

The Relationship Between Residential Environment Color Perception and Mental Health Outcomes: A Cross-Sectional Study of Urban Communities

Shibo Fei^{1*}, Ke Chen¹

¹Taizhou Polytechnic College, No. 8 Tianxing Road, Taizhou Medical High-Tech Zone, Jiangsu 225300, China

Abstract

INTRODUCTION: The impact of urban residential environments on residents' mental health has attracted growing attention. As an important element of environmental perception, the psychological effects of color remain insufficiently studied systematically. This cross-sectional study aims to develop a systematic analysis of residential environment color and to establish design strategies and application methods for residential color.

OBJECTIVES: To explore the relationship between urban residents' perception of residential environment color and their mental health outcomes (e.g., anxiety, depression, life satisfaction).

METHODS: A cross-sectional study design was adopted. For the stratified cross-sectional investigation, three dimensions—architecture, landscape, and interior—were established as research domains. Through questionnaire surveys and a color perception scale, a sample of 800 urban community residents from 30 communities across China was investigated. SPSS was used to perform correlation analysis and multiple regression analysis.

RESULTS: The perception of residential environment color at the architectural, landscape, and interior levels was significantly correlated with mental health indicators ($p < 0.01$). Different hues were directly or indirectly associated with positive and anxious emotions and exerted psychological effects on community residents.

CONCLUSION: Color perception in the residential environment is an important factor influencing urban residents' mental health. It is recommended that the application of color psychology be incorporated into urban planning and interior design.

Keywords: Color perception, Mental health, Residential environment, Urban community, Cross-sectional study, Environmental psychology

Received on 29 July 2026, accepted on 29 September 2026, published on 14 October 2026

Copyright © 2026 Shibo Fei *et al.*, licensed to EAI. This is an open access article distributed under the terms of the [CC BY-NC-SA 4.0](#), which permits copying, redistributing, remixing, transformation, and building upon the material in any medium so long as the original work is properly cited.

doi: 10.4108/eetpht.11.14234

1. Introduction

With the acceleration of global urbanization, cities have become the primary habitat of humanity; however, high population density, fast-paced living, and complex environmental stimuli pose severe mental health challenges to residents. A large body of research confirms that urban life is significantly associated with the high prevalence of mental health problems such as anxiety and depression; chronic

exposure to stressors such as congestion, noise, and spatial oppression continuously depletes psychological resources [1-2]. Among these, the high density and visual monotony of residential spaces further weaken residents' sense of environmental control and exacerbate psychological burden. The present survey shows that the anxiety (the mean of GAD-7=4.88) and depression (the mean of PHQ-9=5.21) levels of

*Corresponding author. Email: feishibo@tzpc.edu.cn

community residents have approached the symptom threshold. How to optimize the built environment to provide residents with a psychological buffer has thus become a core issue in public health and urban planning.

Color constitutes a core element of the visual environment and an important medium through which the environment interacts with individual psychology. Research in environmental psychology indicates that color is not a mere physical attribute but a key stimulus that may be associated with variations in emotional valence, arousal, and cognitive states [3]: highly saturated warm tones can stimulate vitality yet easily induce tension, whereas low-saturation cool tones have a calming and relaxing effect, and natural color palettes promote attention restoration and positive emotion through a "biophilic" connection [4-5]. Its effects are modulated by brightness, purity, and mode of combination, and are further shaped by environmental function, cultural background, and individual differences [6]. In the urban residential environment, color-transmitted through the multiple carriers of architecture, landscape, and interior- constitutes the visual environment to which residents are most frequently exposed, exerts a continuous and pervasive influence on psychological states, and thereby offers a potential intervention pathway for mental health promotion. Automated colour-analysis research shows that computational palette extraction can assist designers while preserving human judgment, supporting the present emphasis on context-sensitive colour perception [7].

Although the psychological effects of color have been widely validated and research on the built environment and mental health has accumulated substantially, notable gaps remain in the existing literature: most studies focus on macro-level elements such as green space, building form, and noise, with insufficient attention to color as a fine-grained, perceptual variable[8-9]; existing color research is either confined to laboratory studies of single color patches or concentrated on specific spaces, lacking integrated analysis of the three-dimensional composite color environment of architecture, landscape, and interior, and has not clarified the specific mechanisms by which hue, purity, brightness, as well as harmony and functional fit, affect long-term mental health. In China's communities, problems such as "chromatic overexposure", "a thousand cities with one face", and "abrupt artificial colors" stand in contradiction to residents' preference for gentle, natural, and harmonious colors, yet whether this contradiction translates into mental health risks lacks empirical support; especially against the backdrop of rapid urbanization, the lagging governance of community color allows this latent risk to accumulate continuously.

Against this backdrop, taking the urban residential community as the setting, this study focuses on color perception across the three dimensions of architecture, landscape, and interior, and systematically investigates — through a cross-sectional survey — the cross-sectional associations between color attributes, compositional characteristics, functional fit, and residents' mental health. Theoretically, the study integrates environmental psychology, color psychology, and urban planning, proposes the concept of "Chromatic Psychological Environment

(CPE)", and constructs a multidimensional, ecological analytical framework linking color to mental health. Practically, it clarifies a "safe color domain" and design principles that promote mental health, formulates actionable color strategies for urban renewal and community building, and provides a new pathway for low-cost, high-efficiency mental health intervention.

2. Literature Review

2.1 Color-Emotion Relationship from the Perspective of Environmental Psychology

Environmental psychology is devoted to investigating the interaction between the physical environment and human psychology and behavior. Within this theoretical framework, color is not merely a physical property of an object's surface but an environmental stimulus that actively affects individuals' emotional experience, cognitive evaluation, and behavioral tendencies. The residential environment, as the space to which individuals are exposed for the longest time and with which they interact most frequently in daily life, has a profound and sustained impact of its color design on residents' mental health.

Early research primarily focused on laboratory assessments of the emotional valence, arousal, and dominance of single colors[3]. However, the development of environmental psychology shifted the research perspective from abstract color patches to concrete, contextualized built environments. Scholars generally agree that the influence of color on emotion is neither isolated nor absolute but is complexly regulated by the three dimensions of saturation, brightness, and hue, and interacts with multiple factors such as environmental type, cultural background, and individual differences [6].

First, the psychological effects of the physical attributes of color constitute the cornerstone of research. Highly saturated, high-brightness colors — especially warm tones (e.g., red, orange) — are typically associated with higher physiological arousal and more intense emotional responses, capable of stimulating vitality and excitement, yet their overuse may also induce anxiety and tension [5]. Conversely, low-saturation, high-brightness cool tones (e.g., blue, green) are generally considered to have calming and relaxing effects, reducing arousal and alleviating mental stress [10]. In particular, green and blue, commonly found in nature, have been confirmed to effectively promote attention restoration and the generation of positive emotion because of their evolutionary association with open skies and lush vegetation - a phenomenon strongly supported by the "Attention Restoration Theory" and the "Biophilia Hypothesis" [4,11].

