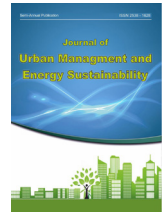


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CASE STUDY RESEARCH PAPER

Investigating the Impact of Biophilic Architectural Criteria on Citizens' Mental Health

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ABSTRACT

Biophilic architecture, as an emerging approach in the design of the built environment, plays an important role in enhancing quality of life and citizens' mental health by emphasizing the reconnection of human beings with nature. Given rising urban density, the reduced connection with nature and the psychological consequences of living in artificial environments, the present study set out to investigate the impact of the criteria of biophilic architecture on citizens' mental health. Adopting a qualitative meta-synthesis approach based on the seven-step framework of Margarete Sandelowski and Julie Barroso, the research corpus comprised scholarly articles, doctoral dissertations and credible national and international sources published between 2010 and 2025. After a systematic search and the application of inclusion and exclusion criteria, 36 studies were selected for the final analysis. The data were analyzed through open, axial and selective coding. The findings revealed that the biophilic architectural criteria affecting citizens' mental health can be classified into three main components: nature-oriented spatial and place experience, connection with nature, and mental health and environmental perception. The results indicate that criteria such as natural daylight, green elements, environmental quality and visual connection with nature play the greatest role in reducing stress, increasing psychological calmness, strengthening concentration, enhancing cognitive performance and increasing satisfaction with the environment. Finally, the conceptual model of the study explains the causal chain of the impact of biophilic architectural criteria as connection with nature, nature-oriented spatial experience, environmental perception to mental health.

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INTRODUCTION

Architecture and the design of built environments have always played a role beyond meeting the functional needs of human beings and are recognized as one of the factors affecting people's physical and mental health. In recent decades, rising urban density, the reduced connection of humans with nature and the spread of artificial environments have raised growing concerns about the psychological consequences of urban life (Kellert & Calabrese, 2015). Among the most important novel approaches to environmental design, biophilic architecture emphasizes restoring the innate connection of human beings with nature in built spaces and seeks, through integrating natural elements and nature-inspired patterns into architecture, to enhance users' quality of life and mental health (Wilson, 1984). The concept of biophilia rests on the assumption that human beings have an innate tendency to connect with nature and that deprivation of this connection can carry numerous negative consequences for mental health (Joye & De Block, 2011). Mental health, as one of the main pillars of sustainable urban development, is not limited to the absence of mental illness; it also includes a sense of life satisfaction, psychological calmness, the ability to cope with everyday tensions and the enjoyment of a good quality of life (World Health Organization, 2022). Numerous studies have shown that the features of the physical environment can play a decisive role in shaping citizens' psychological state, and that the inappropriate design of urban environments prepares the ground for increased stress, anxiety and depression and for a reduced sense of place attachment (Evans, 2003). By contrast, spaces that afford interaction with natural elements can improve cognitive functioning, reduce psychological tension and strengthen the sense of satisfaction and vitality in people (Kaplan & Kaplan, 1989). In this regard, biophilic architecture, as a bridge between the artificial environment and nature, has attracted wide attention among researchers in architecture, environmental psychology and

urban planning. Through employing criteria such as the direct presence of nature, the use of natural light, appropriate ventilation, the use of vegetation, natural views, biomorphic patterns, natural materials and the creation of a sense of refuge and prospect, this approach can enhance users' spatial experience (Browning et al., 2014). Studies show that the presence of biophilic elements in urban environments and buildings is significantly associated with reduced levels of stress hormones, improved concentration, increased positive mood and enhanced mental health (Ryan et al., 2014).

On the other hand, the rapid growth of urbanization in developing countries has reduced the per-capita share of green space and limited citizens' daily opportunities for contact with nature (Beatley, 2016). In many metropolises, the physical development of cities has taken place without sufficient attention to residents' psychological needs, and this has prepared the ground for an increase in mental-health problems (Lederbogen et al., 2011). In such circumstances, biophilic architecture can act as an effective strategy for recreating natural qualities in urban environments and compensating for part of the negative effects of urban life (Kellert, 2018). Despite the growth of global studies on biophilic architecture, in many domestic studies the relationship between biophilic criteria and the various dimensions of citizens' mental health has not yet been examined comprehensively. A major part of the research conducted in Iran has focused on the aesthetic or environmental aspects of design, with less attention to the psychological consequences of the built environment (Habibi et al., 2021). This research gap has meant that the real role of biophilic components in enhancing citizens' mental health and quality of life has not been fully explained. The importance and necessity of this research arise from the fact that citizens' mental health, as one of the key indicators of human development, is directly affected by the quality of living environments. Understanding the criteria of biophilic architecture and the manner of their

effect on the various dimensions of mental health can prepare the ground for designing spaces that, besides meeting functional needs, lead to enhanced psychological calmness, reduced stress, greater life satisfaction and a strengthened sense of belonging to the environment (Ulrich et al., 1991). Accordingly, the main aim of the present study is to investigate and analyses the impact of the criteria of biophilic architecture on citizens' mental health, by identifying the most important biophilic criteria affecting mental health, examining the degree of the effect of each of these criteria, and offering a framework for applying biophilic components in the design of urban and architectural environments.

