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Modeling the Design of Therapeutic Environments for Patients with Schizophrenia Based on Environmental Cognitive Patterns and Its Effect on Anxiety Reduction

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A B S T R A C T

The aim of this study was to develop a model for designing therapeutic environments for patients with schizophrenia based on familiar cognitive patterns and to examine its effect on reducing patient anxiety. This study was conducted using a mixed-methods approach (quantitative–qualitative). In the quantitative phase, 30 hospitalized patients with schizophrenia at Omid Farda Center were interviewed and were asked to report their level of anxiety, based on the Hamilton Anxiety Rating Scale, after viewing images of designed environments. In the qualitative phase, in-depth interviews were conducted with 20 architecture experts. The results of statistical analysis indicated that environmental design incorporating familiar cognitive elements such as lighting, color, furniture, and surface materials had a significant effect on reducing patients' anxiety. The findings suggest that an environmental psychology-based approach can contribute to the development of effective and human-centered therapeutic environments for psychiatric patients.

Keywords: *therapeutic design, schizophrenia, anxiety, environmental psychology, healing architecture, cognitive patterns*

1. Introduction

The rapid growth of mental health disorders in contemporary societies has transformed psychological well-being into a global public health priority, with anxiety disorders and psychotic conditions such as schizophrenia occupying a central position among these concerns. According to global health reports, mental disorders contribute substantially to the overall burden of disease, affecting millions of individuals worldwide and imposing significant social, economic, and clinical costs (1). Within this spectrum, schizophrenia represents one of the most complex and debilitating psychiatric disorders, characterized by disturbances in perception, cognition, emotion, and behavior, often accompanied by persistent

anxiety and impaired functional capacity (2). Anxiety, as both a comorbid condition and a core experiential component in schizophrenia, exacerbates symptom severity, interferes with treatment adherence, and reduces overall quality of life, making its management a critical aspect of therapeutic interventions (3, 4).

In recent decades, the understanding of mental health has evolved from a purely biomedical model toward a more integrative biopsychosocial perspective, emphasizing the interaction between biological predispositions, psychological processes, and environmental influences (5). Within this framework, the physical environment—particularly therapeutic and healthcare settings—has been recognized as a significant determinant of psychological outcomes. Environmental psychology research has consistently demonstrated that spatial characteristics can influence emotional regulation, stress responses, and behavioral patterns, especially among vulnerable populations such as psychiatric patients (6, 7). Consequently, the design of therapeutic environments has emerged as a crucial interdisciplinary domain at the intersection of architecture, psychology, and healthcare.

The concept of healing environments, grounded in evidence-based design principles, suggests that thoughtfully designed spaces can actively contribute to recovery processes, reduce stress, and enhance well-being. Early empirical findings by Ulrich revealed that exposure to natural views could significantly improve recovery outcomes and reduce physiological stress responses (8). Subsequent research has expanded these insights, demonstrating that environmental features such as natural light, vegetation, spatial organization, and sensory qualities can influence patient experiences and health outcomes (9, 10). These findings have led to the development of comprehensive frameworks such as the Optimal Healing Environment (OHE), which emphasizes the integration of environmental, psychological, and social factors in healthcare design (11).

In the context of psychiatric care, the importance of environmental design becomes even more pronounced due to the heightened sensitivity of patients to sensory stimuli and spatial cues. Patients with schizophrenia, in particular, often experience perceptual distortions, cognitive fragmentation, and heightened anxiety responses to unfamiliar or overstimulating environments (12). As a result, poorly designed spaces—characterized by excessive noise, harsh lighting, complex layouts, or unfamiliar forms—can exacerbate symptoms and increase psychological distress. Conversely, environments that are predictable, coherent, and aligned with familiar cognitive patterns can promote a sense of safety, reduce anxiety, and facilitate therapeutic engagement (13, 14).

The theoretical foundations of this approach can be traced to cognitive and behavioral theories, particularly Bandura's social cognitive theory, which emphasizes the reciprocal interaction between individuals, their behaviors, and their environments (15). From this perspective, the environment is not merely a passive backdrop but an active agent that shapes cognition, emotion, and behavior. Similarly, Kaplan's Attention Restoration Theory highlights the restorative effects of natural environments, suggesting that exposure to nature can reduce mental fatigue and improve emotional regulation (16). These theoretical models provide a robust framework for understanding how environmental design can influence anxiety and psychological well-being.

Architectural theory has also contributed significantly to this discourse by emphasizing the role of spatial organization, symbolism, and user experience in shaping human behavior. Lang argued that architectural environments should be designed based on behavioral sciences to ensure that they respond effectively to human needs and perceptions (17). In healthcare settings, this principle translates into the creation of spaces that are not only functional but also psychologically supportive and emotionally responsive. Research on hospital architecture has further demonstrated that design innovations can improve patient satisfaction, reduce stress, and enhance clinical outcomes (14).

Recent empirical studies have reinforced the importance of integrating cognitive and environmental considerations in therapeutic design. For instance, Pati highlighted the role of positive distractions, such as access to nature and aesthetically pleasing environments, in reducing stress and improving patient experiences (18). Similarly, Steinberg demonstrated that spatial systems and environmental configurations significantly influence behavioral patterns and emotional responses in healthcare settings (19). These

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findings suggest that environmental design can serve as a non-pharmacological intervention, complementing traditional medical and psychological treatments.

Furthermore, contemporary research has increasingly focused on resilience and coping mechanisms among individuals affected by severe mental disorders. Studies have shown that supportive environments can enhance psychological resilience, particularly among patients and their caregivers, by reducing stressors and promoting adaptive coping strategies (20). In this regard, therapeutic environments designed with attention to cognitive familiarity and sensory coherence can play a critical role in fostering resilience and facilitating recovery.

Methodologically, the investigation of such complex and multidimensional phenomena requires integrative research approaches that combine qualitative and quantitative methods. Mixed-methods research, as outlined by Creswell, enables researchers to capture both the subjective experiences of individuals and the objective patterns observed in empirical data, thereby providing a comprehensive understanding of the research problem (21). In the context of environmental design and mental health, this approach is particularly valuable, as it allows for the exploration of both experiential and measurable dimensions of therapeutic environments. Statistical analysis techniques, as discussed by Cohen, further support the rigorous examination of relationships between environmental variables and psychological outcomes, ensuring the validity and reliability of findings (22).