Second, environmental psychology emphasizes the crucial role of "context" in the color-emotion nexus. The psychological effect of the same color may differ markedly across functional spaces. For example, bright yellow may be read as lively and fun in a children's activity area but as glaring and unsettling in an adult bedroom, where it disturbs

sleep [12]. Studies show that soft green and blue walls can effectively reduce patients' anxiety, whereas traditional white may intensify the cold, alienating sense of "institutionalization"[13]. This indicates that the emotional effect of color must be interpreted within the environmental function and socio-cultural context in which it is situated. As a composite environment, the residential community's color applications in public spaces, building facades, and landscape features collectively shape residents' overall environmental perception and emotional tone [14].

Third, culture and personal experience shape the diversity of color perception. Although certain cross-cultural universal emotional associations exist (e.g., red with passion, blue with tranquility), the symbolic meaning and emotional connotation of many colors are culturally specific [15]. With globalization, these cultural differences become especially salient in multicultural urban communities. Moreover, an individual's personality, past experience, and current mood also modulate their emotional response to environmental color. Therefore, in community color design, pursuing a "universal" optimal solution is often futile; a more reasonable strategy is to provide diverse yet harmonious color combinations that satisfy the psychological needs of different populations. Cross-cultural customer-value research likewise demonstrates that design meanings and preferences vary across cultural contexts, cautioning against universal colour prescriptions [16].

Finally, from the perspective of color combination and harmony theory, environmental psychology research has moved beyond single-color analysis toward the creation of an overall color atmosphere. Research shows that color harmony—the sense of pleasure and order that a color combination conveys to the observer—is key to the positive emotional experience of an environment [14]. Discordant, chaotic color schemes induce visual fatigue and psychological irritability. In the urban community environment, the colors of building facades, road paving, landscape vegetation, and public facilities require integrated design to form a coherent and aesthetically pleasing overall visual narrative. In sum, environmental psychology provides a solid theoretical framework for understanding the relationship between community color and residents' mental health: color directly affects emotional arousal and valence through its physical attributes, yet is complexly modulated by environmental function, cultural background, individual differences, and compositional harmony; future design must apply color strategies scientifically from an evidence-based standpoint to create built environments that promote mental health.

2.2 Existing Research on Urban Environment and Mental Health

With the acceleration of global urbanization, more than half of the world's population now resides in cities, a proportion expected to keep rising. As areas of highly concentrated human activity, cities' physical and social environments increasingly constitute a core issue in public health and urban

planning regarding their impact on residents' mental health [1]. A large body of research indicates an association between urban life and higher incidence of mental illnesses (such as anxiety disorders, depression, and schizophrenia). Therefore, systematically examining how key elements of the urban built environment affect residents' mental health is a necessary step in providing the macro-theoretical background for this study's investigation of the specific variable of community color environment.

Among the elements of the urban built environment, the psychological restorative function of green space has the broadest and most solid research foundation and is widely regarded as an effective "mental health resource." One of its core mechanisms is stress reduction and attention restoration: exposure to nature, even brief visual exposure, can effectively lower cortisol levels and slow heart rate, thereby alleviating physiological and psychological stress [17]; following the "Attention Restoration Theory", nature's "soft fascination" enables people to disengage from attention-demanding urban tasks and recover depleted cognitive resources [18]. Furthermore, well-planned, easily accessible green spaces not only encourage beneficial physical exercise but also provide important venues for community interaction, thereby fostering social support networks and enhancing individual psychological resilience [8]. Multiple large-scale longitudinal studies have also confirmed that living in communities with higher green coverage is significantly associated with persistently higher life satisfaction and lower psychological distress [19].

Beyond green space, the "hard" elements of the built environment—such as building form, street layout, and spatial density—also profoundly affect residents' psychological states. At the level of spatial perception, overly crowded or enclosed spaces easily induce anxiety, whereas public spaces with good visibility and a sense of openness enhance residents' perceived safety [20]. Notably, building height has also been confirmed to correlate with social isolation and depressive symptoms; high-rise residential buildings in particular may increase residents' loneliness by limiting their connection to ground-level public life, with especially pronounced effects on the elderly and families with young children [2,21].

Simultaneously, negative stimuli in the urban environment, or environmental stressors, are important risk factors for mental health problems. Long-term exposure to high-decibel traffic noise not only disturbs sleep but also leads to chronic stress such as anxiety and irritability[22]; in recent years, a growing body of epidemiological evidence has revealed an association between air pollution (especially PM_{2.5}) and the incidence of depression, with potential mechanisms possibly involving neuroinflammatory responses triggered by pollutants[23-24]; moreover, prolonged, congested commuting has been confirmed as one of the main daily stressors for urban residents, significantly associated with decreased life satisfaction[25].

Finally, it must be emphasized that the physical environment does not act in isolation; it often indirectly modulates mental health by influencing social interaction. For example, a community with squares, community centers,

and walkable streets provides residents with more opportunities for social contact, thereby effectively countering the loneliness prevalent in urban life [9]. This "socio-spatial" attribute indicates that the design of the built environment must transcend mere aesthetic and functional considerations to attend to its deeper capacity to promote or inhibit social connection. In sum, the urban built environment constitutes a complex ecosystem affecting residents' mental health through green-space provision, building and street form, environmental stressors, and the shaping of social interaction. Existing research has painted a macro-level picture, but how more refined and perceptual elements within the environment—such as color—integrate into this system and exert their unique effects still requires deeper exploration. Grounded in this context, the present study focuses on the color environment of residential communities, seeking to reveal the role this visual variable plays in regulating the mental health of urban residents.

2.3. Application Status of Color in the Residential Environment

Color shapes residents' daily color background through three major carriers - architecture, landscape, and interior - and as people move among these spaces, different colors induce different psychological changes. This section reviews the application status, problems, and development trends.

2.3.1 Application Status of Color in Community Architectural Environments

The color of building facades is the skeleton of a community's overall color tone, determining its first visual impression and spatial character. Historically, community architectural color has evolved from "functionalist monotony" to "market-driven diversity": older communities, constrained by economy, materials, and a "practicality-first" mindset, exhibit a narrow color spectrum dominated by cement gray, brick red, and white textured coatings, forming a uniform yet lifeless "grayish" tone that easily evokes a sense of oppression and datedness, making it a current priority for renewal; after the new century, with the booming real estate industry, developers adopted large amounts of colored coatings and tiles in pursuit of distinctiveness, giving rise to styles such as "Mediterranean blue-and-white" and "neoclassical beige," yet, lacking systematic color planning, fell into the pitfalls of "chromatic overexposure" (abuse of high saturation and high contrast causing visual-order chaos) and "a thousand cities with one face" (blindly following trends leading to homogenization). At present, various urban renewal and old-community renovation efforts also list facade painting as a key task.

From the perspective of existing problems, the absence of color management and technical limitations jointly create challenges: macro-level color planning has insufficient binding force at the micro level of communities, and adjacent parcels acting independently of one another form abrupt "color islands"; inferior coatings fade and peel in the short term, and color differences between batches aggravate facade

disorder; residents' later-added security grilles, air-conditioner units, etc., of inconsistent specifications, form hard-to-manage visual blemishes that seriously damage the original design intent of the building color. Overall, community architectural color is moving from spontaneous to conscious; in the future, the statutory status of urban color planning must be strengthened, innovation pursued on the basis of respecting regional context, and color persistence and harmony ensured through fine management and high-quality materials, so as to build a community image that fosters identity and belonging.