MATERIALS AND METHODS

In recent decades, alongside the rapid growth of urbanization and the increasing distance of human beings from natural environments, the attention of researchers in architecture, urban planning and environmental psychology to the role of nature in enhancing mental health has grown. Among these, biophilic architecture has been proposed as a human-centered approach that seeks to recreate the innate bond of human beings with nature in the built environment. The theoretical root of this approach goes back to the "biophilia" hypothesis a concept that Wilson regards as the innate human tendency to connect with life and living processes (Wilson, 1984). On this basis, the human need to be present in nature is not merely an aesthetic preference but part of the human psychological and evolutionary structure. Biophilic architecture, by drawing on natural elements, daylight, natural ventilation, plants, water, natural materials, green views, organic patterns and multisensory experiences, seeks to enhance the psychological and perceptual quality of space. Kellert and Calabrese introduce biophilic design as an approach for creating a "suitable habitat for human beings" in the built environment – a habitat able to answer human physical, psychological and emotional needs in connection with nature (Kellert & Cal-

abrese, 2015). From this perspective, a building is not merely a physical structure but a ground for lived experience, psychological calmness, the reduction of environmental pressures and the strengthening of a sense of place attachment. Research in environmental psychology has likewise shown that contact with nature can reduce stress, improve mood, increase concentration and support mental restoration. Kaplan and Kaplan's Attention Restoration Theory holds that natural environments, owing to qualities such as soft fascination, a sense of being away from everyday pressures, extent and compatibility with the individual's needs, provide the ground for restoring attention and reducing mental fatigue (Kaplan & Kaplan, 1989). In the same line, Ulrich's Stress Reduction Theory emphasizes that viewing natural scenes can reduce the emotional and physiological reactions associated with tension and facilitate the individual's psychological return to equilibrium (Ulrich et al., 1991).

One of the classic studies in this field is Ulrich's research on the effect of a natural view on hospitalized patients. Its results showed that patients who viewed a scene of trees from their room window, compared with patients who faced a brick wall, had shorter stays, needed fewer analgesics and received more positive nursing notes (Ulrich, 1984). This finding was among the first empirical evidence that the visual and natural quality of the built environment can affect human health outcomes. In the recent literature on biophilic design, the criteria of this approach are usually classified as direct connection with nature, indirect connection with nature, and spatial-place experience of nature. Browning, Ryan and Clancy introduced fourteen patterns of biophilic design, including visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, the presence of water, dynamic and diffuse light, connection with natural systems, biomorphic forms and patterns, complexity and order, prospect, refuge, mystery and risk/peril (Browning et al., 2014). These patterns show that the effect of

biophilic design is not limited to adding plants to a space but includes a set of spatial, sensory, perceptual and psychological qualities. Recent review studies likewise show that biophilic design can play a significant role in enhancing users' health and well-being (Zhong et al., 2022) and that some components such as natural light, the presence of plants, views of nature and multisensory qualities are of greater importance (Tekin et al., 2023). At the urban scale, the importance of biophilic architecture becomes ever more apparent, because citizens live in dense, high-tension environments that often lack natural qualities. Building density, noise pollution, the reduction of green spaces, the shortage of natural light and visual monotony can prepare the ground for increased anxiety, mental fatigue and reduced satisfaction with the living environment. In such conditions, employing biophilic criteria in the design of buildings, public spaces, pedestrian routes, courtyards, facades and semi-open spaces can be an effective solution for reducing psychological pressures and enhancing citizens' mental health (Beatley, 2016).

Theoretical Foundations

The review of the literature shows that biophilic architecture is an approach that goes beyond the mere use of natural elements in built spaces and emphasizes creating a deep, multidimensional bond between human beings and nature (Kellert, 2018). This approach is founded on the biophilia hypothesis, which holds that human beings have an innate tendency to connect with nature and other forms of life, and that this connection plays an important role in preserving their physical and mental health (Wilson, 1984). Numerous studies have shown that the presence of natural elements in living and working environments can reduce stress, improve mood, increase concentration and enhance mental health (Ulrich, 1984) (Kaplan & Kaplan, 1989). Analysis of domestic and international studies shows that the biophilic architectural criteria affecting citizens' mental health can be classified into four main concep-

tual clusters, inspired by the patterns of Kellert and Calabrese (2015), Browning et al. (2014) and Ryan et al. (2014) as well as related domestic research (Pourjafar et al., 2021) (Mohammadi et al., 2020): direct connection with nature, indirect connection with nature, nature-oriented spatial and place experience, and mental health and environmental perception.

Direct and Indirect connection with nature

This component refers to the real, tangible presence of natural elements in the built environment. Natural light, vegetation, water, airflow and other living elements are among its most important parts. Research shows that direct contact with nature reduces cortisol levels, reduces anxiety and increases the sense of calmness and happiness (Ulrich et al., 1991) (Park et al., 2010). The presence of plants and natural scenes in urban environments can also reduce mental fatigue and increase people's capacity for psychological restoration (Kaplan, 1995). Its indicators include: access to and observation of green space; the presence of plants in indoor and outdoor spaces; the use of natural light; and the presence of water elements. This component refers to the use of natural features, patterns and symbols in architectural design. The use of natural materials, nature-inspired colours, organic patterns and biomorphic forms are among its most important indicators (Kellert & Calabrese, 2015). Studies show that even in the absence of real natural elements, the use of natural images, forms and materials can produce positive psychological reactions and reduce the level of stress (Joye, 2007) (Browning et al., 2014). Its indicators include: the use of natural materials; the use of biomorphic and organic patterns; natural colours; and the representation of nature in architectural design.

Nature-oriented spatial and place experience

This component relates to the quality of the organisation of space and the way users experience the environment. Concepts such as prospect and refuge, a sense of exploration, spatial complexity,

continuity with the natural environment and the possibility of experiencing natural changes fall into this category (Appleton, 1975) (Ryan et al., 2014). Research has shown that spaces with variety, legibility and a visual connection with nature create a greater sense of security, environmental control and psychological comfort in users (Berto, 2005) (Kellert, 2018). Its indicators include: access to natural views; spatial variety and complexity; a sense of security and refuge; and a visual connection with the natural environment.