Despite the growing body of evidence supporting the role of environmental design in mental health, there remains a significant gap in the application of cognitive-based design principles specifically tailored to patients with schizophrenia. While previous studies have explored general aspects of healing environments, fewer investigations have systematically examined how familiar cognitive patterns—such as recognizable forms, predictable layouts, and biologically meaningful stimuli—can influence anxiety reduction in this population. Moreover, the integration of architectural design with psychological theory and empirical validation remains underdeveloped, highlighting the need for interdisciplinary research that bridges these domains.

In addition, the measurement of anxiety in clinical populations requires reliable and standardized tools to ensure accurate assessment and comparability across studies. The Hamilton Anxiety Rating Scale, introduced as a systematic method for evaluating anxiety symptoms, has been widely used in clinical research and practice due to its robustness and sensitivity to changes in symptom severity (23). The use of such validated instruments is essential for assessing the effectiveness of environmental interventions and for establishing evidence-based design guidelines.

Overall, the convergence of theoretical frameworks, empirical evidence, and methodological advancements underscores the importance of considering environmental design as an integral component of mental healthcare. By incorporating principles of environmental psychology, cognitive theory, and evidence-based design, it is possible to create therapeutic spaces that not only support clinical treatment but also actively contribute to psychological well-being and recovery. Such an approach aligns with contemporary trends in healthcare design, which emphasize patient-centered care, holistic treatment, and the integration of physical and psychological dimensions of health (24).

Therefore, given the increasing prevalence of mental health disorders, the complex needs of patients with schizophrenia, and the demonstrated influence of environmental factors on psychological outcomes, the present study aims to develop a model for designing therapeutic environments based on familiar cognitive patterns and to examine its effect on reducing anxiety in patients with schizophrenia.

2. Methods and Materials

In the present study, which was conducted with the aim of developing a model for designing therapeutic environments for patients with schizophrenia based on the application of familiar cognitive patterns and examining its effect on anxiety, a mixed-methods research design was employed. This approach involves the integration of qualitative and quantitative methods to achieve a deeper and more comprehensive analysis of the research problem. In this type of methodology, the researcher seeks to utilize the strengths of both approaches, not only applying numerical and statistical data to test hypotheses, but also interpreting the phenomenon more profoundly through

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qualitative content analysis and participants' subjective perceptions. The first phase of the study was qualitative and was designed based on the Delphi method. In this phase, semi-structured and in-depth interviews were conducted with 20 experts in architecture, environmental psychology, and therapeutic space design to identify influential environmental design components from their professional perspectives. The data obtained from these interviews were analyzed using thematic analysis, leading to the extraction of a list of initial indicators and components whose roles in reducing patient anxiety could be examined. To assess the content validity of the identified indicators, the Content Validity Ratio (CVR) was utilized, and to evaluate the reliability of the data collection instrument, Cronbach's alpha coefficient was calculated, with a value of 0.758 indicating acceptable reliability. In the second phase, which constituted the quantitative part of the study, a pretest–posttest design without a control group was employed. The statistical population consisted of 30 hospitalized patients with schizophrenia at the "Omid Farda" psychotherapy center, who were included in the study after obtaining written informed consent from themselves or their families and approval from the attending physician. Initially, patients' anxiety levels were measured using the standardized Hamilton Anxiety Rating Scale, and baseline scores were recorded. Subsequently, images of three therapeutic environments designed based on familiar cognitive components (such as natural lighting, soft color palettes, familiar furniture arrangements, access to natural elements, and simple forms) were shown to each patient for two minutes. Participants were asked to imagine themselves within the depicted environment and establish a mental connection with it. Immediately after viewing the images, the anxiety assessment was administered again to evaluate the effect of the simulated environmental experience. In the next step, images of two environments lacking cognitive components but similar in size and function were presented, and anxiety levels were measured once more. The data collected through this process were analyzed using SPSS software. Statistical tests including the Kolmogorov–Smirnov test were used to assess the normality of data distribution, a one-sample t-test was employed to examine the significance of differences between pre- and post-intervention scores, and Pearson correlation analysis was conducted to evaluate the relationship between cognitive design indicators and patients' anxiety levels. Exploratory factor analysis was also applied to identify and consolidate the effective indicators. The integration of qualitative and quantitative methods in this study enabled the researcher to address the phenomenon from both interpretive–subjective and empirical–statistical perspectives; that is, the lived experiences of experts and the semantic analysis of qualitative data in the first phase were complemented by the objective measurement of the environmental intervention's effect on reducing patient anxiety in the second phase. Qualitative findings indicated that the presence of familiar elements in the environment, particularly natural light and soft, predictable colors, created a sense of "psychological safety" for patients with schizophrenia and contributed to the reduction of anxiety symptoms. At the same time, quantitative results, reflected in the significant reduction in mean anxiety scores after exposure to the designed environments, supported the positive impact of these components. This convergence of findings enhanced the internal validity of the study and demonstrated that a mixed-methods approach can serve as a powerful tool for analyzing complex interdisciplinary issues such as architectural design for mental health. A notable aspect of this methodology is that reliance on only one approach would not have been sufficient to address the complexities of the research problem. If only statistical data had been considered, the deeper understanding of patients' subjective experiences and design sensitivities would have been lost, whereas the exclusive use of qualitative methods would have limited the generalizability of the findings. In essence, the mixed-methods approach in this study functioned as a bridge between scientific explanation and human interpretation, revealing the latent dimensions of environmental influence on anxiety and providing an integrated and practical model for the design of therapeutic spaces. Therefore, this study represents not only a novel contribution in the field of therapeutic architecture from a substantive perspective but also a successful example of the practical application of mixed-methods research in architecture and behavioral sciences from a methodological standpoint.

