements in design of courtyards, Khoo Teck Puat (Source: architizer.com, 2022).

Water, another element of direct contact with nature, has been used extensively in interior and environmental design. The lake existing in the field was included in the design and supported with garden elements (Figure 14). Also, the lake and contributing to the surrounding which refer to natural landscape and ecosystem. In this hospital, where natural landscape elements were included, windows are used in many spaces, giving the patient rooms the opportunity to direct contact with nature (Designsingapore.org).

Figure 14. Integration of water and vegetation in design (Source: divisare.com, 2022).

Indirect experience of nature: The use of natural materials and colors stand out in the interior design. Wooden materials used in furniture and as floor coverings, the predominantly use of natural colors provide the opportunity to experience nature indirectly (Figure 15). All these elements have created a reminder of nature for patients, staff and visitors (Modi and Parmar, 2020). However, the organic forms are not included into design to enhance the indirect experience.

Figure 15. The patient's room in Khoo Teck Puat Hospital (Source: rmjm.com, 2022).

Experience of space and place: In this healthcare space, transition areas have made it easy to move between buildings and contain items that will stimulate to many senses such as auditory and visional. With the use of glass in the transition areas, the outside view of the natural scenery is fostered. It also refers to mobility and wayfinding features (Figure 16). Thus, patients and visitors do not experience the

feeling of being lost and isolated, and experience of encountering nature takes place in unexpected moments. According to Messeidy (2019), various observation and hiding areas were created in the interior of the hospital and aroused the patients' sense of security and movement. The balconies, courtyards and glass walls are contributing to prospect and refuge. At the same time, Teck Puat points to the theme of sustainability by collecting and recycling rainwater (Modi and Parmar, 2020). This rainwater pond points to the natural landscape and the calming power of water, helping patients get away from stress. The pond obtained from the rain water also provided the arrangement of the land in general (Modi and Parmar, 2020). Open to the public, the garden creates an inviting environment that places the hospital closer to the community (Designsingapore.org). This design not only contributes to sustainability, but also supports cultural communication.

Figure 16. The transition areas between buildings, Khoo Teck Puat (Source: earthbound.report, 2020).

It can be said that, the direct experience of nature in this healthcare space is provided effectively with the backing of many patterns. It is observed that that the pond in the land supports the place where it is located ecologically and stimulates the patients audibly and visually also supports the communication within the hospital. This healing environment also incorporates elements that enhance the experience of the space and place, such as its approach to ecological problems and its design process that invites locals to participate. But it is rare to encounter organic forms and natural colors that provide an indirect experience of nature.

Butaro Hospital was established in 2011 in the Burera region, which is the

country's poorest region in terms of health and other resources, and its design was undertaken by Mass Design Group (Archinect, 2011). They have adopted a holistic approach in their design decisions; bringing nature and technology together. This hospital plays a vital role in society, providing healthcare service, which is the civil right, to local and surrounding communities and contributing to well-being (Youtube, 2021). In Burera district with at least 400,000 residents, where there is not even a single doctor (Murphy and Taub, 2010). With the establishing of Butaro Hospital, have brought a lot of renovations in terms of healthcare, learning and technology (Youtube, 2021).

Butaro Hospital supported the use of local materials and local employment and allowed local people to participate in the construction of the hospital. Nightingale was the defender of nature itself and nature in built environment. Adopting the principles of Florence Nightingale, natural light and ventilation were assured in this healthcare setting. (Capolongo et al., 2015). With a capacity of 150 beds, this hospital has been designed with a holistic approach to recovery with respecting local values and natural landscape (Murphy and Taub, 2010). Due to the poor health services, the few treatment centers in the region have become a source of epidemics. Therefore, preventing this situation has become an important design issue (Designboom, 2013). This makes Mass Design Group's first priority. The main design aim is to reduce the spread of the diseases that dominate the region, and for this purpose, staff, patient and visitor circulations have been considered (Massdesigngroup, 2022). This healthcare space, which is thought to progress with the help of selected biophilic design approach, will be examined under three main headings.

Direct experience of nature: As noted, in this region, prevention of airborne diseases was seen as a necessity and landscape design and ventilation strategy is the result of a careful study in this sense. Operable windows that dominate the entire building allow natural daylight. Also, passive ventilation provided with the positioning of windows (Murphy and Taub, 2010). It is also worth noting that these design interventions are effective in meeting the determined biophilic criteria, while also achieving cost savings. (Figure 17).

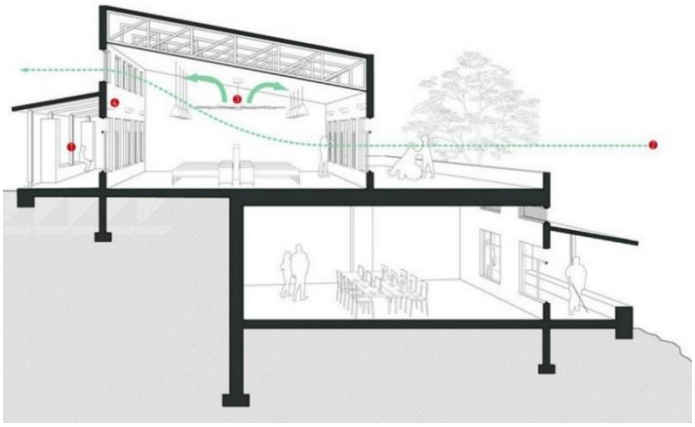

Figure 17. Cross ventilation strategy of Butaro Hospital (Source: designboom.com, 2013).

According to design team, soft landscapes were inhibited the bacterial growth. The trees and flowers added together with the landscape areas provide shade and daylight, while creating pleasant walking areas (Massdesigngroup, 2022). This allows patients to spend more time outside and get in touch with nature (Figure 18). A notable difference between the interior and the exterior of the hospital is that the plant criteria can be clearly observed outside but lack in the inside.

Figure 18. Landscaped walking areas, Butaro Hospital (Source: designboom.com, 2013).

Butaro Hospital was built on a hill, and various terraces were integrated into the design (Figure 19). As has been observed, the selection of the land emphasizes integration with nature and this healthcare setting is in harmony with its

surroundings. This also the emphasis of the biophilic design criteria.