2.3.2 Application Status of Color in Community Landscape Environments

Landscape color is directly related to residents' daily experience. Regarding soft planting, its application is exploring a shift from "green" to "colorful", yet planning depth remains insufficient: traditional greening emphasizes ecological shade and holds a singular conception of "green"; although in recent years there has been a deliberate addition of flowering and foliage plants, seasonal color planning is generally lacking, with configuration concentrated in spring, leaving color discontinuities in summer, autumn, and winter, and failing to form a continuous four-season rhythmic sequence; flowers often fall into festival arrangements or rigid color-block collages, losing natural elegance.

Regarding hardscape and public facilities, a balance between coordination and functionality is lacking: road paving mostly uses gray and red palettes with ambiguous spatial identity; "street furnituresuch" as fitness equipment, playground facilities, seats, and trash bins derives its color from manufacturers' standard colors ("engineering blue", "postal green", or high-saturation orange and purple)—functional yet seldom integrated with surroundings, often becoming jarring, abrupt stimuli that disrupt harmony. Although awareness of landscape color has awakened and designers attempt to use color to define functional spaces (primary colors in children's areas, neutral colors in quiet areas), most efforts remain at the level of "point-like" decoration, failing to elevate color to a core thread running through planning-design-construction-management; empirical research on color psychology and residents' preferences is insufficient, lacking scientific specificity. In the future, a shift from scattered ornamentation to full-lifecycle systematic planning is necessary, deeply exploiting the potential of plant color and improving the environmental integration of hard facilities.

2.3.3 Application Status of Color in Community Interior Environments

Interior color is more private and personalized, directly reflecting residents' aesthetic and psychological needs, and is characterized by "pursuing individual expression under common constraints". At the common level, the fine-decoration delivery of commercial housing shapes large-scale base color schemes: to cater to the broadest acceptance and control costs, developers' fine-decoration standards generally adopt a color strategy with a safety—net mechanism—walls dominated by plain white or very light beige and light gray,

floors of natural-wood-toned flooring or light-yellow and grayish tiles, and kitchens/bathrooms with white or light-coffee integrated cabinetry and sanitary ware. This neutralized tone creates a bright, open, and non-dated visual base; its advantage is granting residents great freedom for later personalized soft furnishing, but its disadvantage is that the base color of countless households becomes highly identical, lacking warmth and personality, and even appearing lifeless due to excessive coldness.

At the individual level, residents' soft-furnishing colors are diverse and emotive: color expression through furniture, curtains, textiles, wall decor, and lighting is extremely rich, containing both rational coordination following design aesthetics and affective projections of personal emotion, yet accompanied by "color overload"(piling too many colors or strong patterns in a small space causing visual chaos and anxiety) and blind following of trending colors ("advanced gray", "Morandi", "creamy style"- though elevating aesthetics, they also create new homogenization that may not meet all residents' expectations). Moreover, awareness of the scientific application of interior color awaits popularization; public choices mostly rely on intuition, feng shui, or online imitation, lacking scientific understanding of how color affects emotion, sleep, family interaction, and even children's cognition. Future interior color will pay more attention to the combination of "healthy living" and "personalized customization", considering light reflectance, emotional guidance, and individual matching, so that color evolves from a decorative means into a core active element in constructing a healthy and comfortable home.

2.4 Application of Cross-Sectional Studies in Environmental Psychology

Cross-sectional studies explore associations between environmental exposure and mental health outcomes by collecting data at a specific point in time; owing to their efficiency, economy, and ability to capture characteristics of broad populations, they are widely used in large-sample research on the built environment-wellbeing link[8]. For example, Triguero-Mas et al.[26] used cross-sectional data to analyze the green-space coverage and mental health of thousands of residents in Barcelona, finding that higher green coverage was significantly associated with less use of sedatives/antidepressants. Although the cross-sectional design cannot establish causality (it cannot rule out reverse causality or confounding-variable interference)[27], it holds irreplaceable value in generating hypotheses and identifying risk/protective factors; the use of multivariate models can control for confounding to some extent, and combining GIS-based objective exposure measurement with standardized scales can improve reliability and validity[28]. This study adopts a cross-sectional design, aiming to preliminarily map the association between community color environment and mental health, providing an empirical basis for subsequent causal research and design interventions.

3. Experimental Methods

3.1 Study Design

A cross-sectional survey, employing the three elements of color (brightness, purity, hue), was conducted to collect data on the architecture, landscape, and interior colors of the residential environment in a single sweep.

3.2 Participants

800 urban residents from 30 communities across China, aged 18-65, covering different genders, occupations, and dwelling types. This study was approved by the Ethics Committee of Taizhou Polytechnic College (Approval No. TZPC-2025-001). All participants provided written informed consent prior to data collection. No vulnerable populations were included in the study, and participants were informed of their right to withdraw at any time without penalty. Communities were selected through stratified random sampling across six provincial-level regions in eastern, central, and western China, and eligible residents were recruited via door-to-door household visits and community notice boards. Of 940 invited residents, 800 completed the survey, yielding a response rate of 85.1%. Missing values were handled by listwise deletion, and no weighting was applied.

3.3 Measurement Instruments

A self-developed Color Perception Scale assessed perception of the dominant hue, purity, and brightness of the residential environment; mental health scales included the GAD-7, PHQ-9, and the Satisfaction With Life Scale (SWLS); demographic variables included age, gender, education, income, and length of residence. The self-developed Color Perception Scale comprised 12 items rated on a 5-point Likert scale, with higher scores indicating stronger perceived hue, purity, and brightness. In the current sample, internal consistency was acceptable (Cronbach's alpha = 0.82 for the total scale; subscale alpha = 0.76-0.84). Confirmatory factor analysis supported a three-factor structure consistent with the brightness-purity-hue framework (CFI = 0.95, RMSEA = 0.06), and the scale showed convergent validity with the Brief Mood Introspection Scale ($r = 0.61$). The GAD-7, PHQ-9, and SWLS are validated instruments with established psychometric properties; in this sample their Cronbach's alpha values were 0.89, 0.86, and 0.87, respectively.

3.4 Data Analysis

SPSS was used for descriptive statistics, Pearson correlation analysis, and multiple linear regression analysis. Given the number of simultaneous tests across multiple color attributes and outcomes, a Bonferroni correction was applied to control the family-wise error rate, and only associations surviving the adjusted threshold ($p < 0.05/k$) were interpreted as

statistically robust. Prior to regression, assumptions of linearity, independence, homoscedasticity, and normality of residuals were examined; multicollinearity was assessed using the variance inflation factor (VIF), with $VIF < 5$ indicating acceptable tolerance. Effect sizes (standardized beta and partial correlation coefficients) and 95% confidence intervals were reported for all regression coefficients. A priori power analysis indicated that $N = 800$ provided power of at least 0.80 to detect a small-to-medium effect ($f^2 = 0.15$) at $\alpha = 0.05$.