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In this study, which aimed to examine the effect of therapeutic environment design based on familiar cognitive patterns on reducing anxiety in patients with schizophrenia, various instruments were employed for data collection in order to obtain valid and analyzable data from multiple scientific perspectives and to evaluate the research hypotheses within both empirical and theoretical contexts. The first instrument used was the Hamilton Anxiety Rating Scale (HARS), which is considered one of the most valid and widely used tools for assessing anxiety in psychiatry and clinical psychology. This questionnaire is designed to evaluate the severity of anxiety symptoms and consists of 14 items, each measuring a specific aspect of psychological and physiological symptoms of anxiety, including tension, fear, insomnia, concentration difficulties, irritability, somatic complaints, and phobic fears. In this study, patients with schizophrenia completed the questionnaire before the environmental intervention (i.e., presentation of images of designed environments) and after it, allowing for the assessment of differences in anxiety scores and the extent of reduction or increase based on the intervention. Due to its standardized structure, applicability to clinical populations, and precise scoring system, the Hamilton questionnaire is an appropriate tool for measuring changes in anxiety levels. The second instrument used was Delphi interviews with experts in architecture and environmental psychology. The Delphi method, as a qualitative approach based on expert consensus, played a key role in identifying cognitive design indicators. In this process, 20 specialists in architecture, therapeutic space design, environmental psychology, and behavioral therapy were purposively selected and participated in multiple rounds of semi-structured interviews. In the initial stage, general perspectives of experts regarding physical and environmental factors influencing anxiety in psychiatric patients were collected. In subsequent stages, the data extracted from the initial interviews were structured into Delphi questionnaires and redistributed to the same participants for confirmation or revision in order to achieve theoretical consensus. The primary objective of employing this method was to extract components such as lighting type, color schemes, spatial form, furniture arrangement, surface quality, and the presence of natural elements in therapeutic environments, which, from the experts' perspective, directly influence patients' behavior and emotional states. Qualitative content analysis of the interviews resulted in a list of design indicators that were used as independent variables in subsequent phases of the study. To assess face and content validity of the questionnaires and extracted data, the Content Validity Ratio (CVR) was applied, through which the degree of expert agreement on the necessity of each component was calculated. Reliability of the instruments was evaluated using Cronbach's alpha coefficient, yielding a value of 0.758, which indicates acceptable reliability. These procedures ensured a high level of scientific validity for the data collection instruments and provided confidence for the final data analysis. It is noteworthy that the integration of quantitative and qualitative instruments, namely the Hamilton questionnaire and Delphi interviews, enabled the researcher to obtain both numerical, statistically analyzable data regarding patients' anxiety levels and qualitative insights into expert perspectives, experiences, and interpretations regarding the quality of therapeutic environments. In other words, these instruments complemented each other: the Delphi interviews, as an exploratory tool, provided the theoretical foundation and qualitative design indicators, while the Hamilton questionnaire, as an evaluative tool, measured the practical and psychological effects of the designs. One of the major advantages of using the Hamilton questionnaire was the ability to compare anxiety scores before and after exposure to designed environments, which significantly enhanced the precision of statistical analysis. Similarly, the use of the Delphi method facilitated the incorporation of collective expert knowledge in selecting and validating design components, thereby enriching the final model of therapeutic space design both scientifically and empirically. The integration of these two instruments within an empirical field study reflects a scientific and applied approach to the problem of architectural design for reducing anxiety in psychiatric patients and can serve as an effective model for similar research. Furthermore, the use of standardized instruments such as HARS enhanced the generalizability of the findings and enabled comparison with other international studies. Overall, the use of the Hamilton questionnaire and Delphi interviews provided a comprehensive and multidimensional framework for data

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collection, allowing the researcher to approach the topic from multiple perspectives, gather diverse data, and ultimately propose a practical and scientifically grounded model for designing therapeutic environments for patients with schizophrenia. This combination of instruments created a unique methodological synergy within the research process, ensuring that the findings are both scientifically robust and practically applicable.

The statistical population of this study was designed in such a way as to enable a precise and multidimensional examination of the effect of cognitive-based therapeutic environment design on reducing anxiety in patients with schizophrenia. Accordingly, the population was divided into two distinct but complementary groups, both of which played key roles in generating research data. The first group consisted of 30 patients diagnosed with schizophrenia who were hospitalized at the "Omid Farda" treatment center and were included in the study under full medical supervision, after obtaining informed consent from themselves or their families. The selection of these patients was purposive and conducted in accordance with ethical and medical principles, such that only individuals with sufficient cognitive capacity to understand the questionnaires and engage mentally with the presented environmental images were included. Diversity in gender, age, duration of illness, and severity of the disorder was considered within this group to ensure broader coverage and enhance the generalizability of the findings. For this group, the research procedure was designed such that the initial level of anxiety was measured using the validated Hamilton Anxiety Rating Scale (HARS), and baseline scores were recorded. Subsequently, images of three therapeutic environments designed based on familiar cognitive patterns were presented to each patient, and they were asked to imagine themselves within these environments. Afterward, anxiety levels were measured again, and differences between pretest and posttest scores were examined. Additionally, images of two environments lacking cognitive components were shown to patients in order to assess the relative impact of different spatial conditions on anxiety. All procedures were conducted in the presence of a psychiatrist and a nurse to ensure the patients' psychological safety and to prevent any potential distress or exacerbation of symptoms. The second group of the statistical population consisted of 20 specialists from various fields relevant to the research topic, who were purposively selected. These experts were active in disciplines such as architecture, interior design, environmental psychology, psychiatry, cognitive-behavioral therapy, and therapeutic space design, and possessed either academic or professional experience in these areas. This group played a central role in the qualitative phase of the study, namely the Delphi process. In the initial stage, in-depth interviews were conducted with these individuals, and they were asked to identify environmental design components that influence anxiety reduction in patients with schizophrenia based on their knowledge and experience. In subsequent stages, the findings extracted from the interviews were formulated into questionnaires and returned to the same participants for validation and consensus building. This process enabled the researcher to compile a valid, consensus-based list of cognitive design components and apply them in the design of sample environments. The specialized nature of the qualitative sample enhanced the conceptual validity of the design model and prevented theoretical dispersion in the selection of indicators. Furthermore, the Content Validity Ratio (CVR) was used in data analysis to determine which components were considered most important by experts and which should be excluded. For example, natural lighting, familiar and cool color schemes, organic forms, the use of natural materials, predictable furniture arrangements, and visual access to green spaces were among the highest-rated components. The use of this dual statistical population—one based on the lived experiences of patients and the other on the scientific and practical expertise of specialists—was a major strength of the study, ensuring that the findings were both empirically effective in reducing anxiety and theoretically valid in architectural design. The inclusion of real patients with schizophrenia provided authentic and reliable data regarding spatial perception within the target group, while the participation of experts strengthened the scientific basis of environmental design. Moreover, the integration of these two groups within the statistical population allowed the researcher to develop a final model for therapeutic environment design not only based on aesthetic and functional criteria but also grounded in cognitive,

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behavioral, and psychological indicators. As a result, this study, through the careful and purposeful design of its statistical population, established a bridge between empirical reality and scientific theory and proposed an integrated and operational model for designing human-centered therapeutic environments—a model that can be implemented in psychotherapy centers, psychiatric institutions, and even specialized care facilities, and can also serve as a framework for policy-making in therapeutic environment design. Finally, the data obtained from both groups—patients and experts—were analyzed in an integrated manner using statistical software and qualitative content analysis, allowing for the examination of relationships between design indicators and anxiety reduction, as well as the prioritization of components. This demonstrates that the statistical population in this study was not only appropriately selected but also systematically and scientifically engaged in the process of knowledge production and model development.