Mental health and environmental perception

This component encompasses the psychological consequences of experiencing biophilic environments. Reduced stress, increased life satisfaction, improved mood, enhanced concentration and a

sense of place attachment are among its most important dimensions (Bratman et al., 2019) (White et al., 2019). Studies conducted in urban environments show that spaces designed on the basis of biophilic principles can increase social interactions, reduce symptoms of depression and enhance citizens' subjective well-being (Beatley, 2016) (Gillis & Gatersleben, 2015). Its indicators include: reduced stress and anxiety; an increased sense of calmness; satisfaction with the environment; place attachment; and improved social interactions. On this basis, the theoretical framework of the present study is formed by relying on four main components and a set of indicators derived from the theoretical literature and empirical research. Tab. 1 summarizes this framework. (Tab. 1)

Table 1: Theoretical framework: components, indicators and theoretical sources (Source: Authors)

Main component	Indicators	Theoretical sources
Direct connection with nature	Access to and observation of green space; presence of plants in indoor and outdoor spaces; use of natural light; presence of water elements (water features, ponds, flowing water)	Ulrich, 1984; Kaplan & Kaplan, 1989; Kellert & Calabrese, 2015; Browning et al., 2014; White et al., 2019
Indirect connection with nature	Use of natural materials; use of biomorphic patterns and forms; nature-inspired colours; representation of nature in architectural design (natural images and symbols)	Kellert et al., 2008; Joye, 2007; Browning et al., 2014; Ryan et al., 2014
Nature-oriented spatial and place experience	Access to natural views; sense of refuge and spatial security; spatial variety and complexity; visual and physical connection with the natural environment	Appleton, 1975; Ulrich, 1984; Berto, 2005; Kaplan, 1995; Kellert, 2018
Mental health and environmental perception	Reduced stress and anxiety; increased calmness and psychological comfort; satisfaction with the environment and quality of life; place attachment and positive social interaction	Ulrich et al., 1991; Bratman et al., 2019; White et al., 2019; Beatley, 2016; Gillis & Gatersleben, 2015

Methodology

This study is of the qualitative meta-synthesis type and draws on the seven-step logic of Sandelowski and Barroso: defining the question, sys-

tematic searching, screening and selection, data extraction, coding and synthesis, quality control, and presentation of the final model. For reporting transparency, the ENTREQ principles were used

in composing the text, and the CASP checklist was used to appraise the adequacy of the sources (Sandelowski & Barroso, 2007) (Tong et al., 2012) (CASP, 2023). The methodological section rests on the premise that, in a subject such as biophilic architecture and mental health which depends simultaneously on conceptual, empirical-design and standards-based evidence meta-synthesis is the most appropriate way to move beyond the dispersion of data and reach a design-oriented model. In the fields of urban planning and urban-geography studies, meta-synthesis, as one of the effective research methods, has the capacity to analyses empirical data drawn from diverse urban projects, field studies and simulation models. By making it possible to identify general patterns and recurring relationships across different studies, this approach provides a deeper and more comprehensive understanding of urban processes and dynamics. The method used in the present study is meta-synthesis, which rests on combining, comparing and integrating the key features, components and factors present in the research literature. This method known in some sources as qualitative meta-analysis seeks the systematic analysis of prior research, the identification and resolution of inconsistencies and contradictions among findings, and the integration of results in order to extract fundamental concepts and themes. In addition, by revealing

knowledge gaps, meta-synthesis also identifies potential avenues for future research (Cooper & Hedges, 2009).

On this basis, the scope of the present study comprises all scholarly articles published in credible international databases, as well as doctoral dissertations from reputable universities, in the field of biophilic architecture and its relationship with citizens' mental health and subjective well-being. This study, drawing on the qualitative meta-synthesis method and the framework of Sandelowski and Barroso, systematically examines the architectural components affecting biophilic architecture and their role in enhancing citizens' mental health. In the first stage, a systematic search was conducted in credible and widely used databases, including Scopus, Web of Science, ScienceDirect, PubMed, Springer, Google Scholar, SID and Magiran. The search used the main keywords related to the research topic: "biophilic architecture", "architectural criteria", "mental health", "environmental perception quality", "psychological well-being" and "human-nature connection". The time span of the selected studies covered mainly the last fifteen years (2010–2025). The domains examined included architecture, urban planning, environmental sciences, environmental psychology, urban design and urban health. Figure 1 shows the seven-step meta-synthesis process. (Fig. 1)

Figure 1. The seven-step meta-synthesis process (Sandelowski & Barroso, 2007)



Figure 1: The seven-step meta-synthesis process (Sandelowski & Barroso, 2007)

In the data-analysis stage, the information extracted from the selected studies was examined through a three-stage coding process. In the first step, initial codes were identified and extracted from the raw data. These codes were then classified into axial categories on the basis of con-

ceptual and content similarities, and finally the main themes of the research were extracted. To ensure reliability and increase the validity of the analyses, mechanisms including the calculation of the inter-coder agreement coefficient, independent review by experienced research-

ers, and group critique and evaluation sessions were used; the inter-coder reliability coefficient was calculated at 80 per cent, indicating an acceptable level of agreement. The quality appraisal of the selected studies was carried out using the standard Critical Appraisal Skills Programme (CASP) tool (McHugh, 2012) (Sandelowski & Barroso, 2007); sources that obtained at least the minimum score were selected, and this screening ultimately led to the selection of 36 qualitative studies with the highest methodological standards.

Definition of meta-synthesis

Meta-synthesis, known in the social-science literature by concepts such as research review and systematic review, is one of the important research approaches and is usually employed to reach general conclusions from the findings of empirical research. Its main aim is the integration of research findings, their critical analysis, the identification of inconsistencies and contradictions, and the discovery of fundamental issues and gaps to guide future research (Cooper, 2009). Specifically, meta-synthesis seeks to identify and gather all the available evidence on a subject and to analyse it in an unbiased, systematic manner. This approach is particularly important in qualitative research, which is often multidimensional, complex and varied in nature. Its most important advantage is that it provides a ground for reaching a deeper, more comprehensive and more systematic understanding of complex human and environmental phenomena. To analyse the data and extract the concepts, criteria and components related to biophilic architecture and mental health, the seven-step model of Sandelowski and Barroso was used, comprising: (1) determining the focus of the study and formulating the research question; (2) conducting a systematic literature review; (3) searching for and selecting appropriate scholarly sources; (4) extracting and retrieving information from the selected sources; (5) analyzing and synthesizing the findings; (6)

quality control of the studies and presentation of the findings; and (7) explaining the results of the analytic process (Sandelowski & Barroso, 2007) (Chenail, 2009).