3.5 Sample Characteristics and Descriptive Statistics

This study successfully collected 800 valid questionnaires from 30 urban communities across China. Before conducting the core variable analyses, we first performed descriptive statistical analyses on the sample's demographic characteristics and major mental health indicators, to gain a comprehensive understanding of the sample's basic composition and overall status. As shown in Table 1, the sample was relatively balanced in gender distribution, with slightly more women than men (52.0% vs. 48.0%); in age composition, the 26-45 young-and-middle-aged group predominated (62.0%), representing the core force of urban community activity; in educational background, those with a college degree or above accounted for the vast majority (85.0%), reflecting the sample's high cultural level; dwelling type was dominated by high-rise residential buildings (60.0%), consistent with the current mainstream urban dwelling form in China.

Descriptive statistics on the major mental health indicators (see Table 2) show that the sample's overall anxiety level ($M=4.88$) and depression level ($M=5.21$) were at the critical point between mild symptoms and the asymptomatic range (the cutoff is typically 5), indicating a certain degree of mental health risk among community residents; the mean life satisfaction was 21.56, at a moderately high level. The large standard deviations of each variable indicate significant individual differences in mental health outcomes within the sample, providing ample variance space for subsequent exploration of the influence of factors such as environmental color perception.

Table 1. Distribution of Sample Demographic Characteristics (N = 800)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	384	48.0
	Female	416	52.0
Age group	18-25	152	19.0
	26-35	288	36.0
	36-45	208	26.0
	46-65	152	19.0
Education	High school and below	120	15.0
	College (associate)	240	30.0

Occupation	Bachelor's	352	44.0
	Master's and above	88	11.0
	Professionals/technical	256	32.0
	Commerce/service	200	25.0
	Student	112	14.0
	Freelance/other	132	16.5
Length of residence	Retired/unemployed	100	12.5
	< 1 year	96	12.0
	1-5 years	312	39.0
	6-10 years	224	28.0
	> 10 years	168	21.0
Dwelling type	High-rise	480	60.0
	Multi-story	256	32.0
	Other (villa/bungalow, etc.)	64	8.0

Table 2. Descriptive Statistics of Major Mental Health Variables (N = 800)

Variable	Scale	Mean (M)	SD	Min	Max
Anxiety level	GAD-7	4.88	3.51	0	21
Depression level	PHQ-9	5.21	3.89	0	27
Life satisfaction	SWLS	21.56	6.42	5	35

3.6 Participant Basic Information and Color Preference Distribution

To explore the possibility of color preference as a potential moderating variable and to provide background information for subsequent analyses, this study investigated participants' color preferences for the three dimensions of the residential environment (architecture, landscape, interior); participants were asked to select their most preferred option from preset color palettes (Table 3). Architectural facade preference: participants' color preference for building facades was highly concentrated in warm tones (42.0%) and neutral colors (30.0%), consistent with the literature review's point that warm tones (e.g., beige, light coffee) convey warmth and comfort, and that neutral colors, as "safe colors", do not easily become dated; residents generally did not favor large-area use of cool tones (18.0%) or vivid colors (3.0%) as the dominant architectural color.

Community landscape preference: in the landscape environment, natural color palettes (green, wood, earth tones, etc.) received overwhelming preference (62.0%). This result strongly corroborates the "Biophilia Hypothesis" and residents' intrinsic psychological need for the natural environment and also reflects from the side why the abrupt colors of artificial facilities elicit negative perceptions. Personal interior preference: similar to architectural preference, in personal interior spaces, warm tones (39.0%) and neutral colors (26.0%) remained the mainstream choices, consistent with the "creamy style" trend analyzed earlier; residents tend to create a warm, soft, and individually

grounded home atmosphere; notably, the proportion choosing cool tones as the interior dominant (16.0%) was slightly higher than for landscape but lower than for architecture, possibly related to the psychological effect of cool tones aiding concentration in specific functional spaces (e.g., studies).

In summary, participants' color preferences across different environmental dimensions exhibited clear logic and functional orientation, overall tending toward gentle, natural, and harmonious color environments. This preference distribution not only provides important background explanation for the association between residents' color perception and mental health in the subsequent "Results Analysis" section but also suggests that when the real environment conflicts with residents' intrinsic color preferences, it may become a latent factor triggering psychological discomfort.

In summary, participants' color preferences across different environmental dimensions exhibited clear logic and functional orientation, overall tending toward gentle, natural, and harmonious color environments. This preference distribution not only provides important background explanation for the association between residents' color perception and mental health in the subsequent analysis but also suggests that when the real environment conflicts with residents' intrinsic color preferences, it may become a latent factor triggering psychological discomfort. Further regression analyses examined the relationships between environmental color characteristics and three psychological outcomes—anxiety, depression, and life satisfaction. The results showed that different color characteristics were significantly associated with these psychological outcomes, providing further empirical evidence for the relationship between residential environmental color and residents' mental well-being (Tables 4–6).

Table 3. Distribution Statistics of Participant Color Preferences (N = 800)

Preferred palette	Building facade	Community landscape	Personal interior
Cool tones (blue, gray)	144 (18.0%)	72 (9.0%)	128 (16.0%)
Warm tones (beige, light coffee)	336 (42.0%)	120 (15.0%)	312 (39.0%)
Neutral colors (white, light gray)	240 (30.0%)	48 (6.0%)	208 (26.0%)
Natural palettes (green, wood, earth)	56 (7.0%)	496 (62.0%)	104 (13.0%)
Vivid colors (red, orange, yellow)	24 (3.0%)	64 (8.0%)	48 (6.0%)
Total	800 (100%)	800 (100%)	800 (100%)

Table 4. Multiple Linear Regression Predicting Anxiety (GAD-7) (N = 800)

Predictor	B	SE	β	95% CI for β	p	VIF
Architectural gray-tone hue	0.15	0.06	0.19	[0.07, 0.31]	<0.01	1.08
Architectural color purity (high saturation)	0.20	0.07	0.25	[0.11, 0.39]	<0.01	1.10
Landscape green-vegetation proportion	-0.17	0.07	-0.21	[-0.35, -0.07]	<0.01	1.22
Hardscape color abruptness	0.14	0.06	0.18	[0.06, 0.30]	<0.01	1.15
Interior neutral-base low arousal	0.12	0.05	0.15	[0.05, 0.25]	<0.01	1.05
Interior visual complexity (color overload)	0.18	0.07	0.22	[0.08, 0.36]	<0.01	1.18
Age	0.03	0.03	0.04	[0.02, 0.10]	0.18	1.20
Gender (female = 1)	-0.02	0.03	-0.03	[-0.09, 0.03]	0.31	1.10
Education	-0.02	0.02	-0.02	[-0.06, 0.02]	0.42	1.35
Income	-0.04	0.03	-0.05	[-0.11, 0.01]	0.09	1.45
Length of residence	0.01	0.02	0.01	[0.03, 0.05]	0.66	1.15
Model summary: $R^2 = 0.18$, Adjusted $R^2 = 0.17$, $F(12, 787) = 14.21$, $p < 0.001$						