Figure 19. Natural environment of Butaro Hospital (Source: archinect.com, 2011).

The site selection also contributing to natural ventilation and light. At the same time, it acts as a positive distraction for patients, presenting a wide angled natural landscape. These intentions, allow patients immediate touch with nature both inside and outside and foster the direct experience of nature.

Indirect experience of nature: Butaro hospital known for the use of natural material the volcanic stone, which is common in the region (Massdesigngroup, 2022). The gray volcanic stones were applied continuously on several facades (Figure 20), giving the space a certain texture. At the same time, the sitting areas created with stone provided users with a close but indirect contact with nature. These walls, which were created with craftsmen selected from the local people, have an influence on indirect experience of nature (Designboom, 2013).

Figure 20. Local material use in Butaro Hospital (Source: designboom.com, 2013).

However, it can be observed that, natural forms and colors are hardly used. Organic shapes, textiles or furnishings were not used either, and the connotation of nature was limited only by the landscape and natural materials. Also, natural colors are integrated only in patient wards (Figure 21) and in wayfinding tokens.

Figure 21. The use of color in the patients' wards of Butaro Hospital (Source: designboom.com, 2013).

Experience of space and place: Transition areas, consisting of closed and open courtyards, enriched the experience of the space. Separate transitional spaces for doctors and patients also reduce infection risk, as well as for tuberculosis patients were provided isolated rooms and ultraviolet rays used in necessary areas (Murphy and Taub, 2010). The operable windows in the patient rooms allow patients to communicate with the outside world whenever they want, and this fosters the prospect and refugee experiences. Natural vistas are also visible from the windows that enhance the broad vision of users. These design decisions are both preventing the infection and, ensure safe and sheltered areas for patients. The color-coded signs used to prevent contamination also make it easier the patient's wayfinding and increased their mobility. At the same time, walkways supported by landscape, encourage patients to be more mobile and communicate with each other (Massdesigngroup, 2022). Butaro Hospital, has established a respectful communication with nature with its harmonical façade and mass, that does not try to dominate nature. At the same time, the use of volcanic local stone and participation of local craftsmen, creates cultural attachment to this place (Murphy and Taub, 2010). It is worth noting that, besides providing treatment, the Butaro hospital also delivers healthcare education. This institution, which contributes education to many students in the medical field, supports cultural interaction (Youtube, 2021).

In this healthcare facility, direct experience of nature is fully satisfied while there is little emphasis on indirect experiences of nature. We can see various patterns such as prospect and refuge, mobility, wayfinding and cultural attachment under the title of experiencing space and place. Although there are limited opportunities in terms of structure and organization in Rwanda, it is possible to discuss many biophilic parameters mentioned under three main headings in Butaro Hospital.

The Royal Children's Hospital in Melbourne, was designed with the unity of Battle Smart and Billard Leece Partnership in 2011 (Architectureanddesign, 2013). Two existing buildings were combined and a renovation was carried out with a design approach that incorporating nature. This approach resulted in to be awarded as the best health building of the year, by the World Architecture Festival Awards in 2012 (Batessmart, 2012). The designers were aimed to harmonize with the adjacent

natural environment. Royal Children's Hospital has adopted the principle of keeping patients and visitors away from the stressful clinical environment by incorporating many direct and indirect experience features into design (ArchitectureAu, 2012). This healthcare structure was designed by considering the principles of evidence-based design which targeted helping the healing process with creating a peaceful environment (Phiri and Chen, 2014). The Royal Children Hospital offering the users a well-designed physical environment that helps reducing stress and contributing to recovery process (ArchitectureAu, 2012). In this respect, three main biophilic topics, which are claimed to enhance recovery process, will be discussed over this healthcare structure.

Direct experience of nature: With the help of the opening in the ceiling of main entrance, maximum benefit from daylight was obtained and the facade cladding designed according to the angle of the sun to provide a naturally lit environment in the patient rooms (Figure 22).

Figure 22. Façade design in Royal Children Hospital (Source: Batessmart, 2012).

The hospital, which communicates closely with the Royal Park, ensured that the children are intertwined with the greenery and play (ArchitectureAu, 2012). The designed courtyards contributed to the inclusion of the natural environment in the building and facilitated the users' access to the natural environment (Frearson, 2012). This fosters the experience of nature with the criteria of landscape. At the same time,

it can be thought that, these courtyards are expected to allow users to join the flow of life and get rid of the emotions such as stress and anxiety. Indoor and outdoor plants, courtyards and gardens enhanced the direct experience of nature. However, in the patient rooms, only the view from the window was satisfied and there was no greenery (Figure, 23).

Figure 23. Children's patient room in Royal Children Hospital (Source: architectureau.com, 2012).

Water is an important factor in experiencing nature directly. Especially when it comes to children, it becomes more important issue and serve as a positive distraction. The Royal Children's Hospital placed the element of water in various places and emphasized the presence of water, especially with the aquarium (Figure 24) (Frearson, 2012).

Figure 24. The water element in Royal Children Hospital (Source: rch.org.au, 2018).

Indirect experience of nature: The use of natural colors, can be frequently encountered in the design of Royal Children Hospital, from facades to interior design. The use of soft colors, especially appealing to children, can be seen in furniture, wall paints, door and window frames (Figure 25), (ArchitectureAu, 2012).

Figure 25. Soft colors in design (Source: architectureanddesign.com, 2013).

Also, many color schemes are used in patient rooms, waiting areas and even medical operation spaces (Figure,26). These can be observed in paintings, installations and opening claddings (Figure 27). In addition to all these features, the Royal Children's Hospital design includes organic forms. The curvilinear forms were used in circulation areas, façades and furnishings and with this, created a more inviting atmosphere. While natural colors and forms are encountered in this health structure, traditional and natural materials are scarcely encountered.

Figure 26. Use of color in Royal Children Hospital (Source: architectureau.com, 2012).

Figure 27. Examples of indirect experience in Royal Children Hospital (Source: architectureanddesign.com, 2013).