In this study, which examines the effect of therapeutic environment design based on familiar cognitive patterns on reducing anxiety in patients with schizophrenia, statistical data analysis played a fundamental role in validating the findings and testing the research hypotheses. To analyze the quantitative data collected from the Hamilton Anxiety Rating Scale (HARS), which was completed by patients before and after exposure to images of the designed environments, SPSS software (Version 25) was utilized. The first step in the statistical analysis involved testing the normality of data distribution using the Kolmogorov–Smirnov test. The results of this test indicated that the data followed a normal distribution, thereby permitting the use of parametric tests in subsequent analyses. In the next stage, descriptive statistics were employed to determine the mean, standard deviation, minimum, and maximum anxiety scores in both pretest and posttest phases. A comparison of mean anxiety scores before and after the intervention revealed a significant reduction in anxiety levels following exposure to therapeutic environments designed based on familiar cognitive patterns. To examine this difference, a paired-samples t-test was conducted, and statistical significance was confirmed at the 95% confidence level ($p < .05$). The results demonstrated that the difference between pre-intervention and post-intervention anxiety scores was statistically significant, indicating that the reduction in anxiety can be attributed to the cognitive design of the environment. Furthermore, Pearson correlation analysis was used to examine the relationship between independent variables (environmental design components such as lighting, color, form, spatial arrangement, and connection to nature) and the dependent variable (level of anxiety). The findings indicated that certain design components, including natural lighting, soft color palettes, and familiar forms, exhibited significant negative correlations with anxiety levels. For instance, the presence of natural light showed the strongest negative correlation with anxiety scores, a finding consistent with prior research on the psychological effects of environmental lighting. Additionally, multiple linear regression analysis was employed to examine the simultaneous effects of multiple design indicators on anxiety. In this analysis, independent variables were entered into the model concurrently to determine their relative contributions to predicting the dependent variable. The results indicated that the combined effects of lighting, color, furniture arrangement, and visual connection to green spaces produced an effective predictive model for anxiety reduction, explaining approximately 68% of the variance in the dependent variable ($R^2 = 0.68$). This finding underscores the importance of integrating multiple components in a cohesive environmental design. In addition to SPSS, LISREL software (Version 8.8) was used to analyze the structural relationships among design components and cognitive indicators and to evaluate the fit of the conceptual research model. The proposed model, which was developed based on qualitative findings from Delphi interviews and quantitative data, was validated using confirmatory factor analysis (CFA). Model fit indices, including the Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Chi-square statistics, were examined. The results indicated that the proposed model demonstrated a satisfactory fit, with RMSEA values below 0.08, CFI values above 0.90, and a χ^2/df ratio below 3. These results suggest that the conceptual model of cognitive therapeutic environment design adequately explains the relationships between observed variables and the latent construct of

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anxiety reduction. In this model, direct paths between latent design variables (such as cognitive lighting, psychologically informed color schemes, familiar spatial arrangements, sensory connection with nature, and environmental form) and anxiety reduction were statistically significant and associated with substantial path coefficients. For example, the path coefficient between environmental form and anxiety reduction was 0.52, while the coefficient for natural lighting was 0.61, indicating the strongest effects within the model. Indirect paths were also analyzed to identify the role of mediating variables. Path analysis revealed that familiar spatial arrangements and environmental forms contribute indirectly to anxiety reduction through enhancing a sense of psychological safety. A major advantage of using LISREL in this study was its capability to simultaneously analyze multiple causal relationships among variables, which cannot be achieved by SPSS alone. This structural analysis enhanced the generalizability of the cognitive design model and enabled the researcher to present a coherent framework of internal relationships among variables in the environmental design process. Overall, the combined use of SPSS and LISREL provided an integrated approach encompassing descriptive, inferential, and structural statistical analyses, thereby increasing the depth and accuracy of the findings. This analytical integration not only provided clear answers to the research hypotheses but also enabled the testing of the conceptual model and clarified the individual and combined roles of environmental design components in reducing anxiety among patients with schizophrenia. As a final conclusion, the statistical analyses demonstrated that designing therapeutic environments based on cognitive and environmental psychology principles can significantly reduce anxiety levels in patients with schizophrenia, and this effect was confirmed not only at the perceptual level but also through rigorous statistical evidence. These findings highlight the necessity of incorporating psychologically informed design principles in treatment and rehabilitation centers for psychiatric patients and pave the way for further applied research in this domain.

3. Findings and Results

The results obtained from this study clearly demonstrate that exposure of patients with schizophrenia to environments designed on the basis of environmental cognitive components led to a significant reduction in their anxiety levels, such that the data collected through advanced and comparative statistical tests, including the paired-samples t-test, Pearson correlation analysis, and multiple regression analysis, clearly confirmed that the mean anxiety scores of patients significantly decreased after the mental and visual experience of these environments. In these therapeutic environments, design was carried out on the basis of environmental psychology principles and familiar cognitive patterns; more specifically, architectural elements such as soft natural light, cool and calming colors, gentle and predictable forms, simple and familiar arrangements, and visual connection with natural elements (such as plants, green landscapes, or daylight from the sky) were incorporated into the design, all of which, according to prior scientific findings in the fields of environmental psychology and healing design, can enhance a sense of psychological safety, mental calmness, and reduction of anxiety-related arousal in individuals. In this regard, anxiety scores were measured using the standardized Hamilton questionnaire before and after presentation of images of these environments to the patients, and analysis of the results showed that anxiety levels declined, with this reduction being statistically significant at the 95% confidence level. Moreover, comparison with images of non-cognitive designed environments—those using environmental elements lacking familiarity and mental affinity, such as intense colors, harsh forms, complex layouts, and glaring artificial lighting—showed that in such environments no significant change in patients' anxiety levels occurred, and in some cases they even led to increased feelings of tension and mental unrest. This comparison not only highlights the effectiveness of cognitive design, but also emphasizes the importance of the presence of specific components in designing therapeutic spaces for psychiatric patients. Among the components that showed the greatest effect in reducing anxiety in this study were controlled natural light (neither too intense nor too dim), colors with blue, green, and earthy undertones that are associated with human biological memory, the use of natural materials such as wood, soft textures, avoidance of broken and asymmetrical forms, the presence of windows overlooking open space or