FINDINGS AND DISCUSSION

In this section, the research process and the results of the qualitative data analysis based on the meta-synthesis method are described across the seven steps.

Focusing the study and formulating the research question

Mental health is one of the most important indicators of the quality of human life in urban and built environments; the World Health Organization defines it as a state of well-being in which the individual is able to recognize their own capacities, cope with the everyday tensions of life, work productively and participate effectively in society. In recent decades, alongside the growth of urbanization and the spread of artificial environments, the distancing of human beings from nature has been recognized as one of the factors contributing to increased stress, anxiety, depression and psychological burnout. In response to this challenge, the concept of biophilic architecture has been proposed as a design-oriented approach that emphasizes reconnecting human beings with nature. Nevertheless, a comprehensive framework that systematically explains the architectural criteria affecting mental health in biophilic architecture has not yet fully taken shape. The main question of this research therefore focuses on identifying and extracting the architectural criteria of mental health and gauging the degree of the effect of biophilic architecture on these criteria.

Systematic literature review

To reach the theoretical framework, a systematic search of scholarly sources was conducted in credible international and domestic databases including Scopus, Web of Science, ScienceDirect, PubMed, Springer, Google Scholar, SID and Ma-

giran, using the keywords: biophilic architecture, mental health, psychological well-being, nature-based design and architectural criteria. The time span of the search covered the last fifteen years (2010–2025). Inclusion criteria comprised: a direct relationship with biophilic architecture and mental health; publication in credible scholarly journals or reputable academic dissertations; a clear and assessable methodology; and a focus on built environments and user experience. Exclusion criteria comprised studies without a direct relationship, non-systematic review articles, studies with insufficient data, and non-scholarly sources.

Searching for and selecting appropriate sources

On the basis of the inclusion and exclusion crite-

ria, about 1,760 scholarly sources were identified in the first stage, comprising articles, dissertations and research reports. In the first step, the titles and keywords of the studies were examined and irrelevant studies were removed, leaving about 260 sources after the initial screening. In the next stage, the abstracts of the studies were examined in detail, which led to the removal of low-relevance sources and a reduction to 85 sources. The full texts of the selected sources were then examined and, by applying stricter criteria of scholarly quality, methodological validity and conformity with the research topic, 36 credible studies comprising scholarly articles and doctoral dissertations were finally selected. Fig. 2 shows this screening process. (Fig. 2)

Figure 2. Systematic search and screening of the sources

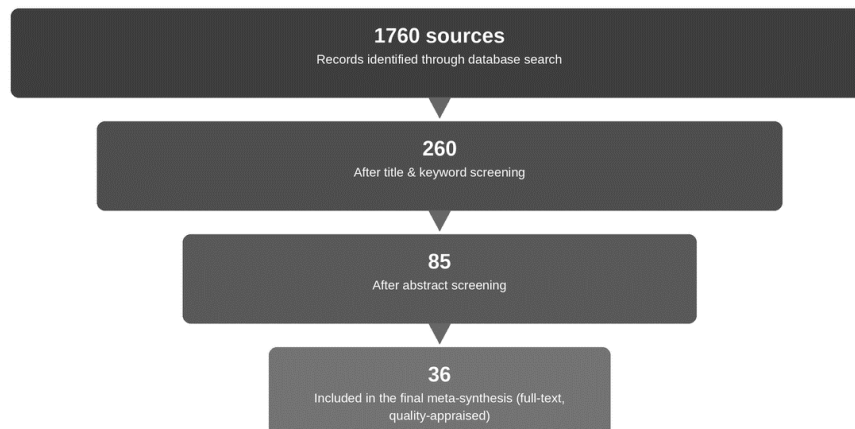


Figure 2: Systematic search and screening of the sources (Source: Authors)

These 36 final sources formed the basis of the qualitative analysis and were subjected to content analysis through open, axial and selective coding in order to extract the architectural cri-

teria affecting mental health within the framework of biophilic architecture. Table 2 lists the corpus of the analyzed studies. (Tab. 2)

Table 2: The 36 studies included in the meta-synthesis corpus

No.	Author (year)	Title	Propo- sitions
1	Ghazal Zare (2024)	Explaining biophilic design strategies affecting the health of patients hospitalized in hospitals	20