Experience of space and place: The location of the hospital has a continuous, broad view over the natural environment (Figure 28). While this location provides an advantageous situation for prospect, one of the biophilic design parameters, it can make children feel vulnerable and may reduce the parameter of refuge. The use of colors in this wellness space was mentioned above. These colors serve not only the direct experience of nature. At the same time, color codes facilitate the mobility of both children and their families by supporting wayfinding issues which enhance the experience of space and place. Similarly, the designer allows customization in patient rooms, making children feel safer even if they are in a clinical environment (Battessmart, 2012). Transition spaces also well-defined with the integration of color codes and glass material. This hospital also draws attention with its environmentalist approach such as achieving water reuse, taking advantage of natural light and ventilation and adopting energy saving policies (Battessmart, 2012). Those design decisions have contributed to the experience of space.

Figure 28. The natural landscape of Royal Children Hospital (Source: Batessmart, 2012).

The Royal Children Hospital, can be an effective example of integration of nature. It meets most of the biophilic criteria determined within the scope of this study.

The Friendship Hospital located in rural are of Bangladesh, far from the urban spaces. This healthcare structure, designed by architect Kashef Chowdhury, was opened in 2018 and was rated as the best building of the year by the Royal Institute of British Architects in 2021 (Crook, 2022). Architecturally speaking, it can be shown as an example of the effective use of the site, and which is facing environmental problems. The design of this healthcare facility, influenced by the scenery of adjacent riverside (Archdaily, 2021). It has created a built environment in harmony with its natural landscape by adapting to the low-rise buildings and water elements around it (Figure 29). Additionally, this building, was designed with a reasonable budget with limited sources and provides healthcare services to thousands of patients every year. Friendship Hospital, which was deemed worthy of the best building award of 2021, will be discussed under three main headings within the framework of biophilic design principles.

Figure 29. The natural landscape of Friendship Hospital (Source: archdaily.com, 2021).

Direct experience of nature: The courtyards, which are abundantly included in the design, serve as a tool for natural ventilation and at the same time provide natural lighting environment by letting the sunlight in (Crook, 2022). The operation areas are supported by air conditioners and located in the shaded areas, whereas the patient wards are located where natural daylight can be used most efficiently. While the mentioned courtyards serve for natural lighting and ventilation, they also create relaxation areas for patients by giving them the opportunity to contact nature (Figure 30).

Figure 30. The courtyards of Friendship Hospital (Source: archdaily.com, 2021).

Direct experience of nature can be leaded by the use of water and green

elements. In this design, water element is used as a distinctive design decision, it divides the hospital mass into two parts and creates a sharp boundary between patients and in-patients (Figure 31). The water element used here refers to ecological problems; was producing solutions such as cooling the building and converting the accumulated rain water (Archdaily, 2022).

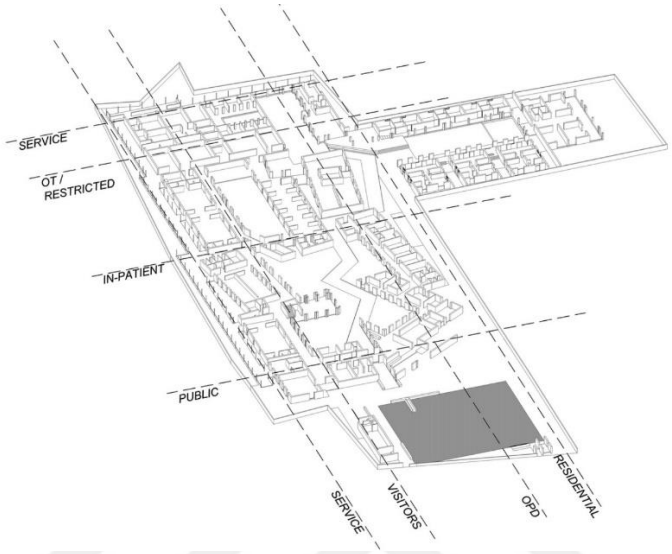

Figure 31. Functional Diagram of Friendship Hospital (Source: archdaily.com, 2021).

At the same time, it was thought that the visual and auditory power of this canal (Figure 32) had a positive distracting effect on patients and reduced stress. Thus, visitors, patients and employees have the opportunity to meet with nature in the built environment (Archeyes, 2021). Designed with respect for its natural environment, this building is of similar height to the houses around it, and a design approach was developed by the architect to solve environmental problems rather than laying another brick.

Figure 32. The canal that harvesting water (Source: archeyes.com, 2021)

Another prevailing element in direct experience of nature is plants. The architect claims that, it can be observed use of green element in the forms of gardens, courtyards and trees (Hossain, 2021). However, it can be observed that, the green element (such as flowers, potted plants, vertical gardens etc.) has not been used interior spaces as often as it is used in outdoor landscape. The greenery that exists in the site itself is lacking in the building scale.

To summarize in terms of biophilic principles of direct experience, natural ventilation and lighting were used in an exemplary way. The created canal, emphasizes the water element and can also be presented as a support to the natural ecosystem. It also refers to the weather principle by contributing to the microclimate inside the building. However, lack of plant element or other living organisms can be observed in interiors.

Indirect experience of nature: The brick material, which refers to the local pattern and was chosen due to its high durability, was used on the flooring and all facades of the building (Figure 33). This local material has been built by the local people and has become the symbol of this healthcare structure. At the same time, on some façades, these bricks were supported by rhythmic openings, aiming to both let

in the daylight and create shaded areas (Crook, 2022).