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a courtyard, and furniture arranged in a group-based and intimate manner. From a psychological perspective, these elements contribute to the formation of familiarity, environmental predictability, and a reduced sense of threat or alienation, thereby providing a comprehensible and low-stress setting for patients with schizophrenia, who commonly suffer from fragmented internal experiences, persistent anxiety, and sensory hallucinations. In explaining the reason for this significant reduction in anxiety, reference can be made to theories of environmental processing and cognitive models of anxiety, which state that unfamiliar, complex, or harsh environmental stimuli can, in patients with mental disorders, especially schizophrenia, lead to excessive activation of the brain's alarm system, such as the amygdala, and trigger stress responses, whereas environments containing familiar, simple, biological, and natural stimuli can reduce irritability of the central nervous system. The findings of this study correspond well with the existing theoretical literature, including the OHE framework (Optimal Healing Environment) and the DSHIE model (Design Strategies for a Healing Indoor Environment), and indicate that patients' spatial perception of their surroundings is not merely a function of form and function, but is also highly dependent on cognitive load, degree of mental familiarity, sensory memory, and the emotional effect of space. In fact, the design of therapeutic environments for patients with schizophrenia cannot be limited solely to physical functions such as safety, ventilation, or daylight access, but must also be based on psychological principles and sensory perception. Therefore, one of the key findings of this study is that mere exposure to a therapeutic environment designed according to cognitive patterns, even at the level of mental imagery and without physical presence, can affect anxiety reduction, a matter that further underscores the importance of mentally oriented and cognitively legible design. From a clinical perspective, reduced anxiety in psychiatric patients can also have positive effects on the course of treatment, patient participation in psychotherapy sessions, reduced need for sedative medications, and shorter hospital stays. Such environments may also prevent relapse after discharge. For this reason, the results of this study can provide guidance for administrators of treatment centers, healthcare architects, psychiatrists, and policy-makers, so that in the design and revision of psychotherapy environments they may employ indicators whose effectiveness in reducing anxiety has been scientifically demonstrated. In final terms, it may be concluded that the design of therapeutic environments can not only play a complementary role in pharmacological and psychotherapeutic processes, but can itself function as an independent psychological intervention in controlling and reducing anxiety in patients with schizophrenia, provided that it is designed on the basis of cognitive, biological, and environmental psychology principles rather than solely functionalist considerations.

3.1. Effective Components: Lighting, Color, Furniture, Micro-Spatial Layout, Texture, and Materials

The findings of this study clearly show that certain specific environmental components, such as lighting, color, furniture, micro-spatial layout, and texture and materials, play a significant role in reducing anxiety levels in patients with schizophrenia, and these elements, as cognitive keys in the design of therapeutic environments, can be employed in the treatment process and in enhancing patients' psychological quality of life. In the domain of lighting, the data indicate that natural light of moderate intensity, with the possibility of user control, had the greatest positive effect on mood and mental calming in patients. The presence of natural light not only helps regulate the body's circadian rhythm, but also directly affects anxiety levels by influencing melatonin and serotonin secretion. On the other hand, the use of artificial lighting with a warm, non-glare spectrum in interior spaces also prevents environmental stress and strengthens a sense of calm. Color, as one of the foundational elements in design, also exerts considerable psychological effects in psychiatric patients, especially individuals with schizophrenia. The findings indicate that cool and natural colors such as soft green, light blue, earth tones, and warm whites had the strongest effects in reducing psychological irritability and creating a sense of security. Neutral and light colors made the space appear larger, more predictable, and safer, and thus reduced the sense of confinement and anxiety in patients. By contrast, intense and contrasting colors or those with high saturation generated strong emotional reactions and in some cases led to excessive arousal and mood instability in patients. In the

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domain of furniture, the research results showed that the use of furniture with ergonomic design, soft and rounded forms, appropriate height, and gentle fabric coverings produced the greatest degree of satisfaction and comfort in patients. Furniture with harsh forms, sharp edges, or dry metallic and plastic materials increased the psychological distance between the user and the environment and intensified the sense of alienation. In fact, when patients encounter objects and forms that are familiar to them in terms of biological memory and prior experience, they regain a sense of environmental controllability and their anxiety decreases. Another important influential component is the arrangement of micro-spaces, or interior layout planning, which includes the placement of spatial elements within therapeutic units. In this regard, the design of spaces with clear and uncomplicated circulation routes, open sightlines, places for voluntary solitude, and avoidance of spatial dead ends plays a fundamental role in reducing confusion and arousal in patients. Spaces in which patients can easily find their way, experience social interaction if they wish, and at the same time preserve their personal privacy are far more effective than rigid, partitioned, or complexly designed spaces. Likewise, the creation of semi-private areas furnished comfortably at different points throughout the wards provides patients with opportunities for rest, conversation, or individual concentration and reduces their anxiety. Regarding texture and materials, the data derived from specialist interviews and patient responses showed that the use of natural materials such as wood, soft natural stone, breathable fabrics, and flooring with relative softness had the greatest positive effect in creating a sense of psychological warmth, security, and calm. Through their mental association with nature and pleasant past memories, these materials created a kind of sensory familiarity that proved effective in reducing symptoms of psychological disconnection. In addition, the use of wall and floor finishes with soft colors, ease of cleaning, and absence of intense light reflection contributed to visual calmness. Avoidance of shiny metallic surfaces, cold glass, or harsh industrial finishes was strongly recommended by specialists, because such surfaces, in schizophrenic patients with distortions in sensory perception, may lead to arousal, anxiety, or even stimulation of visual and auditory hallucinations. The combination of all these components in therapeutic environment design has its greatest effect when they are used in an integrated and coordinated manner; that is, the mere presence of natural light or a calming color, if accompanied by inappropriate furniture or a complex spatial layout, cannot produce the expected anxiolytic effect. Therefore, effective design for anxiety reduction must be carried out systematically and comprehensively rather than through isolated interventions. From a theoretical perspective, the findings of this study are aligned with environmental psychology theories, including Place Attachment Theory, Attention Restoration Theory, and the Samueli Optimal Healing Environment model, all of which emphasize the role of environmental components in generating positive emotions, reducing stress, and improving human psychological well-being. Ultimately, it can be concluded that appropriate lighting, familiar colors, ergonomic furniture, logical arrangement of micro-spaces, and proper selection of texture and materials all play a fundamental role in creating a cognitively legible and calming therapeutic environment for patients with schizophrenia and should be considered strategic principles in the design of psychiatric therapeutic environments. These findings can provide valuable guidance for architects, interior designers, treatment center administrators, and healthcare policy-makers so that in the design of future spaces they may select components that have been scientifically shown to be effective in reducing anxiety and promoting patients' mental health.