2	Parmis Naseri (2024)	Explaining a neurobiological theoretical model of biophilic design in architecture for energy conservation in the environment, using content analysis	24
3	Seyedeh Maryam Mousavi (2023)	Investigating the effect of biophilic architecture on enhancing the psychological dimension of patients' health in therapeutic environments	19
4	Negin Sadat Moghaddasi (2023)	The effect of biophilic architecture on the physical–environmental resilience of residential complexes (case: Tehran International Tower)	21
5	Zahra Golzar (2023)	Investigating biophilic architecture components for enhancing the mental health of residents of residential complexes	28
6	Pooneh Shaliha (2023)	Explaining indicators for improving the quality of conventional urban housing with emphasis on biophilic architecture (case: District 1 of Tehran)	24
7	Zohreh Farshi Haghi (2023)	Explaining biophilic architecture components in the livability of a hot and dry climate (case: Semnan)	20
8	Mahmoud Golabchi (2023)	Assessing customer attraction with a focus on biophilic design features (case: Saray-e Moshir, Shiraz)	18
9	Farin Khaneshenas (2023)	The effect of biophilic design patterns on employees' health and well-being: a systematic review	28
10	Samar Demi (2023)	A comparative study of the biophilic approach and healing landscapes in their effect on the senses of autistic children	17
11	Faezeh Yazdani Rostam (2023)	Reading the design requirements of biophilic in-between spaces in residential complexes of Tehran (case: Ekbatan Phase 1)	19
12	Parisa Ghobadi (2023)	Analyzing the effect of biophilic urban space on people's stress levels	17
13	Farin Khaneshenas (2023)	The biophilic attitude: an approach to enhancing the qualitative level of the living environment of residential-complex residents	20
14	Mohammad Assarzadegan (2023)	Hierarchical analysis of indicators affecting the user in educational environments designed on biophilic patterns	22
15	Mahjoubeh Nouhi Bazanjani (2022)	Design principles of biophilic architecture in a specialized cardiovascular hospital from the standpoint of patients' health quality	20
16	Mahjoubeh Nouhi Bazanjani (2022)	Design principles of biophilic architecture in a specialized cardiovascular hospital from the standpoint of patients' health quality	13
17	Mahdi Sadat (2022)	The effect of biophilic design in office space on improving mental health	18
18	Sirous Bavar (2022)	Assessing the effect of biophilic architecture principles on housing design quality in the climate of northern Iran	22
19	Mohammad Reza Ghorbani Param (2022)	Reviewing the trend of biophilic urbanism theory and its effects on the calmness and environmental security of cities	19

20	Mahdi Sadat (2022)	The effect of biophilic design in office space on improving mental health	20
21	Zahra Sadat Hosseini (2022)	The effect of the presence of the sky in architectural space on human hygiene, mental health and crime reduction	20
22	Mostafa Arghiani (2022)	Investigating the design of educational space with a stress-reduction approach using biophilic design	17
23	Mitra Faraji (2021)	The effect of neighborhood-environment features on mental health, relying on the mediating variables of residents' preferences	35
24	Zahra Lahouti (2021)	Investigating the relationship between the non-physical features of the open space of residential complexes and the mental health of the elderly	17
25	Zahra Shabanpour Sheshkal (2021)	Gauging the relationship between access to public spaces and the mental health of the elderly	16
26	Moein Firouzi (2021)	Investigating the dimensions of biophilic architecture in Persian gardens with Kellert's "biophilic value" theory (case: Shazdeh Garden, Mahan)	16
27	Maryam Ebrahimpour (2021)	Biophilic planning: a new approach to achieving livability in Iran's new towns (case: Hashtgerd new town)	22
28	Asadollah Naghdi (2021)	The mechanism of the effect of urban natural view corridors in Hamedan on citizens' mental health	14
29	Sajjad Akbari Baldarlou (2020)	The effect of biophilic architecture on mental health and people's behavior towards protecting the environment	19
30	Maryam Valizadeh (2020)	Investigating the effect of mental health on society's tendency towards sustainable architecture	18
31	Aghil Emamgholi (2019)	The effect of architecture on health: an idea for therapeutic architecture	18
32	Farisa Naeimi Foroutani Nejad (2019)	Investigating the importance of physical architectural components in residential-complex types on stress and depression (9 complexes in Tehran)	21
33	Ali Fakhari (2019)	Studying the functions, achievements and challenges of designing and implementing a community-oriented mental-health center	15
34	Soraya Taheri (2018)	The effects of increased density on mental health	17
35	Sima Haji Ali Akbari Mehrizi (2017)	The relationship between death anxiety and mental health, spiritual health and social support in students	17
36	Leila Mohammadi (2016)	The mediating role of positive and negative affect in the relationship between the meaning of life and mental health	17

Extraction, analysis and synthesis of the findings

After completing the corpus table, the important and relevant propositions of each article or dissertation were re-identified and, together with the source of each proposition, extracted

and listed; thus, the first stage of open coding was completed. Next, to complete the open coding in the second stage, the fields were classified into six sections: the core category, causal conditions, contextual conditions, intervening conditions, strategies and consequences. The prop-

ositions extracted in the previous stage were then placed into the relevant fields. In all, from the total of about 670 classified propositions, 166 propositions were placed in the core-cate-

gory section, 132 in causal conditions, 86 in contextual conditions, 74 in intervening conditions, 89 in strategies and 101 in consequences. Tab. 3 summarizes this distribution. (Tab. 3)

Table 3: Second-stage analysis: the six fields and the distribution of propositions

No.	Field	Propositions
1	Core category	166
2	Causal conditions	132
3	Contextual conditions	86
4	Intervening conditions	74
5	Strategies	89
6	Consequences	101
	Total	648

After axial coding, the extracted categories in each field were placed alongside one another in matrices in order to form the initial propositions. Through analyzing the points of commonality and the relative importance of the axial state-

ments in each field, the final axial statement of each field was extracted; this process ultimately led to six general statements. As an example, the labelling of the “intervening conditions” field is presented in Table 4. (Tab. 4)