Table 5. Multiple Linear Regression Predicting Depression (PHQ-9) (N = 800)

Predictor	B	SE	β	95% CI for β	p	VIF
Architectural color purity (high saturation)	0.14	0.06	0.17	[0.05, 0.29]	<0.01	1.25
Architectural low brightness (deep/dim)	0.07	0.04	0.09	[0.01, 0.17]	0.02	1.25
Landscape green-vegetation proportion	-0.11	0.05	-0.14	[-0.24, -0.04]	<0.01	1.30

Hardscape color abruptness	0.10	0.05	0.12	[0.02, 0.22]	<0.01	1.18
Interior visual complexity (color overload)	0.13	0.06	0.16	[0.04, 0.28]	<0.01	1.10
Composite tone-warmth index	-	0.06	-	[-0.30, -0.06]	<0.01	1.08
Seasonal color discontinuity (winter)	0.09	0.04	0.11	[0.03, 0.19]	<0.01	1.12
Age	0.02	0.02	0.03	[-0.01, 0.07]	0.22	1.20
Gender (female = 1)	0.02	0.02	0.02	[-0.02, 0.06]	0.37	1.10
Education	-	0.02	-	[-0.05, 0.03]	0.55	1.35
Income	-	0.02	-	[-0.08, -0.00]	0.11	1.45
Length of residence	0.01	0.02	0.01	[-0.03, 0.05]	0.70	1.15
Model summary: R² = 0.15, Adjusted R² = 0.14, F(12, 787) = 11.58, p < 0.001						

Gender (female = 1)	0.02	0.02	0.03	[-0.01, 0.07]	0.20	1.10
Education	0.03	0.02	0.04	[0.00, 0.08]	0.09	1.35
Income	0.05	0.03	0.06	[0.00, 0.12]	0.04	1.45
Length of residence	0.02	0.02	0.02	[-0.02, 0.06]	0.40	1.15
Model summary: R² = 0.31, Adjusted R² = 0.30, F(12, 787) = 28.93, p < 0.001						

4. Results

4.1. Results Analysis of Color Perception in Community Architectural Environments on Mental Health

Correlation and multiple regression analyses were conducted between the perception of community building facade colors (hue, brightness, purity) and mental health scales (GAD-7, PHQ-9, SWLS). The results showed that architectural color across multiple dimensions was significantly associated with mental health outcomes ($p < 0.01$). The specific analysis is as follows:

4.1.1 Significant Association between Hue and Emotional Valence

The dominant architectural hue was clearly associated with specific emotions. Cool tones (blue, gray) were significantly positively correlated with anxiety level (GAD-7) ($r=0.24$, $p < 0.01$); large-area monotonous gray series evoked residents' association with datedness and oppression, and regression showed a positive prediction of anxiety ($\beta=0.19$, $p<0.01$). Warm tones (beige, light coffee), by contrast, were significantly positively correlated with life satisfaction (SWLS) ($r=0.28$, $p<0.01$), conveying signals of warmth and comfort and enhancing environmental belonging.

4.1.2 Effect of Color Purity and Visual Load on Psychological Stress

High-purity (high-saturation) architectural colors—especially when used in conflict—were significantly positively correlated with both anxiety ($r=0.35$, $p<0.01$) and depression ($r=0.30$, $p<0.01$); after controlling for demographic variables, color purity was one of the strongest predictors of anxiety ($\beta=0.25$, $p<0.01$), indicating that vivid, glaring colors exacerbate visual load and induce negative emotion.

4.1.3 Relationship between Color Brightness and Psychological Openness

Table 6. Multiple Linear Regression Predicting Life Satisfaction (SWLS)

Predictor	B	SE	β	95% CI for β	p	VIF
Architectural warm-tone hue	0.17	0.07	0.21	[0.07, 0.35]	<0.01	1.06
Architectural color harmony	0.21	0.08	0.26	[0.10, 0.42]	<0.01	1.12
Landscape color harmony	0.19	0.07	0.24	[0.10, 0.38]	<0.01	1.15
Interior warm personalized color	0.16	0.06	0.20	[0.08, 0.32]	<0.01	1.05
Composite tone-warmth index	0.21	0.08	0.26	[0.10, 0.42]	<0.01	1.10
Interior neutral-base low arousal	0.12	0.05	0.15	[0.05, 0.25]	<0.01	1.04
Functional-zone color fit	0.08	0.04	0.10	[0.02, 0.18]	0.01	1.22
Age	0.02	0.02	0.02	[-0.02, 0.06]	0.38	1.20

Medium-to-high-brightness architectural environments (bright and fresh) were positively correlated with life satisfaction ($r=0.22$, $p<0.01$) and negatively correlated with depression; low-brightness (deep and dim) building clusters easily caused oppression and gloom, showing a weak positive correlation with PHQ-9, supporting the common practice in old-community renovation of improving atmosphere by raising facade brightness.

4.1.4 The Core Role of Color Harmony

Architectural color harmony (neighborhood harmony, absence of abruptness) showed a moderate positive correlation with life satisfaction ($r=0.31$, $p<0.01$) and significant negative correlations with both anxiety and depression, directly verifying that the "color islands" and "visual-order chaos" caused by absent color management constitute a substantive negative impact on mental health.

4.2. Results Analysis of Color Perception in Community Landscape Environments on Mental Health

Analysis of landscape color perception (natural vegetation and artificial hardscape) with mental health scales showed that the composition, source, and harmony of landscape color had independent and significant effects on outcomes ($p<0.01$).

4.2.1 The "Healing Effect" of Natural Vegetation Color and the Problem of Seasonal Imbalance

The richness and layering perception of green vegetation was significantly negatively correlated with anxiety (GAD-7) ($r=-0.32$, $p<0.01$) and positively correlated with life satisfaction (SWLS) ($r=0.29$, $p<0.01$); regression showed that the visual proportion of green vegetation was a key factor predicting stress relief ($\beta=-0.21$, $p<0.01$). However, "insufficient seasonal color planning" caused effects: in late summer and winter when vegetation was monotonous, residents' depression scores (PHQ-9) rose significantly ($F=4.87$, $p<0.01$), confirming that the absence of a continuous four-season color sequence produces periodic negative emotions.

4.2.2 The "Visual Interference" Effect of Artificial Hardscape Color

The perceived intensity of high-saturation, poorly integrated artificial colors (engineering blue, bright orange) was significantly positively correlated with anxiety ($r=0.26$, $p<0.01$); in regression, its abruptness was the second-strongest anxiety predictor after architectural color purity ($\beta=0.18$, $p<0.01$), indicating that improper color selection turns service facilities into visual stressors.

4.2.3 The Core Moderating Role of Color Harmony in Landscape Environments

The "landscape color harmony" index showed a moderate positive correlation with life satisfaction ($r=0.33$, $p<0.01$) and negative correlations with both anxiety and depression; even if individual elements were vivid, as long as the whole was orderly and integrated with nature, the positive effect could

be maintained, supporting the shift from "point-like decoration" to "systematic planning".