In order to validate the instruments used in the present study, which was conducted to examine the effect of therapeutic environment design based on cognitive patterns on reducing anxiety in patients with schizophrenia, a detailed analysis of validity and reliability indices was considered one of the necessary and fundamental stages of the research. Validity, as a criterion for assessing the accuracy and correctness of measuring the concepts under study, and reliability, as an index of the stability and repeatability of the instrument across repeated assessments, are among the most important components that ensure confidence in the final research findings. In this study, the standardized Hamilton Anxiety Rating Scale (HARS) was used to assess patients' anxiety, as it is regarded as one of the most valid instruments for measuring anxiety in

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psychiatric patients. To confirm the content validity of the instrument, the opinions of eight specialists in psychiatry, clinical psychology, therapeutic environment design, and healing architecture were obtained. Content validity was calculated through the Content Validity Ratio (CVR) using Lawshe's formula, in which the proportion of expert judgments regarding the necessity of each item was examined. Items with CVR values higher than the critical value specified in Lawshe's table (for eight experts, a minimum of 0.75) were accepted as having strong content validity, whereas items with lower scores were either eliminated or revised. Ultimately, a questionnaire with optimal content validity and approved by experts was developed. In addition, to evaluate face validity, the clarity, simplicity, and apparent appropriateness of the items in relation to the measured concept were examined, and the experts independently expressed their views regarding the comprehensibility and clarity of the items for the target population, namely patients with schizophrenia. The results indicated that all items had a high level of comprehensibility and were understandable for patients. Furthermore, to evaluate construct validity, particularly in the design of questionnaires related to environmental cognitive components, exploratory factor analysis (EFA) was employed to identify the factor structure of the instrument. At this stage, the Kaiser–Meyer–Olkin (KMO) test was used to assess sampling adequacy, and Bartlett's test was used to examine correlations among variables. The obtained KMO value was 0.742, indicating adequate sampling for factor analysis. Bartlett's test was also significant at a level below .001, confirming the suitability of the correlation matrix among items for factor analysis. In the factor analysis, the extracted components were categorized using varimax rotation, and a factor loading above 0.40 was considered the criterion for retaining items. The principal components included cognitive lighting, calming color schemes, familiar spatial forms, logical furniture arrangement, and connection with nature, all of which were retained in the factor structure and formed the conceptual model of the study. On the other hand, to assess instrument reliability and the internal consistency of items, Cronbach's alpha coefficient was used. The Cronbach's alpha calculated for the entire Hamilton questionnaire was 0.758, which was considered acceptable and above the minimum criterion of 0.70 for newly used instruments. Separate reliability coefficients were also calculated for the environmental design subscales, all of which ranged from 0.72 to 0.81; these values indicate high internal consistency and appropriate coherence among items. For further confirmation of reliability, the test–retest method was also used, in which the Hamilton questionnaire was administered to 10 selected patients on two occasions with a 7-day interval, and the Pearson correlation coefficient between the two administrations was 0.87, indicating high temporal stability of the instrument. Such validity and reliability indices provided strong assurance for the final data analysis and research inferences. Since research instruments are regarded as a key link in the chain of scientific credibility, these analyses played a fundamental role in legitimizing the final results. Based on these statistical indices, it can be argued that the instruments used in the study were not only capable of measuring the target variables with high accuracy, but also possessed the stability and consistency necessary for replication and generalization. Therefore, the analysis of validity and reliability indices in this study not only strengthened the internal validity of the research, but also created the basis for applying the findings to practical planning in the design of psychiatric therapeutic environments. This high level of validity made it possible for the proposed design model based on environmental cognitive components to be introduced as a standard framework for human-centered design in psychotherapy centers.

Figure 1

Mean Anxiety Scores Before and After Exposure to the Designed Environment (Before vs. After Exposure):

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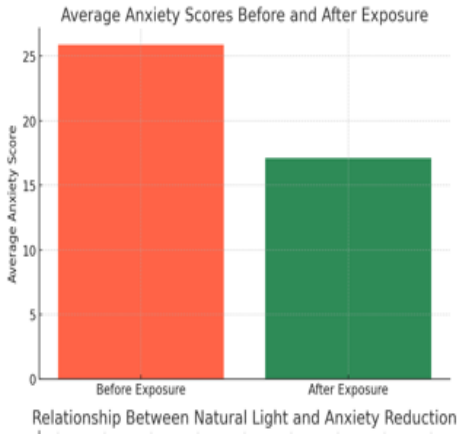
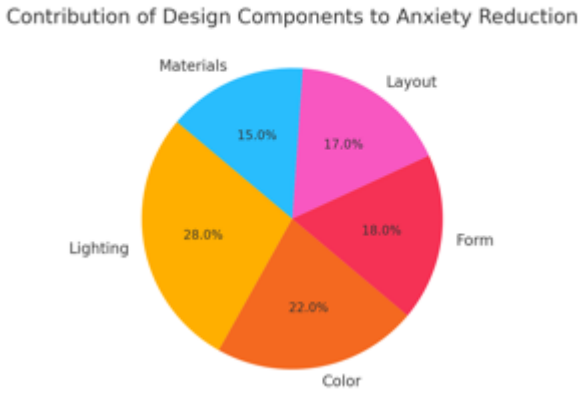


This bar chart compares the mean anxiety scores of patients with schizophrenia before and after exposure to the therapeutic environment designed on the basis of cognitive components. As shown in the chart, the mean anxiety score decreased substantially after exposure. This statistically significant reduction indicates that even the mental or visual experience of an environment designed according to familiar cognitive principles, such as natural light, soft colors, and familiar forms, can be effective in calming patients and reducing their level of emotional arousal. Such a result clearly confirms the importance of the role of environmental design in non-pharmacological interventions.