Table 4: Example of field labelling: the “intervening conditions” field

Label	Extracted codes	Sources	Count
Organic texture	Social relations; sense of belonging; environmental quality; resilience; biophilic city; biophilic design; human-centred; human-centred buildings; biophilic criteria; biophilic architecture; environment; integration of nature; multiple senses	Nouhi Bazanjani (2022); Demi (2023); Naseri (2024); Yazdani Rostam (2023); Moghaddasi (2023)	13
Form integration	Environmental experience; affinity with nature; biophilic design; human-nature relationship; stress reduction; stimulation of creativity; physical and mental well-being; nature-based design; sustainable design; human-nature bond; air quality	Assar zadegan (2023); Arghiani (2022); Sadat (2022); Khaneshenas (2023)	11
Natural elements	Bond with nature; biophilic architecture; spiritual calmness; human-nature bond; natural images; creating balance; preserving calmness; general health; mechanical quality; traditional architecture; sense of calmness; personal and spiritual security	Sadat (2022); Khaneshenas (2023); Farshi Haghi (2023); Ghorbani Param (2022)	12
Biological processes	Negative feeling; psychological disorders; preserving health and calmness; mental ability; cognitive performance; restoration of concentration; biophilia; interaction with nature; evolved human-nature relations; biophilic design; nature-oriented design; integration of natural and artificial environments	Ghobadi (2023); Zare (2024); Golabchi (2023); Nouhi Bazanjani (2022); Demi (2023)	12
Physical environment	Biophilia; photosynthetic processes; ecological effects; natural systems; physical and mental comfort; biophilic architecture and design; connection with the natural world; stress improvement; mental health; environmental mastery; quality of life; environmental desirability and quality; housing quality; urban management; liveability; satisfaction; dynamic ecosystem	Farshi Haghi (2023); Ghorbani Param (2022); Bavar (2022); Golzar (2023); Shaliha (2023); Ebrahimpour (2021)	19

Nature	Natural environment; power of concentration; sense of place; connection to the natural environment; psychological stress; interaction with nature; scaling down nature; quality of the living environment; human–nature relationship; biophilic architecture; environmental desirability; quality of life; mental health; relations between stressful events and health	Khaneshenas (2023); Firouzi (2021); Farshi Haghi (2023); Bavar (2022); Golzar (2023)	14
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Through analyzing the two-by-two matrices of the open codes in each field, the core axial statement of the “intervening conditions” field was extracted as follows: “Biophilic architecture, by introducing the elements of nature (water, plants, sound and image), improves air quality and physical–mental health, reduces stress and increases creativity and the sense of belonging, and creates a sustainable, inspiring experience.” After axial coding, the extracted categories in each field were placed together in matrices to form initial propositions. After reviewing, sharing, and prioritizing these propositions, the axial statements in each matrix were identified. Next, by analyzing the commonalities and importance of the axial statements in each field, the final axial statement for each field was extracted. Ultimately, this process resulted in six general statements. An example of the axial coding process and formation of matrices is presented below. (Fig. 3)

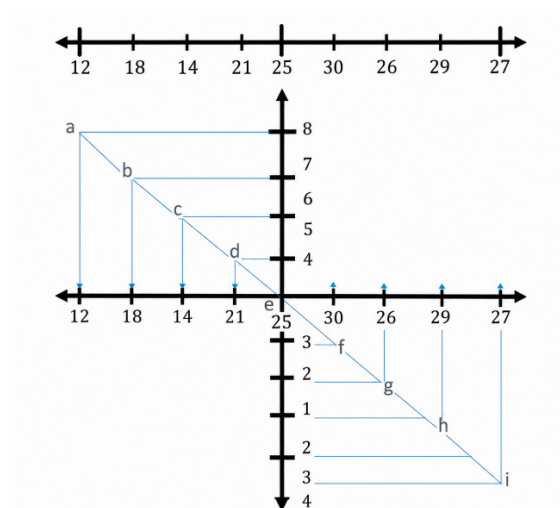


Figure 3: Example of a two-by-two matrix of open codes of labels together (Source: Authors)

- a= Human-nature connection and meeting physical and psychological needs
- b= Eco-orientation, sense of place and social belonging
- c= Physical-mental comfort and enhancing concentration
- d= Natural systems and reducing stress and ecological impacts
- e= Housing as an ecosystem and promoting satisfaction
- f= Green spaces, improving air quality and reducing stress
- g= Integrating human dimensions and restoring the vitality of space
- h= Organic form and multi-sensory stimulation
- i= Natural elements, peace and security

Key phrase: Biophilic architecture, by introducing elements of nature (water, plants, sound and image), improves air quality and physical-mental health, reduces stress and increases creativity and a sense of belonging, and creates a sustainable and inspiring experience.

Quality control

Throughout the research, an effort was made to provide a clear and precise explanation for each stage. To control and preserve the quality of the research, the validity and reliability of the extracted codes were examined. To assess validity, the Critical Appraisal Skills Programme tool was used: a checklist based on ten questions (1) research aims, (2) methodological rationale, (3) research design, (4) sampling method, (5) data collection, (6) reflexivity, (7) ethical considerations, (8) rigour of data analysis, (9) clear statement of findings, and (10) research value was prepared, and the selected studies were scored

on each criterion; studies with a quality score above the threshold were retained and the rest removed, so that 36 studies from reputable universities entered the meta-synthesis process. To gauge reliability, the final sources together with the extracted open codes were given to six experts in the field, who were asked to continue the coding process so that the results could be compared with the researcher's findings; five of the experts agreed with the researcher on the axial codes, concepts and categories, and the reliability coefficient was thus calculated at 83 per cent, indicating acceptable reliability.

Presentation of the findings of the analytic process

The architectural categories affecting biophilic architecture were extracted in three coding stages: open, axial and selective. First, the raw data were converted into initial codes through open coding; these codes were then organized into axial codes at two levels; and finally, in the selective-coding stage, the axial codes were classified and finalized into the main categories. As shown in Table 5, the results were organized into three categories visual–environmental, spatial–dimensional, and functional–patterned components. (Fig. 4)

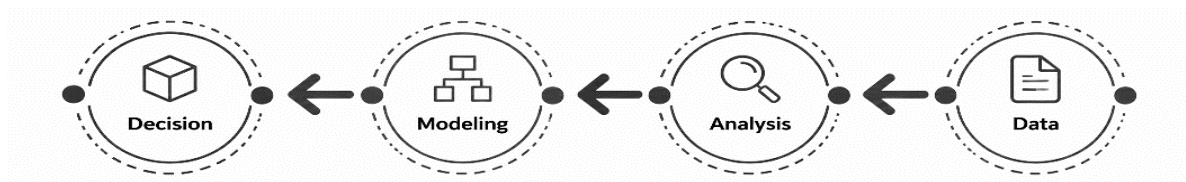


Figure 4: Analysis process (Source: Authors)