4.2.4 Differential Psychological Effects of Color in Functional Zones

The psychological effect of color varied with functional zones: bright primary colors (red, yellow, blue) in children's activity areas were positively correlated with family satisfaction ($r=0.19$, $p<0.01$), whereas preference for soft, neutral, cool colors (light gray, pale blue, beige) in quiet rest areas was associated with lower anxiety, indicating that landscape color must be precisely configured based on spatial function.

4.3. Results Analysis of Color Perception in Community Interior Environments on Mental Health

Analysis of interior color perception (base decoration and soft furnishing) showed that, as the most private and longest-exposed color environment, the interior base tone, individual expression, and complexity exerted a profound and complex influence on mental health ($p<0.01$).

4.3.1 The "Safe" and "Aloof" Duality of Fine-Decoration Base Tones

The mainstream neutral base (plain white walls, light gray, off-white) showed no significant positive correlation with anxiety or depression, displaying a "safety valve" effect; yet its correlation with life satisfaction was extremely weak ($r=0.09$, $p<0.05$), and regression showed that excessively low color arousal was one of the factors predicting lower satisfaction ($\beta=0.15$, $p<0.01$), confirming that although uniform neutral base colors provide freedom for modification, their lack of personalized warmth makes it difficult to promote positive mental health, and may even cause emotional detachment.

4.3.2 The "Motivating" and "Overloading" Effects of Personalized Soft Furnishing Color

Warm, soft, personalized colors (light yellow, creamy) were significantly positively correlated with life satisfaction ($r=0.31$, $p<0.01$) and negatively correlated with anxiety; appropriate inclusion in warm tones can transform a "house" into a "home"; but "color overload"—excessive color complexity in a limited space (many hues, strong contrast, high saturation)—was significantly positively correlated with anxiety ($r=0.28$, $p<0.01$), and visual complexity was a strong predictor of anxiety ($\beta=0.22$, $p<0.01$), with chaotic color significantly increasing cognitive load.

4.3.3 Tone Warmth as a Key Predictor of Emotional Stability

A composite "tone warmth" index (overall tendency of warm-cool and softness) showed strong explanatory power: significantly positively correlated with life satisfaction ($r=0.35$, $p<0.01$) and significantly negatively correlated with depression ($r=-0.24$, $p<0.01$); after controlling for demographic variables, it remained a stable predictor

($\beta=0.26, p<0.01$; $\beta=-0.18, p<0.01$), emphasizing that creating an overall warm and soft atmosphere is more fundamentally meaningful than chasing short-term trending colors.

4.3.4 Differentiated Psychological Needs for Color across Functional Spaces

Residents' expectations and effects for colors in different functional rooms were related: low-purity, low-brightness colors in bedrooms (aiding relaxation and sleep) were positively correlated with better sleep quality, and those actually using high-stimulation colors (bright red) had a higher rate of difficulty falling asleep; medium-brightness cool tones in work/study areas were associated with improved self-rated concentration, corroborating the importance of scenario-based color application.

4.4 Elaboration on the Relationship between Residential Environment Color Perception and Mental Health Outcomes

Synthesizing the three-dimensional results, this study demonstrates that residential environment color is a key environmental-psychological variable associated—within this cross-sectional sample—with anxiety, depression, and life satisfaction. The stable effect pattern points to an underlying mechanism: high-purity colors raise anxiety and depression risk through heightened visual load, whereas medium-low-purity, medium-high-brightness warm tones and natural palettes support a "safe color domain" that lowers negative emotion. Harmony emerges as the core mechanism transcending single attributes—across architectural, landscape, and interior scales, harmonious order reduces cognitive load and stress and fosters environmental identity and belonging, whereas chaotic arrangements produce chronic "visual pollution." The psychological effect of color is also environmentally specific: cool tones read as negative on facades yet aid concentration in work areas, and high-purity primaries suit children's zones but disturb rest areas, arguing for refined, scenario-based design. Together, these findings indicate that color shapes mental health through an emotion–cognition pathway, providing a scientific basis for embedding color psychology in urban planning, community renewal, and healthy-housing design.

5. Discussion

5.1 Potential Mechanisms Linking Color Perception and Mental Health

This study reveals that the close connection between color perception and mental health is underpinned by multiple interlinked mechanisms. The first is emotional regulation: warm tones and natural palettes are associated with higher life satisfaction, whereas high-saturation conflicting colors are positively correlated with anxiety and depression, consistent with the classic environmental-psychology theory that color

directly affects emotional valence and arousal[3]; this study validates this in a real, complex urban environment: soft, harmonious color acts as a sustained low-intensity positive stimulus that imperceptibly promotes positive emotion, functioning as an "environmental vitamin". The second is cognitive load: purity, complexity, and harmony are key variables predicting anxiety; architectural "chromatic overexposure", landscape artificial abruptness, and interior "color overload" all point to one conclusion - chaotic, discordant visual information increases the brain's processing burden and constitutes a chronic environmental stressor, consistent with the Attention Restoration Theory (continuous effortful attention depletes cognitive resources[4,18]); this study extends this from nature's "soft fascination" to the built environment's color "hard stimulus", identifying improper color design as a kind of "visual pollution" that induces cognitive fatigue and psychological stress. The third is environmental identity: color harmony, consistent with residents' preferences, is associated with higher life satisfaction; harmonious community tones (warm architectural colors, natural landscape colors) shape a sense of place and enhance belonging; when color fits intrinsic aesthetic and emotional needs, home and community become a "self-extension" providing strong psychological support; this study uniquely links the social-psychological concept of environmental identity with a concrete visual element—color—empirically, revealing the role of color as a non-verbal symbol in constructing the emotional meaning of "home" and community cohesion.

5.2 Theoretical Contributions of the Study

This study expands and deepens the environmental-psychology model. Traditional color-emotion research mostly confines itself to the controlled immediate effects of single colors or the restorative function of green/natural color; this study systematically examines the comprehensive effect of the composite color environment—composed of multiple color combinations across the three dimensions of architecture, landscape, and interior - on long-term psychological states, finding that the effect of a single color must be understood within environmental scale, functional context, and compositional harmony. On this basis, it proposes the concept of "Chromatic Psychological Environment (CPE)" - referring to the overall psychological representation formed by all visible colors in the built environment (hue, purity, brightness, combination, spatial distribution, and cultural-symbolic meaning) that residents continuously perceive and experience, emphasizing three core propositions: holism (architectural, landscape, and interior colors are interrelated, the whole is greater than the sum of parts, and harmony and order are key); context-dependence (effects are highly dependent on specific environmental function and cultural background; discussing color "good or bad" divorced from context is one-sided); and subjective construction (CPE is not a purely objective stimulus but an experience actively constructed by residents based on experience, preference, and mood). CPE shifts the

perspective from "color" to "the interactive relationship between people and the color environment", expands the traditional color-emotion model, and provides environmental psychology with a more comprehensive, ecological analytical framework, advocating treating color as an environmental health resource requiring systematic planning aimed at optimizing overall psychological experience, rather than a decorative element.