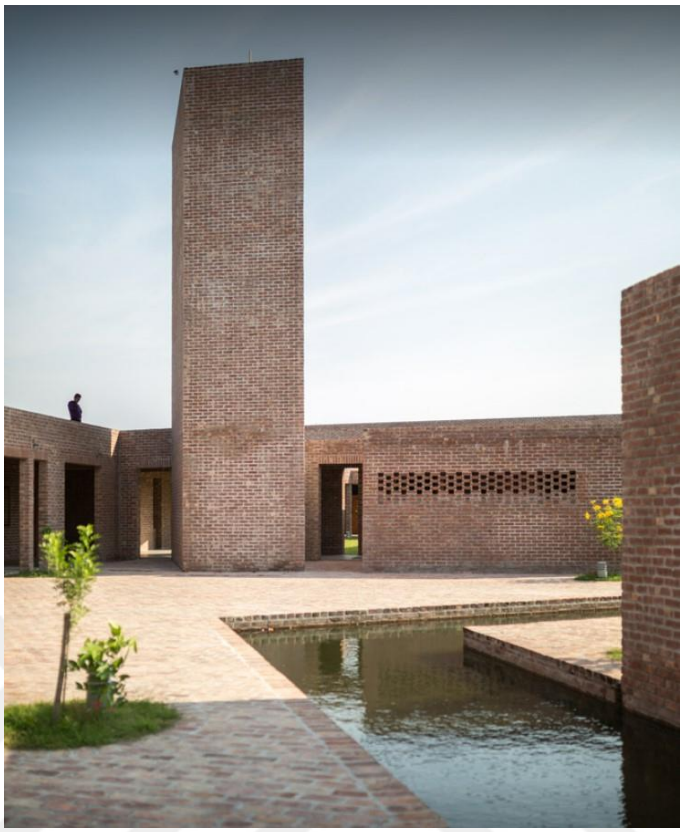

Figure 33. The use of natural material in Friendship Hospital (Source: archdaily.com, 2021).

The use of natural materials can also be observed in wooden window frames and selected interior materials (Figure 34). In addition, the use of naturalistic shapes, a pattern of indirect experience of nature, can be observed in the rhythmic openings created in brick walls. Although the use of natural materials has been intensively implemented, the reminders of nature such as, organic forms, indoor plantings or natural fabrics have not been used in the design of Friendship Hospital. Even if there are a few signs about the indirect experience of nature, it can be said that it is incomplete compared to other examples.

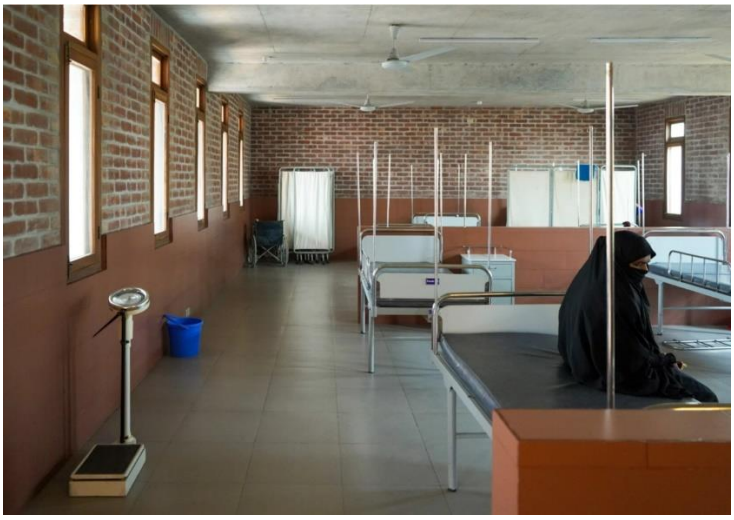

Figure 34. The use of natural materials in interior design (Source: aljazeera.com, 2022)

Experience of space and place: The brick volumes which implemented by local craftsmen and the ecological solutions which are harvesting rainwater and the regulation of microclimate by the canal, referring to cultural and ecological attachment. At the same time, intensive using of local materials and designing with respect to the natural environment, are the factors that enhance the experience of space and place. The outdoor pathways provide sheltered spaces for patients to walk with the view of natural landscape and increase mobility (Archeyes, 2021). Also, for the visitors provide a resting area away from the clinical environment (Figure, 35).

Figure 35. Exterior spaces for patients and visitors in Friendship Hospital (Source: archeyes.com, 2021).

In addition, the designer provided balconies for locals to worship in isolation and playing with the masses, he created private spaces for patients, visitors and caregivers (Figure 36). These design decisions made users feel safe but did not

obstruct the field of view. In this way, biophilic design principles such as the transitional spaces, prospect and refuge, mobility and cultural attachment were pointed out and fostered the experience of the space and place.

Figure 36. Enclosed spaces in Friendship Hospital (Source: aljazeera.com, 2022).

To examine the three main topics of biophilic design, while this hospital includes features related to direct experience of nature, it has missing points regarding indirect experience. The designer has taken a successful stance especially in the experience of the space and place, by taking into account not only the physiological but also the psychological needs of the patients, visitors and caregivers. To celebrate the local people and the environment, it included traditional materials and aimed to meet the needs of the local population. And this resulted in a healthcare space that has been recognized and rewarded by the people living there.

To sum up, studies have shown that, the physical environment has positive effects on healing. Researchers explained that biophilic design can contribute to healing, especially if it is used in a meaningful way. Examples of healthcare spaces from various scales and locations were selected for discussing the principles of biophilic design. Maggie's Yorkshire, Khoo Teck Puat Hospital, Royal Children Hospital, Butaro Hospital and Friendship Hospital, which are thought to have biophilic criteria in their designs.

In Maggie's Yorkshire, it has been observed that, contained many of the parameters required for the direct experience of nature and fully met the in the indirect experience. In this clinic, that provide special care services to the cancer patients, psychological factors are kept in the foreground and so the experience of space and place is highlighted.

In Khoo Teck Puat Hospital, the plant, which is one of the parameters of the direct experience of nature, has been used extensively indoors and outdoors, and a more natural environment has been tried to be created for patients. However, it can be said that the indirect experience of nature is insufficient.

Royal Children's Hospital is seen as the example that uses biophilic design principles most in its design. Many attempts have been made to experience the space directly and indirectly. Experiencing the space was seen as the most important design decision for this hospital, whose target users are children.

Butaro and Friendship Hospitals have similar characteristics due to their approach to local environment and material use. In both hospitals, adapting to their natural environments led to an increased focus on sustainability and elevating the society in which they were located. These hospitals were able to meet many of the criteria of the direct and spatial experiences of nature, but they were remained inadequate to reflect the indirect effects.