Figure 2

Pie Chart of the Contribution of Design Components to Anxiety Reduction (Pie Chart – Component Contribution):



In this chart, five key environmental design components that were effective in reducing anxiety in patients with schizophrenia are ranked according to their percentage of contribution. The largest share belonged to lighting, accounting for 28%, reflecting its established role in regulating biological rhythms and reducing patients' mental tension. Color ranked second with a contribution of 22%, indicating the effect of calming colors on the human psyche. Spatial form, layout of elements, and materials ranked in the subsequent positions, respectively. This analysis emphasizes that effective design for psychiatric patients must be based on a set of coordinated components, and focusing on only one factor is insufficient.

Figure 3

Scatter Plot of the Relationship Between Natural Light Intensity and Anxiety Reduction (Scatter Plot – Light vs. Anxiety Reduction):

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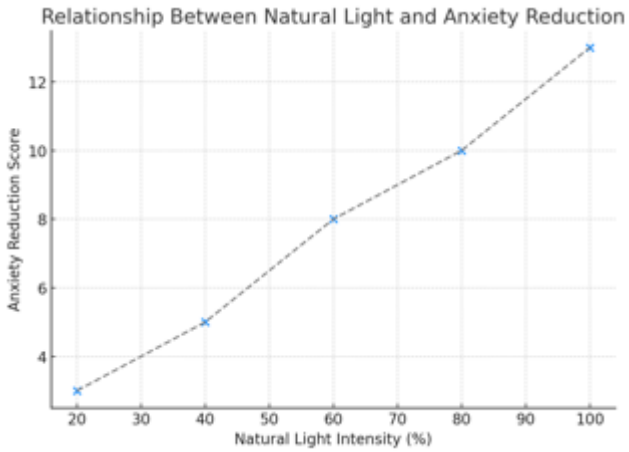
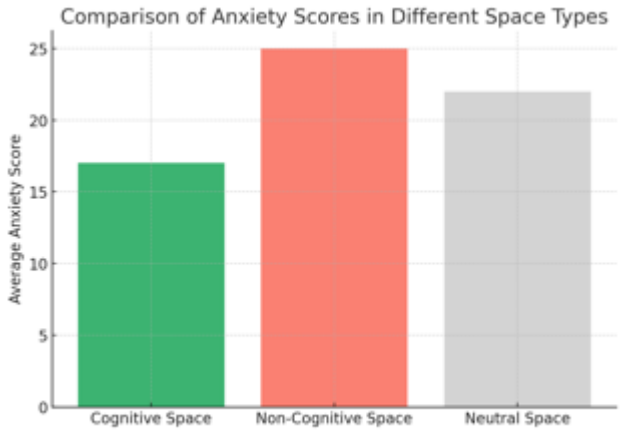


This chart shows that there is a direct and positive relationship between increased intensity of natural light in the therapeutic environment and reduction in patients' anxiety scores. In other words, as the amount of natural light received increases, a greater reduction in anxiety is observed. This finding is consistent with theories of environmental psychology and lighting science, since natural light plays a role in mood improvement, increased secretion of affect-regulating hormones, and creation of a sense of temporality in patients. This effect is particularly important in patients with schizophrenia, who often experience disturbances in the perception of time and place.

Figure 4

Comparison of Mean Anxiety Scores Across Three Types of Therapeutic Environment (Bar Chart – Space Type vs. Anxiety):



This chart compares the mean anxiety scores across three types of therapeutic environment: cognitive space, non-cognitive space, and neutral space. According to the chart, the cognitive space clearly produced the lowest level of anxiety, whereas the non-cognitive space, characterized by unfamiliar or stimulating colors and forms, produced the highest level of anxiety. The neutral space was positioned between these two. This significant difference indicates that the type of environmental design has a direct effect on the psychological experience of patients, and cognitively oriented design can be used as a therapeutic tool in the management of anxiety.

4. Discussion

The findings of the present study demonstrated that exposure to therapeutic environments designed based on familiar cognitive patterns led to a statistically significant reduction in anxiety among patients with schizophrenia. This reduction, confirmed through paired-samples t-tests, Pearson correlation, and multiple regression analyses, indicates that environmental design can function as an

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effective non-pharmacological intervention in the management of anxiety symptoms. Specifically, components such as controlled natural lighting, calming color schemes, familiar spatial forms, coherent layouts, and visual access to nature showed strong associations with decreased anxiety levels. These results are consistent with the broader literature in environmental psychology and healthcare design, which emphasizes the role of environmental stimuli in modulating emotional and physiological responses. For instance, the stress-reduction theory proposed by Ulrich highlights that exposure to supportive environmental features, particularly natural elements, can significantly lower stress and promote recovery (8, 9). Similarly, the observed importance of natural light and visual connection to greenery in the current study aligns with Kaplan's Attention Restoration Theory, which posits that natural environments facilitate cognitive recovery and emotional regulation (16).

The significant negative correlation between environmental design components and anxiety levels observed in this study further supports the notion that physical space is not merely a passive context but an active determinant of psychological states. From a theoretical standpoint, this finding can be interpreted through Bandura's social cognitive theory, which emphasizes the reciprocal interaction between individuals and their environments (15). In this framework, environments that are predictable, familiar, and cognitively coherent reduce uncertainty and perceived threat, thereby lowering anxiety. Conversely, environments characterized by complexity, ambiguity, or unfamiliarity may increase cognitive load and trigger stress responses. This interpretation is particularly relevant for patients with schizophrenia, whose cognitive processing and perceptual integration are often impaired, making them more sensitive to environmental inconsistencies and overstimulation (12).