Which are presented in the table below in three practical, spatial dimensional, and functional categories: environmental visual, functional paradigm. (Tab. 5)

Table 5: Multi-level coding of the architectural factors affecting biophilic architecture (Source: Authors)

Classification	Category	Selective codes
Visual–environmental components	Nature-oriented spatial and place experience	Environmental quality; environment; integration of nature; multiple senses; air quality; natural images; biophilia; photosynthetic processes; ecological effects; natural systems; natural environment; scaling down nature; environmental quality; dynamic ecosystem; traditional architecture
Spatial–dimensional	Connection with nature	Biophilic city; biophilic design; biophilic criteria; biophilic architecture; nature-oriented design; sustainable design; human–nature bond; bond with nature; human–nature relationship; affinity with nature; interaction with nature; evolved human–nature relations; integration of natural and artificial environments; connection with the natural world; sense of place; connection to the natural environment; housing quality; urban management; livability; environmental desirability; mechanical quality
Functional–patterned components	Mental health and environmental perception	Social relations; sense of belonging; resilience; human-centered; human-centered buildings; environmental experience; stress reduction; stimulation of creativity; physical and mental well-being; spiritual calmness; creating balance; preserving calmness; general health; sense of calmness; personal and spiritual security; negative feeling; psychological disorders; mental ability; cognitive performance; restoration of concentration; physical and mental comfort; stress improvement; mental health; environmental mastery; quality of life; satisfaction; power of concentration; psychological stress

This study, through the systematic analysis of 36 scholarly sources, identified the components of the biophilic architectural criteria affecting citizens' mental health. The findings showed that biophilic architecture as an organized approach in the design of the built environment, formed through the integration of natural elements, biological patterns, spatial qualities and multisensory stimuli – reflects a dynamic relationship between human beings and nature and, beyond merely physical considerations, emphasizes perceptual experience, the sense of belonging and the quality of human interaction with the environment. The results also showed that the biophilic criteria can play a dual role: in the absence of an effective bond with nature they may prepare the ground for increased stress and reduced psychological quality, while under favorable design they act as an enhancer of mental health and subjective well-being. Employing active, strategic design based on biophilic criteria such as integrating nature into architectural spaces, strengthening visual and sensory connection with natural elements, improving environmental and air quality, and creating human-centered spaces can significantly reduce stress, increase psychological calmness, strengthen concentration, enhance cognitive performance and increase citizens' satisfaction.

CONCLUSION AND RESULTS

The present study aimed to explain the causal relationships between biophilic architectural criteria and the various dimensions of citizens' mental health. Analyzing 36 selected studies showed that three main components nature-oriented spatial and place experience, connection with nature, and mental health and environmental perception can be identified as the main pillars of the conceptual model. The key findings showed that, in the biophilic architecture–mental health system, “connection with nature” is the most fundamental causal and influential factor, while “mental health and environmental perception” plays the greatest effect-receiving role. Among

the indicators, “natural light”, “the presence of green elements”, “environmental quality” and “visual connection with nature” had the strongest causal role; by contrast, “stress reduction”, “increased psychological calmness”, “strengthened concentration” and “satisfaction with the environment” were identified as the most important final consequences. These findings show that, without an effective bond between human beings and nature in the spatial structure of the environment, limited physical interventions cannot lead to a sustainable enhancement of citizens' mental health.

The results of the present study are consistent with the findings of Kellert and Calabrese (2015), who introduce biophilic architecture as a framework for recreating the human–nature relationship in the built environment (Kellert & Calabrese, 2015). However, going beyond their descriptive approach, the present study shows that the effect of biophilic criteria has a hierarchical structure and that some criteria play a more foundational role in enhancing mental health. The findings are also in line with Wilson's biophilia theory (Wilson, 1984), which regards the innate human tendency towards nature as a source of psychological balance. Compared with Ulrich's research (Ulrich, 1984), which confirmed the positive effect of natural scenes on reducing patients' stress, the results of this study show that the effect of nature is not limited to visual observation but is also strengthened through multisensory experience, spatial quality and environmental perception. The findings are likewise consistent with the Attention Restoration Theory of Kaplan and Kaplan (Kaplan & Kaplan, 1989), especially regarding the role of natural spaces in restoring concentration and reducing mental fatigue; yet the present study shows that the quality of spatial organization and the manner of integrating natural elements into architecture play a more decisive role than the mere presence of nature. At the level of domestic studies, the findings of the present study are consistent with the results of Pourjafar et al. (Pourjafar et

al., 2021) on the effect of environmental features on users' psychological experience, and with the results of Habibi et al. (Habibi et al., 2021), who emphasised the importance of human-centred, nature-oriented design in enhancing quality of life. However, the present study takes a further step and shows that biophilic criteria operate not only at the aesthetic or physical level but also at the level of perception, spatial meaning-making and place identity. At the international level, the findings are consistent with the results of Beatley (Beatley, 2016) on the role of biophilic urbanism in enhancing urban liveability, and with the findings of Browning et al. (Browning et al., 2014) on the importance of the fourteen patterns of biophilic design, while showing that criteria such as natural light, green elements and environmental

quality are more influential than the other patterns. On this basis, the final conceptual model of the research is the outcome of the systematic integration of the meta-synthesis findings with the dimensions of citizens' mental health. This model draws the chain of the effect of biophilic architectural criteria as "connection with nature → nature-oriented spatial experience → environmental perception → mental health". In this model, the biophilic architectural criteria occupy the position of causal variables, spatial experience and environmental perception the position of mediating variables, and citizens' mental health the position of the final consequence. This framework can provide a practical basis for mental-health-oriented architectural design and urban planning. (Fig. 5)