The examples and biophilic design principles presented in this study (Table 2). However, are not sufficient to provide solid recommendations for biophilic design. Despite all of these examples' intentions to heal, it has been observed that their design is dictated by climate, cultural background, and the environment in which they are settled. But it can be indicated that it is essential to ensure constant communication with nature so that biophilic design principles can be implemented effectively. Promoting positive interaction between humans and nature reinforces our sense of responsibility and belonging by fostering an emotional connection with space.

Table 2. Summary of selected examples

SELECTED BIOPHILIC DESGIN PRINCIPLES	Direct experience of nature					Indirect experience of nature			Experience of space and place			
	Light	Air	Water	Plants	Natural landscapes and ecosystem	Natural materials	Natural colors	Naturalistic shapes and forms	Prospect and refuge	Transitional spaces	Mobility and wayfinding	Cultural and ecological attachment to place
Maggie's Yorkshire	*	*	*	*		*	*	*	*			*
Khoo Tech Puat Hospital	*	*	*	*	*	*	*		*	*	*	*
Butaro Hospital	*	*		*	*	*			*	*	*	*
Royal Children Hospital	*	*	*	*	*		*	*	*	*	*	*
Friendship Hospital	*	*	*		*	*			*	*	*	*

4.5. Discussion

Although the biophilic design appears to contribute to the visual appeal of the building, it has a broader effect. There is also evidence in the literature that the effects of building-scale sustainability, restorative function for people, and energy conservation are emphasized (Wijesooriya and Brambilla, 2021).

A number of examples were provided to illustrate the effects of biophilic design on human health and well-being. The examples and biophilic design principles presented in this study, however, are not sufficient to provide a solid guide for biophilic design. In Kellert's view, biophilic design should go beyond making just recommendations in the field of practice (Kellert, 2018). In this regard, it is necessary to step back and examine biophilia from all angles.

Firstly, in the literature, biophilia is emphasized as a hypothesis, which is susceptible to different interpretations and may vary from person to person (Gaekwad et al., 2022). Similarly, Joye and De Block criticize the term as being too comprehensive and hypothetical, and they go on to proposing a new definition for

biophilia as “a set of genetic predispositions of different strength, involving different sorts of affective states toward different kinds of life-like things” (Joye and De Block, 200, p.193). They also argue that the idea of biophilia being inherited is inherited evolutionarily is a weak proposition. It is worth to note that the issue of man and nature that is the subject of the biophilia hypothesis is already complicated and multidimensional (Gaekwad et al., 2022). It can therefore be concluded that the principles of biophilic design are also involved in this complexity and that they encounter a number of obstacles while being translated into actual designed environments. Though the restorative effects of biophilic design on humans are emphasized in this study, psychological concerns need to be discussed as well.

A concern about biophilic design, which is prevalent in literature, is underlined by Joye and De Block. Joye and De Block (2011) point out that despite the emphasis on love of nature, nature's negative effects are almost neglected. It is argued that we should also focus on nonrestorative moments when we are in nature. At this point, biophobia appears to be an issue that contradicts with the healing power of nature. Biophobia can be defined as “natural stimuli and configurations that induce avoidance responses” (Kellert and Wilson, 1993, Yost, 2011) of briefly, “fear of nature” (Estok, 2017). According to Ulrich, biophilia and biophobia are both genetically transmitted, and biophobia is just as acceptable as biophilia (Kellert and Wilson, 1993; Yost, 2011). The most common fear in literature revolves around animals like spiders and snakes, but a sense of getting lost can also trigger a biophobia in vast forests. Among 439 young people, snakes, dogs, insects and wildlands were rated as their biggest fear according to a study (Gullone, 2000). Another research conducted by Bixler and Carlisle among 60 student which attended school field trip, reveal that, students are most intimidated by wildland areas because of fear of lost (Yost, 2011). Yost pointed out a growing concern for today's children, who often grow up in cities and feel resentful toward nature, is how we create an awareness of environmental protection when it is so alien to them (2011). That is why, education about nature has become so crucial. Furthermore, there are also fears brought by the modern cities, such as guns and cars, which are more likely to be encountered today. However, research indicates that these fears are less prevalent and easier to overcome than those encountered in nature (Joye and De Block, 2011). Biophobia can be shown as evidence that biophilic design might be not an objective

issue (Joye and De Block, 2011). Since, this situation can vary from person to person, it is uncontrollable in the design phase, but still, it is stated that the positive effects of nature are more dominant (Wijesooriya and Brambilla, 2021). At this point, the role of design is to balance biophobia with biophilia so that restorative environments can be created (Bolten and Barbiero, 2020).

Another psychological concern that needed to be detailed is culture. An argument in the literature that proposes that biophilic design, which contradicts the built environment we live in, is the result of natural selection and cultural learning (Sideris, 2003; Tidball, 2012; Gaekwad et al.,2022). In line with this, culture becomes a notable issue in biophilic design. Kellert and Calabrese stated that, cultural features in built environment affects the level of place belonging (2015). Accordingly, Liu and his colleagues made research about the influence of local elements on urban dwellings. It is stated that, attachment to the place can be improved by creating familiar spaces to its habitants and offered landscape elements that fostering the local identity (Liu et al., 2018). Similarly, according to another research, culture shapes our perceptions of the environment and has an important role to play in nature-human relationships (Fox and Xu, 2017). However, this also emphasizes the ambiguity of biophilic principles due to the fact that culture is a subjective concept and its effects may differ from person to person (Joye and De Block, 2011). The misleading use of cultural elements in the built environment can have adverse psychological effects and might contribute to disinformation (Zhong, Schröder and Bekkering, 2021). Nevertheless, all studies converge on a point, that the city is preferred over nature and even if it comes from culturally different norms (Gullone, 2000). In addition, the studies also highlight concerns about meaningful applications of biophilic design, such as “lack of knowledge, land and legal limitations, durability and cost” (Wijesooriya and Brambilla, 2021, pp. 8-11). Even if architectural structures weren't built specifically to promote biophilia, nature has a long history in architecture. It may be that there is still a lack of information on such a long-standing phenomenon, the subjectivity of biophilia is merely ignored, and there is not enough measurable data (Zhong, Schröder and Bekkering, 2021). Other concerns are regarding how biophilic design should be implemented efficiently. It is known that in accordance with current regulations, there are a number of incentives and restrictions relating to the spatial functions. Integrating nature into the built

environment can result in horizontal expansion. It is possible for this situation to be hindered by regulatory and cost barriers (Zhong, Schröder and Bekkering, 2021). It is stated that with design solutions, the physical obstacles standing in the way of biophilia will be minimized. Addressing psychological concerns in particular may seem like a stringent task, but it is important to solve for meaningful biophilic design implementation.