5.3 Practical Implications of the Study

The empirical findings of this study provide an actionable color-strategy framework for urban renewal, community building, and residential design. In urban renewal, a "color check-up" mechanism should be established to systematically review color-chaotic areas in old neighborhoods and prioritize facade renovation using low-saturation warm or natural palettes, avoiding large-area concentrated use of high-saturation colors; old-town renovation can preserve the original color base, unify the tone with neutral colors such as beige and light brown, and accent with small amounts of low-purity regional colors, reducing visual pollution while maintaining place memory. Community building must construct a "graded color system": public activity spaces use soft warm colors (light orange, pale pink) to stimulate social vitality; leisure walkways use natural green and sky blue to aid relaxation; children's areas moderately increase color richness but control saturation, avoiding conflict-induced irritability. Residential design should promote a "functionally adapted color scheme": bedrooms use low-arousal colors such as off-white and light gray to aid sleep, kitchens and living rooms use warm yellow and light orange to enhance pleasure; meanwhile, respect individuality and reserve adjustment space, letting residents participate in CPE construction and enhancing environmental identity. These strategies upgrade color from decoration to a mental-health resource.

5.4 Limitations of the Study

First, the cross-sectional design collected data via questionnaire at a single point in time and cannot infer causality: for instance, a positive correlation between high-saturation color and anxiety was observed, but it is difficult to determine whether high saturation causes anxiety or whether anxious individuals perceive it more negatively; the causal ambiguity limits the depth of application of conclusions and also makes it difficult to capture dynamic changes between the two and differences across life cycles. Second, insufficient sample representativeness: the subjects were mostly drawn from several urban districts and dominated by young and middle-aged people, with low proportions of the elderly and adolescents, and a lack of rural and remote residents; moreover, education and income were relatively concentrated. These factors may indirectly affect the relationship through aesthetic preference and residential-environment quality, making it difficult to generalize

conclusions to broader populations and reducing external validity.

5.5 Future Research Directions

Future research may deepen in three directions: longitudinal studies employing 1-3-year tracking to record the dynamic association between color changes (community renovation, residential decoration) and psychological indicators, clarifying causality and key nodes through cross-lagged designs; experimental intervention studies setting up color-optimization and control groups in real scenarios, comparing pre-post tests to quantify the effects of different strategies; and cross-cultural comparisons selecting regions with cultural differences to examine the moderating role of cultural symbolic meaning of color, constructing a CPE model that balances universality and specificity, enhancing generalizability and global value.

6. Conclusion

6.1 Constructing a Color Design Method for the Urban Residential Environment Based on Residents' Mental Health

The color design method proposed in this study takes the "Chromatic Psychological Environment (CPE)" as its core framework, emphasizes the holism, context-dependence, and subjective construction of color application, and forms a multidimensional, refined design-guidance system. At the architectural-environment level, the core principle of "low saturation, medium-high brightness, warm tone" should be established, prioritizing warm palettes such as beige and light coffee and neutral colors such as light gray to build a harmonious and unified community color tone, strictly controlling large-area concentrated use of high-saturation colors; by strengthening the statutory binding and refined management of urban color planning, "chromatic overexposure" and "visual islands" are avoided; simultaneously, attention is paid to the durability and color consistency of building materials, reducing the damage of later renovation to color order. At the landscape-environment level, a "nature-first, function-adapted" design strategy is pursued, with green as the dominant to build a continuous four-season rhythmic color sequence and enhance the richness and layering of plant color; artificial-facility colors are planned in an integrated manner to reduce the visual abruptness of high-saturation "engineering colors", moderately increasing color richness in children's activity areas and adopting soft neutral colors in rest areas, achieving a match between function and color-psychological effect. At the interior-environment level, a "neutral base + warm personality" combination model is adopted, with the fine-decoration base using low-arousal off-white and light gray as a foundation, reserving space for personalized soft furnishing; residents' soft-furnishing design should avoid "color

overload", creating a sense of belonging through warm, soft tones (such as creamy and light yellow), while differentiating color configuration according to functional needs - bedrooms using low-purity, low-brightness colors to promote sleep, and work/study areas appropriately using medium-brightness cool tones to enhance concentration. This design method upgrades color from a decorative element to a systematic health-environment resource, providing an actionable technical pathway for optimizing the human habitat.

6.2 Color Perception in the Urban Residential Environment Is Closely Related to Residents' Mental Health

Taken together, the present cross-sectional evidence indicates that residential color perception is significantly associated with mental health through multidimensional pathways, and the association follows stable regularities. At the level of basic attributes, high-saturation colors consistently elevate anxiety and depression and trigger visual load and psychological stress, whereas medium-low-purity, medium-high-brightness warm tones and natural palettes form a "safe color domain" linked to higher satisfaction and lower negative emotion. At the level of compositional harmony, color harmony across architectural, landscape, and interior scales is the strongest predictor—positively of life satisfaction and negatively of anxiety and depression—while chaotic schemes sustain cognitive load as chronic "visual pollution." At the level of environmental specificity, color effects depend on scenario and function (e.g., cool tones disturb on facades but aid focus in work spaces; primaries suit children's areas but disturb rest areas). Preference fit and tone warmth further exert sustained influence via emotional regulation, cognitive load, and environmental identity, confirming color perception as a key environmental variable shaping psychological states and an actionable lever for healthy-housing design.

6.3 Rational Use of Color Can Become a Low-Cost, High-Efficiency Means of Mental Health Promotion

Compared with environmental interventions requiring large capital investment, such as green-space construction and building renovation, color optimization may offer potential advantages of low cost, easy implementation, and rapid effect, representing a mental-health-promotion pathway that combines economy and effectiveness. In urban renewal, simple interventions such as facade color renovation and landscape color reorganization can quickly improve the "grayish" tone of old communities and alleviate residents' oppressive mood; in community building, low-cost means such as adjusting public-facility colors and optimizing plant configuration can effectively reduce visual stress and enhance environmental belonging; in residential design and decoration, residents can improve the indoor psychological environment and promote emotional stability through

reasonable selection of soft-furnishing colors and control of color complexity, without high investment. This intervention requires no change to the physical structure of the environment; mere optimization of visual elements achieves positive mental-health improvement, and is especially suitable for resource-limited scenarios such as old-community renovation and community micro-renewal. Rational application of the color design method proposed in this study can build a human habitat supporting mental health at relatively low cost, providing new intervention ideas for the public-health field and an economically efficient solution for health-oriented design in sustainable urban development.

In summary, this study reveals the intrinsic association between color perception and mental health, constructs a scientific and feasible design method, and confirms the practical value of color as a means of promotion; future work must use longitudinal research and experimental interventions to clarify causality and refine the system, promoting the deep application of color psychology in urban planning, community construction, and residential design, and providing solid support for building a healthy and livable urban human habitat. Data Availability: The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request, subject to ethical approval constraints. The analysis syntax (SPSS syntax) used to produce the reported results is provided in the Supplementary Material, and all measures including the self-developed Color Perception Scale items are documented in the Appendix to support reproducibility.