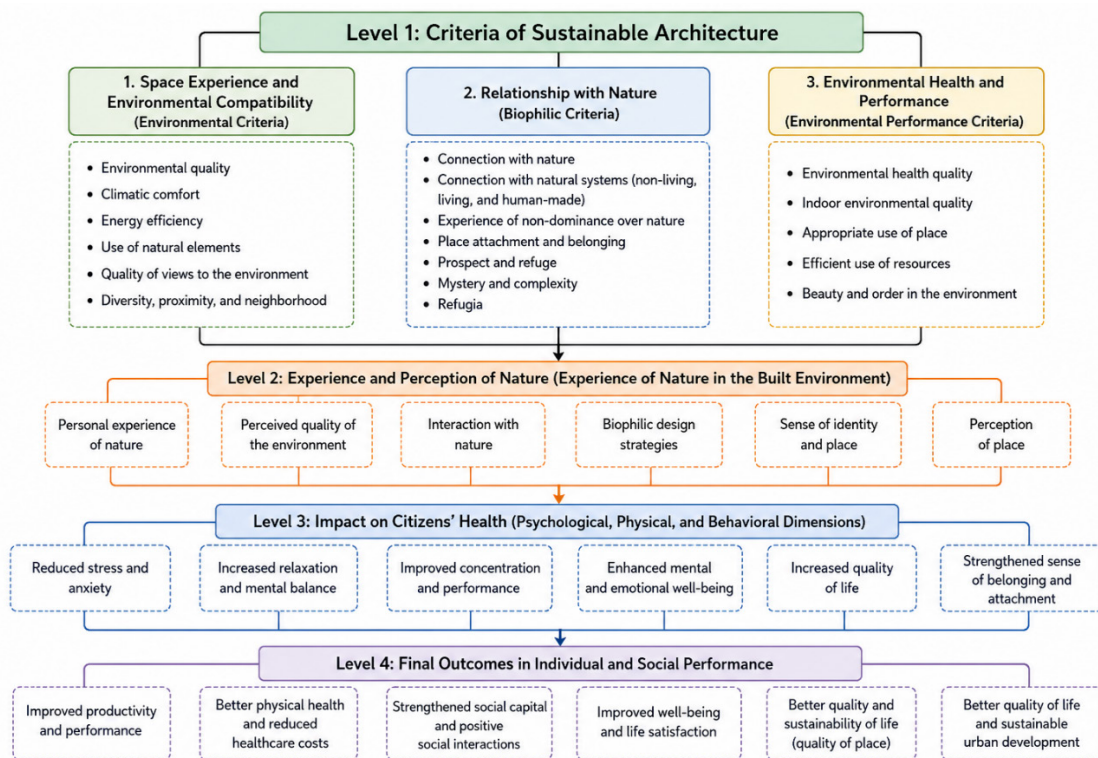


Figure 5: Conceptual model of the biophilic architectural components affecting citizens' mental health (Source: Authors)

In answer to the first research question, the architectural criteria affecting citizens' mental health, within the framework of the biophilic

architecture components, were classified into four interconnected, interdependent layers, as shown in the research model. The first layer

shows that the biophilic architectural criteria comprise four main components: “direct natural elements” (vegetation, water, natural light, natural ventilation), “indirect natural patterns” (natural materials, nature-inspired colors and textures, organic forms), “spatial–physical features” (prospect, openness, refuge, spatial legibility) and “social–behavioral dimensions” (social interaction, sense of belonging, participation and presence). The meta-synthesis findings showed that the direct-natural-elements component, as the starting point of the causal chain, plays the greatest role in shaping users’ spatial experience, since it forms the first level of human contact with the built environment and provides the ground for the effect of the other components. By contrast, the social–behavioral dimensions lie at the end of the chain and are the outward manifestation of enhanced mental health in citizens’ spatial behavior.

In the second layer, formulated in answer to how the biophilic criteria affect the quality of environmental perception, the perceptual–sensory quality of the environment was identified as the central core of the model. This layer is both affected by the physical and natural features and affects the subsequent layers. Indicators such as a sense of calmness, stress reduction, the experience of visual pleasure, the perception of beauty, a sense of security and environmental legibility are direct reflections of the quality of the individual’s encounter with the biophilic environment. The findings showed that the deeper and more meaningful the bond between architectural space and natural elements, the greater the positive perception of the environment and the lower the level of psychological tension and disturbance. The third research question concerned the explanation of the causal model of the relationships between biophilic architectural criteria and citizens’ mental health, in answer to which the third layer of the model was extracted. This layer comprises the internal dimensions of mental health and shows that the effect of biophilic architecture does not remain

merely at the level of environmental perception but is mediated through a set of psychological and cognitive processes. These comprise two main groups: self-referential and internal-regulation processes (self-awareness, self-regulation, reduced anxiety and psychological resilience) and relational–semantic processes (sense of belonging, meaning-seeking, effective social communication and mental creativity). These dimensions show why different people, when facing a similar biophilic environment, experience different levels of mental health.

Finally, the fourth layer of the model concerns the functional consequences of enhanced mental health. On the causal logic of the research, the mental health resulting from the experience of a favorable biophilic environment can lead to improved quality of life, increased concentration, enhanced individual and social productivity, reduced mental fatigue and increased life satisfaction. Citizens who live or work in environments with higher biophilic qualities generally enjoy greater psychological calmness, better adaptive capacity and more favorable social relations. Although individual features can moderate the intensity of these effects, compared with the other layers the first layer the architectural and physical qualities still play the more fundamental causal role. Thus, the proposed model, for the first time in this field, explains in an integrated way the causal chain “biophilic architecture → environmental perception and sensory experience → psychological and social processes → mental health → function and quality of life”.

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