To sum up, in line with Kellert's view, biophilic design should go beyond making just recommendations in the field of application and should include more concrete data (Kellert, 2018). It is advocated that, in order to determine the effectiveness of a project, these principles should be measurable through rigorous experiments (Bolten and Barbiero, 200). In this way the knowledge and experience deficits that impede biophilia can be overcome to some extent.

CHAPTER 5: CONCLUSION

It can be argued that human beings, which are deemed to be inseparable from nature, have developed their relationship with nature according to a utilitarian perspective throughout history. They tended see nature as 'consumable', in order to maintain their own existence (Louv, 2008). Since the 18th century, they have been subject to the consequences of the aforementioned viewpoint. The lack of contact with nature, which leads to disregarding human instincts, negatively impacts well-being and quality of life. These effects include increased stress levels, impaired cognitive function, fatigue, reluctance to engage in physical activity, and depression (Browning, Ryan and Clancy, 2014).

This thesis examines the effectiveness of architecture in healing, focusing on healthcare spaces that directly influence the users' health. Studies show that ignoring human connection with nature and neglecting to engage with the vital processes of nature are detrimental to our physical and psychological well-being. In line with this, the concept of biophilia, which argues for an innate bond with nature, has emerged and it is argued that this bond can be strengthened through experiencing nature. Researchers argue that that instinctual human connection with nature can be revitalized by fostering place attachment and repeating engagement with nature. We can experience its benefit in terms of an increase in the quality of our social and individual lives (Kellert and Calabrese, 2015).

Researchers have studied how biophilia can contribute to healing if used effectively in the light of biophilic design principles and values. In order to reach a meaningful practice of biophilic design, Kellert and Calabrese (2015) presented several design principles. This thesis discussed the biophilic design principles under three subheadings and checked these principles against empirical data as illustrated by actual healthcare spaces.

Specifically, environments that reduce human instinct for shelter are formed as being opposed to human nature and completely disconnected from nature, and these structures, primarily hospitals, have a negative effect on human psychology and health. In today's hospitals, the quantitative factors of the long recovery period, and the low rate of recovery were caused by lack of integration with nature. This led to a situation where patients were unsatisfied and medical staff were underperforming. In

this context, researchers from different disciplines expressed the characteristics of biophilic design that should be considered in architectural design.

Biophilic design aims to prevent harm to ecological systems and people, while contributing the holistic well-being and health of people. It is possible to positively affect the healing processes and influencing the mood of the patient by adding biophilic design qualities to the design of healthcare facilities. In this study, it was aimed to examine and evaluate the impact of biophilic design on patients' recovery processes and overall well-being. In conclusion, it can be argued that adopting biophilic design principles in the design of healthcare spaces may benefit human health and well-being in several ways. Provide psychological restoration that affects quality of life, well-being, and productivity. Researches shows that integrating nature into healthcare settings may improve postoperative recovery and treatment outcomes (Ulrich, 1984; Sternberg, 2009). Furthermore, it was reported that aggression, depression, anxiety, lack of attention, mental fatigue, and stress were decreased, which are frequently seen in hospital environment.

In this study, biophilic design principles were discussed whether can be used as an instrument to foster the therapeutic and welcoming environment. In order to support this discussion, healthcare facilities assumed to have biophilic characteristics were selected and evaluated with parameters appropriate for the healthcare setting. While all of these examples are intended to heal, their design is influenced by weather conditions, cultural backgrounds, and their surrounding environments. But it can be suggested that biophilic design principles can be effectively implemented by maintaining constant communication with nature. Also, it is worth noting that biophilia is emphasized as a hypothesis, which is susceptible to different interpretations.

The present study provides evidence that biophilic design principles could be effective in integrating nature in healthcare settings. However, further evaluation will be needed to determine their impact on health and well-being.

REFERENCES

Agnihotri, K. (2022) Places of healing. *Canadian Family Physician*, Vol. 68(7), pp. 487-489.

Adams, A. (2008) Medicine by design: The architect and the modern hospital, Vol. 187(16) pp.1893-1943. University of Minnesota Press.

Annemans, M., Van Audenhove, C., Vermolen, H. and Heylighen, A. (2012) What makes an environment healing? Users and designer about the Maggie's Cancer Caring Centre London. Proceedings of the 8th International Design and Emotion Conference, London: Out of Control, pp. 1-8.

Amy Frearson (2012). *"We convinced doctors to move to an open-plan wing" - Kristen Whittle and Ron Billard* [Online]. Available at: https://www.dezeen.com/2012/10/25/weve-pulled-doctors-away-from-their-wards-kristen-whittle-and-ron-billard/ . (Accessed: 5 November 2022).

ArchDaily. (2021). *Friendship Hospital Satkhira / Kashef Chowdhury/URBANA* [Online]. Available at: https://www.archdaily.com/926305/friendship-hospital-satkhira-kashef-chowdhury-urbana. (Accessed: 02 January 2023).

Archello. (2022). *Maggie's Leeds / Yorkshire* [Online]. Available at: https://archello.com/project/maggies-leeds

Archeyes. (2021). *Friendship Hospital in Bangladesh / Kashef Chowdhury / URBANA* [Online]. Available at: https://archeyes.com/friendship-hospital-in-bangladesh-kashef-chowdhury-urbana/. (Accessed 02 January 2023).

Archinect. (2012). *ShowCase: Butaro Hospital in Rwanda* [Online]. Available at: https://archinect.com/features/article/16646139/showcase-%20butaro-hospital-in-rwanda

(Accessed: 1 January 2023).