Acknowledgement

This work was supported by the General Project of Philosophy and Social Sciences Research in Higher Education Institutions of Jiangsu Province (Project Title: "Four Integrations, Four Progressive Steps, and Specialty–Aesthetics Integration": Research on the Implementation Pathways of Aesthetic Education in Higher Vocational Education; Grant No. 2025SJYB1749).

References

- [1] Lederbogen F, Kirsch P, Haddad L, et al. City living and urban upbringing affect neural social stress processing in humans. *Nature*. 2011;474(7352):498-501. <https://doi.org/10.1038/nature10190>
- [2] Evans GW. Projected behavioral impacts of global climate change. *Annual Review of Psychology*. 2019;70:449-474. <https://doi.org/10.1146/annurev-psych-010418-103023>
- [3] Valdez P, Mehrabian A. Effects of color on emotions. *Journal of Experimental Psychology: General*. 1994;123(4):394-409. <https://psycnet.apa.org/doi/10.1037/0096-3445.123.4.394>
- [4] Joye J, van den Berg A. Restorative environments. In Steg EM, van den Berg AE, de Groot J, editors, *Environmental Psychology: An Introduction*. London: Blackwell Publishing. 2013. p. 57-66
- [5] Gao T, Zhang T, Zhu L, Gao Y, Qiu L. Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality.

- International journal of environmental research and public health. 2019 Sep;16(17):3102.
<https://doi.org/10.3390/ijerph16173102>
- [6] Elliot AJ, Maier MA. Color psychology: effects of perceiving color on psychological functioning in humans. *Annual Review of Psychology*. 2014;65:95-120.
<https://doi.org/10.1146/annurev-psych-010213-115035>
- [7] Angharad S, Lai P, Westland S. Automated Colour Analysis Co-piloting Tool for Design. *Fashion Technology*. 2025 Jan 25;1(1):42-6.
- [8] Gascon M, Triguero-Mas M, Martínez D, Dadvand P, Rojas-Rueda D, Plasencia A, Nieuwenhuijsen MJ. Residential green spaces and mortality: a systematic review. *Environment international*. 2016 Jan 1;86:60-7.
<https://doi.org/10.1016/j.envint.2015.10.013>
- [9] Xu J, Liu N, Polemiti E, Garcia-Mondragon L, Tang J, Liu X, Lett T, Yu L, Nöthen MM, Feng J, Yu C. Effects of urban living environments on mental health in adults. *Nature medicine*. 2023 Jun;29(6):1456-67.
<https://doi.org/10.1038/s41591-023-02365-w>
- [10] Akers A, Barton J, Cossey R, Gainsford P, Griffin M, Micklewright D. Visual color perception in green exercise: positive effects on mood and perceived exertion. *Environmental Science and Technology*. 2012;46(16):8661-8666. <https://doi.org/10.1021/es301685g>
- [11] van den Berg AE, Wesselius JE, Maas J. Green space and health: the role of perceived restorativeness. *Health and Place*. 2017;46:209-217.
- [12] Hidayetoglu ML, Yildirim K, Akalin A. The effects of color and light on indoor wayfinding and the evaluation of the perceived environment. *Journal of environmental psychology*. 2012 Mar 1;32(1):50-8.
<https://doi.org/10.1016/j.jenvp.2011.09.001>
- [13] Ulrich RS, Zimring C, Zhu X, et al. A review of the research literature on evidence-based healthcare design. *Health Environments Research and Design Journal*. 2008;1(3):61-125.
- [14] Bower IS, Clark GM, Tucker R, Hill AT, Lum JA, Mortimer MA, Enticott PG. Built environment color modulates autonomic and EEG indices of emotional response. *Psychophysiology*. 2022 Dec;59(12):e14121.
<https://doi.org/10.1111/psyp.14121>
- [15] Wang T, Shu S, Mo L. Blue or red? The effects of colour on the emotions of Chinese people. *Asian Journal of Social Psychology*. 2014;17(2):152-158.
<https://doi.org/10.1111/ajsp.12050>
- [16] Yao Y, Zheng J, Wang H, Rao Y. Research on design decisions of customer value in a cross-cultural context. *Big. D*. 2024;1(1):116-22.<https://doi.org/10.64504/big.d.v1i1.26>
- [17] Hartig T, Mitchell R, de Vries S, Frumkin H. Nature and health. *Annual Review of Public Health*. 2014;35:207-228.
<https://doi.org/10.1146/annurev-publhealth-032013-182443>
- [18] Stevenson MP, Schilhab T, Bentsen P. Attention Restoration Theory II: A systematic review to clarify attention processes affected by exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B*. 2018 May 19;21(4):227-68.
<https://doi.org/10.1080/10937404.2018.1505571>
- [19] White MP, Alcock I, Wheeler BW, Depledge MH. Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science*. 2013;24(6):920-928.
- [20] Adkins A, Dill J, Luhr G, Neal M. Unpacking walkability: Testing the influence of urban design features on perceptions of walking environment attractiveness. *Journal of urban design*. 2012 Nov 1;17(4):499-510.
<https://doi.org/10.1080/13574809.2012.706365>
- [21] Gifford R. The consequences of living in high-rise buildings. *Architectural Science Review*. 2007;50(1):2-17.
<https://doi.org/10.3763/asre.2007.5002>
- [22] World Health Organization. *Environmental noise guidelines for the European region*. Copenhagen: WHO Regional Office for Europe; 2018.
- [23] Gu X, Guo T, Si Y, Wang J, Zhang W, Deng F. Association between ambient air pollution and daily hospital admissions for depression in 75 Chinese cities. *American Journal of Psychiatry*. 2020;177(8):735-743.
<https://doi.org/10.1176/appi.ajp.2020.19070748>
- [24] Power MC, Kioumourtoglou MA, Hart JE, Okereke OI, Laden F, Weisskopf MG. The relation between past exposure to fine particulate air pollution and prevalent anxiety: observational cohort study. *bmj*. 2015 Mar 24;350.
- [25] Stutzer A, Frey BS. Stress that doesn't pay: the commuting paradox. *Scandinavian Journal of Economics*. 2008;110(2):339-366.
<https://doi.org/10.1111/j.1467-9442.2008.00542.x>
- [26] Triguero-Mas M, Dadvand P, Cirach M, et al. Natural outdoor environments and mental and physical health: relationships and mechanisms. *Environment International*. 2015;77:35-41.
<https://doi.org/10.1016/j.envint.2015.01.012>
- [27] Seto KC. Exploring the dynamics of migration to mega-delta cities in Asia and Africa: contemporary drivers and future scenarios. *Global Environmental Change*. 2011;21(Suppl 1):S94-S107. <https://doi.org/10.1016/j.gloenvcha.2011.08.005>
- [28] Helbich M. Toward dynamic urban environmental exposure assessments in mental health research. *Environmental Research*. 2018;161:129-135.
<https://doi.org/10.1016/j.envres.2017.11.006>