Moreover, the results of the regression analysis, which indicated that approximately 68% of the variance in anxiety reduction could be explained by environmental design variables, highlight the substantial explanatory power of these factors. This finding reinforces the importance of adopting an integrated design approach, as suggested in architectural theory, where multiple environmental components are considered simultaneously rather than in isolation (17). The synergy observed among lighting, color, spatial organization, and connection to nature suggests that therapeutic effectiveness arises from the holistic configuration of space rather than from individual elements alone. This aligns with the concept of evidence-based design in healthcare architecture, which advocates for the systematic application of research findings to optimize patient outcomes (10, 14).

The qualitative findings derived from the Delphi process further enriched the interpretation of the quantitative results by providing insight into expert perspectives on environmental design. The identification of key components such as cognitive lighting, psychologically appropriate color schemes, and familiar spatial arrangements corresponds closely with prior research emphasizing the importance of sensory and perceptual factors in healthcare environments (6, 13). Additionally, the emphasis on user-centered design and the incorporation of human experience in spatial planning is consistent with Zeisel's framework of environment–behavior–neuroscience integration, which underscores the neurological and psychological impacts of design decisions (11).

Another important finding of the study is the differential impact of cognitive versus non-cognitive environments on anxiety levels. While exposure to cognitively designed environments significantly reduced anxiety, exposure to non-cognitive environments either had no effect or, in some cases, increased anxiety. This contrast highlights the critical role of familiarity and coherence in environmental perception. According to Frumkin, environmental stressors such as noise, visual clutter, and disorganized spatial layouts can contribute to psychological distress and exacerbate mental health conditions (7). The present findings extend this understanding by demonstrating that the absence of cognitively meaningful design elements can negate potential therapeutic benefits and even produce adverse effects.

The clinical implications of these findings are substantial. Anxiety is a major factor influencing treatment outcomes in patients with schizophrenia, affecting adherence to therapy, engagement in social interactions, and overall recovery trajectories (3, 4). By reducing anxiety through environmental design, it is possible to enhance the effectiveness of existing therapeutic interventions, reduce

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reliance on pharmacological treatments, and improve patient satisfaction. This perspective is supported by research indicating that supportive healthcare environments can enhance patient well-being and facilitate recovery processes (24). Furthermore, the integration of positive environmental distractions, as highlighted by Pati, can provide patients with opportunities for mental engagement and emotional relief, thereby reducing stress and promoting healing (18).

The importance of environmental design is further underscored by recent studies on resilience in individuals affected by severe mental disorders. Tailaiti and colleagues demonstrated that supportive environments play a significant role in enhancing psychological resilience among caregivers of patients with schizophrenia, suggesting that similar mechanisms may operate for patients themselves (20). In this context, therapeutic environments that incorporate familiar cognitive patterns can be seen as facilitating adaptive coping mechanisms by reducing environmental stressors and enhancing perceived control. This is particularly important given the findings of Lin and colleagues, which highlight the complex interaction between environmental factors and genetic predispositions in shaping mental health outcomes (5).

From a methodological perspective, the use of a mixed-methods design in this study allowed for a comprehensive examination of the research problem, combining the depth of qualitative insights with the rigor of quantitative analysis. This approach is consistent with Creswell's recommendation for addressing complex research questions that involve both subjective experiences and measurable outcomes (21). The use of standardized measurement tools, such as the Hamilton Anxiety Rating Scale, further strengthened the validity of the findings by ensuring reliable assessment of anxiety levels (23). Additionally, the application of advanced statistical techniques, as discussed by Cohen, provided robust evidence for the relationships between environmental variables and psychological outcomes (22).

One limitation of the present study is the relatively small sample size, particularly in the quantitative phase, which may limit the generalizability of the findings to broader populations. Additionally, the absence of a control group restricts the ability to make definitive causal inferences regarding the observed effects of environmental design. Another limitation is the reliance on visual and mental exposure to designed environments rather than real-world implementation, which may not fully capture the complexity of spatial experience. Furthermore, individual differences in cognitive functioning, illness severity, and prior environmental experiences were not fully controlled, which could have influenced the results. Finally, the cross-sectional nature of the study limits the ability to assess the long-term effects of environmental interventions on anxiety reduction.

Future research should focus on expanding the sample size and including more diverse patient populations to enhance the generalizability of the findings. Longitudinal studies are needed to examine the sustained effects of therapeutic environment design on anxiety and other psychological outcomes over time. Experimental designs with control groups should be employed to strengthen causal interpretations. Additionally, future studies could explore the interaction between environmental design and other therapeutic interventions, such as psychotherapy or pharmacotherapy, to determine potential synergistic effects. The use of immersive technologies, such as virtual reality, may also provide more realistic simulations of therapeutic environments and allow for more precise measurement of patient responses.

From a practical perspective, the findings of this study suggest that healthcare designers and policymakers should prioritize the integration of cognitive and environmental psychology principles in the design of psychiatric facilities. Emphasis should be placed on creating environments that are predictable, familiar, and connected to natural elements, as these features have been shown to reduce anxiety and enhance well-being. Collaboration among architects, clinicians, and researchers is essential to ensure that design decisions are informed by empirical evidence and aligned with patient needs. Moreover, existing healthcare facilities should be evaluated and, where necessary, redesigned to incorporate these principles, thereby improving the quality of care and patient outcomes.

5. Conclusion

In summary, the findings of the present study provide strong empirical support for the role of cognitive-based

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environmental design in reducing anxiety among patients with schizophrenia. By integrating theoretical frameworks from environmental psychology, cognitive theory, and architectural design, the study offers a comprehensive understanding of how therapeutic environments can influence mental health outcomes. These results not only contribute to the academic literature but also have practical implications for the design of healthcare facilities, highlighting the need for interdisciplinary collaboration among architects, psychologists, and healthcare professionals. Ultimately, the study underscores the importance of viewing the physical environment as an active component of therapeutic interventions, capable of enhancing well-being and supporting recovery in individuals with mental health disorders.

Authors' Contributions

All authors contributed substantially to the study and to manuscript development, and all approved the final version.

Declaration

The authors declare that artificial intelligence tools were used only to assist with language editing, translation, and improvement of the manuscript's readability. All conceptualization, study design, data collection, data analysis, interpretation of findings, and final approval of the manuscript were performed by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the content.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The source file reports an anonymous questionnaire-based study in a school population, but it does not specify the approving ethics committee or approval code. Before journal submission, the authors should verify and insert the formal ethics approval details and the exact consent/assent procedures used. The present manuscript therefore avoids inventing unverified ethics identifiers.

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