Architectureanddesign. (2013). *The Royal Children's Hospital* [Online]. Available at: https://www.architectureanddesign.com.au/projects/health-aged-care/the-royal-children-s-hospital# (Accessed: 3 January 2023).

ArchitectureAU. (2012). *The Royal Children's Hospital* [Online]. Available at: https://architectureau.com/articles/2012-australian-interior-design-awardscolour-in-commercial-design/ (Accessed: 5 November 2022).

Batessmart. (2022). *Bridging the gap between nature and healing Royal Children's*

Hospital [Online]. Available at: https://www.batessmart.com/projects/royal-childrens-hospital (Accessed: 5 January, 2023).

Brown, P. (2013) A National Framework for Recovery-Oriented Mental Health Services: Guide for Practitioners and Providers. Australia: *Australian Health Ministers' Advisory Council*.

Browning, W.D., Ryan, C.O. and Clancy, J.O., (2014) *14 Patterns of Biophilic Design: Improving Health & Well-Being in the Built Environment*. Terrapin Bright Green,LLC

Capolongo, S., Bottero, M., Buffoli, M., and Lettieri, E. (2015) *Improving sustainability during hospital design and operation*. Springer International Publishing, doi, 10, 978-3.

Designboom. (2013). *MASS design group completes butaro hospital in rwanda* [Online]. Available at: https://www.designboom.com/architecture/mass-design-group-butaro-hospital-rwanda/ (Accessed: 2 January 2023).

Designsingapore. (2011). *Khoo Teck Puat Hospital* [Online]. Available at: https://pda.designsingapore.org/presidents-design-award/award-recipients/2011/khoo-teck-puat-hospital.html (Accessed: 2 January 2023).

Erikson, M. (2013) An integrative review of what contributes to personal recovery in psychiatric disabilities. *Issues in Mental Health Nursing*, Vol. 34(3), pp.185-191.

Estok, S.C. (2017) Material ecocriticism, genes, and the phobia/philia spectrum. *Neohelicon*, Vol. 44 (2), pp. 297-313.

Firth, K., Smith, K., Sakallaris, B. R., Bellanti, D. M., Crawford, C., and Avant, K. C. (2015) Healing, a Concept Analysis. *Global Advances in Health and Medicine*, Vol.4, pp.44-50.

Fox, D., Xu, F., (2017) Evolutionary and socio-cultural influences on feelings and attitudes towards nature: a cross-cultural study. *Asia Pacific Journal of Tourism Research*, Vol. 22 (2), pp. 187-199.

Frumkin, H. (2001) Beyond toxicity: human health and the natural environment. *American Journal of Preventive Medicine*, Vol. 20(3), pp. 234-240.

Gaekwad J.S., Moslehian A.S., Roös P.B., Walker A. (2022) A meta-analysis of emotional evidence for the biophilia hypothesis and implications for biophilic design [systematic review]. *Frontiers in Psychology*, Vol.13, pp.1-7.

Gesler, W. M. (2003) *Healing Places*. Lanham: Rowman and Littlefield Publishers.

Hamilton, D. K., and Watkins, D. H. (2008) E*vidence-based design for multiple building types*. Canada: John Wiley & Sons.

Gullone, E. (2000) The Biophilia Hypothesis and Life in the 21st Century: Increasing Mental Health or Increasing Pathology? *Journal of Happiness Studies*, Vol.1(3), pp. 293-322.

Heatherwick. (2022). *Maggie's Yorkshire – Leeds, United Kingdom* [Online]. Available at: https://www.heatherwick.com/projects/buildings/maggies/ (Accessed: 6 February 2023)

Heikinheimo, M. (2016) Architecture and Technology: Alvar Aalto's Paimio Sanatorium. Doctoral's dissertation, Finland: *Aalto University*.

Hosking, S. and Haggard, L. (1999) *Healing the Hospital Environment Design, management and maintenance of healthcare premises*, London: Taylor & Francis.

Hossain, S. (2022). *A Bangladesh hospital is world's 'best new building'* [Online]. Available at: https://www.aljazeera.com/gallery/2022/1/31/pictures-world-best-new-building-bangladesh-friendship-hospital-riba-award (Accessed: 5 January 2022).

Huiting, X. (2013) Recovery in mental illnesses: A concept analysis. *International Journal of Caring Sciences*, Vol.6, no.3, pp.439-450.

Hung, S. H., and Chang, C. Y. (2021) Health benefits of evidence-based biophilic-designed environments: A review. *Journal of People, Plants, and Environment*, Vol. 24(1), pp.1-16.

Joye, Y. and De Block, A. (2011) "Nature and I are Two": A Critical Examination of the Biophilia Hypothesis, *Environmental Values*, Vol. 20, no.2, pp. 189–215.

Kaplan, R. (1983) *The Role of Nature in the Urban Context.* In: Altman, I., Wohlwill, J.F. (eds) Behavior and the Natural Environment. Human Behavior and Environment, Vol 6. Boston: Springer.

Kellert, SR. (2005) *Building for Life: Designing and Understanding the Human–Nature Connection*, Washington, DC: Island Press, p. 4.

Kellert, S., and Calabrese, E. (2015) *The practice of biophilic design*. London: Terrapin Bright LLC.

Kellert, SR. (2018) *Nature by Design: The Practice of Biophilic Design*, Yale University Press.

Kellert, S., Heerwagen, J. and Mador, M. (2008). *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. New Jersey: John Wiley and

Sons.

Kisacky, J. (2017*) Rise of the Modern Hospital: An Architectural History of Health and Healing*, 1870-1940. Pittsburgh: University of Pittsburgh Press.

Lichtenstein, A. H., Berger, A., and Cheng, M. J. (2017) Definitions of healing and healing interventions across different culture. *Annals of Palliative Medicine*, Vol. 6(3), pp.248-252.

Liu, Q., Fu, W., van den Bosch, C.C.K., Xiao, Y., Zhu, Z., You, D., Zhu, N., Huang, Q., and Lan, S., (2018) Do local landscape elements enhance individuals' place attachment to new environments? A cross-regional comparative study in China. *Sustainability*, Vol. 10(9), pp.2-17.

MacKenzie D.J. and Galbrun, L., (2007) Noise levels and noise sources in acute care hospital wards. *Building Services Engineering Research and Technology*, Vol. 28, pp.117-131.

Maggie's, K.J.C.T., (2015) *Maggie's Architecture and Landscape Brief Maggie's Centres* Background.

Marcus, C.C., and Sachs, N.A. (2013) *Therapeutic landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces*. New Jersey: John Wiley & Sons.

Massdesigngroup. (2022) *Butaro District Hospital* [Online]. Available at: https://massdesigngroup.org/work/design/butaro-district-hospital (Accessed: 6 November 2022).

Messeidy, R. (2019) Application of biophilic patterns in health care environments to enhance healing. *Engineering Research Journal*, Vol. 163, pp.130-143.

Modi, K. and Parmar, S. (2020) Understanding biophilia and its integration with architecture. *International Journal of Scientific and Engineering Research*, Vol. 11(5), pp. 1403-1440.

Moslehian, A.S., Roös, P.B., Gaekwad, J.S., and Van Galen, L. (2023) Potential risks and beneficial impacts of using indoor plants in the biophilic design of healthcare facilities: A scoping review. *Building and Environment*, Vol. 233, pp.1-12.

Murphy, M. and Mansfield, J. (2017) Can architecture heal? Building as instruments of health. *Architectural Design*, Vol. 87(2), pp. 82-89.

Murphy, M. and Taub, M. (2010) The Problem and Potential of Sustainable Design in Resource Poor Settings: Cases from Rwanda. *ATDF Journal*, Vol.7, pp. 24-29.

Ojamaa, H. (2015) Enhancing The Human-Nature Connection Through Biophilic Design in the Built Environment. Washington: ArchitectureHigh Performance Building, pp. 30-31.

Olmsted, F. L., (1865) The value and care of parks. Report to the Congress of the State of California (Reprinted in Landscape Architecture), Vol. 17, pp.20-23.

Louv, R., 2008. In: Kellert, S.R., Heerwagen, J.H., Mador, M.L. (Eds.), *Children and the Success of Bipphilic Design, Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. Hoboken: John Wiley & Sons, pp. 206-221.

Phiri, M. and Chen, B. (2014) *Sustainability and evidence-based design in the healthcare estate*. Berlin: Springer.

Pilosof, N. P. and Grobman, Y. J. (2021) Evidence-Based Design in Architectural Education: Designing the First Maggie's Centre in Israel. *HERD: Health Environments Research & Design Journal*, Vol. 14(4), pp. 114-129.

Plummer, K. (2018) *Sustainable Healing: Rethinking Cancer Center Design*. OhioLINK Electronic Theses and Dissertations Center. http://rave.ohiolink.edu/etdc/view?acc_num=ucin1522341437826741

Rohde, C. L. E. and Kendle, A. D. (1994) Human well-being, natural landscapes and wild life in urban areas. *English Nature Science Report*, Peterborough. Vol. 22, p.60.

Shi, Z., Qian, H., Zheng, X., Lv, Z., Li, Y., Liu, L. and Nielsen, P.V., (2018) Seasonal variation of window opening behaviors in two naturally ventilated hospital wards. *Building Environment*. Vol.130, pp.85-93.

Signoretta, P., McMahon Moughtin, K. and Moughtin, J.C. (2009) *Urban Design: Health and the Therapeutic Environment* (1st ed.). Routledge. https://doi.org/10.4324/9780080885377

Sternberg, E. M. (2009) *Healing spaces: The science of place and well-being*. Cambridge, Mass: Belknap Press

Tekin, B. H., Corcoran, R. and Gutiérrez, R. U. (2022) The impact of biophilic design in Maggie's Centers: A meta-synthesis analysis. *Frontiers of Architectural Research*, Vol.12, pp.188-207. https://doi.org/10.1016/j.foar.2022.06.013.

Tekin, B.H., Corcoran, R. and Gutierrez, R.U. (2023) A Systematic Review and Conceptual Framework of Biophilic Design Parameters in Clinical Environments, *Health Environments Research & Design Journal* Vol. 16(1), pp. 233-250.

Ulrich, R.S. (1984) View through a window may influence recovery from surgery.

Science. Vol. 224(4647), pp.420-421.

Ulrich, R.S., (1993) *Biophilia, biophobia, and natural landscapes.* In: Kellert, S.R., Wilson, E.O. (Eds.), *The Biophilia Hypothesis*. Island Press, pp. 73-137.

Van den Berg, A. E. (2005*) Health impacts of healing environments; a review of evidence for benefits of nature, daylight, fresh air, and quiet in healthcare settings*. Groningen: UMCG.

Weinberger, A. B., Christensen, A. P., Coburn, A. and Chatterjee, A. (2021) Psychological responses to buildings and natural landscapes. *Journal of Environmental Psychology*, Vol. 77.

Westin. A. F. (1970) Privacy and Freedom. New York: Wash. & Lee L. Rev, Vol.25(1), pp.166-170.

Willis, J., Goad, P. and Logan, C. (2018) Architecture and the modern hospital: Nosokomeion to Hygeia. *Routledge*.

Wilson, E. O. (1986) *Biophilia*. Cambridge: Harvard University Press.

Zhong, W., Schröder, T. and Bekkering, J. (2022) Biophilic design in architecture and its contributions to health, well-being, and sustainability*:* A critical review. *Frontiers of Architectural Research*, Vol. 11(1), pp. 114-141.

[DW Euromaxx]. (2021, June 16). *Can Architecture Help You Heal?* [Video File]. Available at: https://www.youtube.com/watch?v=IxBe5rCKbH4&t=55s

[Partners in Health]. (2021, December 17). *The Promise of Butaro District Hospital: Key Facility Meets Growing Demand, Need for Expansion* [Video File]. Available at: https://www.youtube.com/watch?v=9ZecZBfMtGw

[TedMed]. (2019, February 6). *Using biophilic design to heal body, mind, and soul* [Video File]. Available at: https://www.youtube.com/watch?v=uAmbZCtNC9U