

# *A Study on the Impact of Blue-green Space on Human Mental Health*

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**Abstract:** As attention to human mental health issues increases, and research on the related effects of blue-green space (BGS) in the residential environment increases, it is meaningful to study and analyse this impact from multiple perspectives. One purpose of this article is to systematically classify and summarize this impact. Therefore, this article integrates the research and conclusions of multiple documents. The results show that for humans of different ages, the mental health affected by BGS generally follows the “environmental-physiological-psychological” mechanism. Among them, the elderly is mainly affected by the improvement of social interaction brought by BGS. Young people are mainly affected by the alleviating effects of indoor blue and green factors on various stresses. In addition, landscapes with high green vision rate and low blue vision rate and natural landscapes have positive benefits for the restoration of perception in mental health, and this benefit is also affected by the season. Based on the analysis and summary, suggestions related to urban greening and landscape construction can be obtained, which can play a positive role in the construction of “healthy cities” in the future.

**Keywords:** blue-green space, mental health, different age group

## 1. Introduction

In recent years, affected by multiple factors such as the epidemic and climate change, mental health issue has become a common public concern as a major factor which influences human health. According to a report released by WHO (World Health Organization) last year, nearly one billion people around the world are suffering from mental disorders exploring how to improve mental health and reduce the impact of psychological problems on personal emotions and their daily life has become an important research direction. At the same time, several research have shown that the blue and green space (BGS) is of great positive significance for human mental health. However, as urbanization is expanding, urban residents no longer have direct contact with natural BGS as easily as in the past. Therefore, it is significant to explore the influence of blue and green space on human mental health.

Currently, there are many related studies focusing on the impact of BGS on human society. Berardi, U. et al. [1], based on roof gardens, provides a relatively comprehensive explanation of the ecological benefits that blue and green spaces can bring to humans. There are also many relatively complete conclusions on the mental health benefits of blue and green spaces. Zhou, W. et al. [2] reviewed the academic theory and research results on the psychological benefits of blue and green spaces over the

years. Based on current theories, Zhu, X. [3] combined the physiological data measured by instruments and interviews to conduct research of different distributions of BGS. In addition, some researches have studied the influence of tourists in the same scenic spot in different seasons from the perspective of tourists [4]. Dzhambov, A.M. [5] explored the impact of BGS on the mental health of college students at a certain university within one academic year.

This study systematically analyzes the impact of BGS from the perspective of human mental health and influencing factors and combines the analysis to put forward effective suggestions for future urban blue-green space planning. This article divides the impact of BGS on human mental health into the “environment-physiology-psychology” impact process and conducts specific analysis for different ages. In addition, by exploring the influence degree of BGS from the perspective of season and blue-green space self-distribution, this paper hopes to get the planning suggestions to optimize the blue-green space effect. These suggestions can provide directions for further natural development of the city and assist future urban greening and related urban planning.

## 2. BGS

As a brief description of urban planning and landscaping, BGS is generally divided into blue space and green space. Among them, green space refers to the green area covered by plants, including park and green spaces or community greening. The blue space represents the water-related part of the urban design. Whether it is river, or a lake, or a small artificial pond, as long as it is a water body that can be touched and perceived by human being, it can be regarded as a part of the urban blue space. At present, there are already many blue-green space models that can be studied in the city, such as parks and wetlands. These blue-green spaces can be used as urban carriers of natural spaces and an important link in the construction of a “healthy city”. In a specific study, Jiao, X. X. et al. [6] considered dividing the development system of the index for measuring the BGS into three parts: supply service evaluation stage, adjustment service evaluation stage and cultural service evaluation stage. And these stages It can be further divided into direct function and indirect function of BGS.

In researches and urban designs in reality, the direct function of BGS can be divided into two aspects: economic benefits and ecological benefits. In terms of economic benefits, some areas have incorporated cash crops as one part of urban greening and established irrigation areas to sell these crops for money during the harvest season. In terms of ecological benefits, the environmental benefits that can be brought about by blue-green spaces within cities include energy savings, mitigation of the urban heat island effect, reduction of the risk of urban flooding, and mitigation of noise and air pollution [1].

At the same time, the indirect functions of BGS focus on human activities. First, as an urban green landscape, BGS usually provides activity space for pedestrians or residents. People can use these spaces for physical exercise, leisure and community activities, thereby improving physical health and a sense of community belonging. This can not only bring indirect economic benefits of BGS, but also improve the overall health of visitors from both physical and mental health. In addition, the positive benefits of BGS on the environment can create a more suitable space for survival and residence, and promote the health of citizens from an environmental perspective.

In summary, the research on BGS is not only of great significance in terms of economic and ecological benefits, but also has a positive impact on human activities and health, providing useful guidance for the sustainable development of cities.

### 3. Mental Health Benefits of BGS on Different Age Groups

#### 3.1. Seniors

It is important to deeply study the effects of BGS on the mental health of the elderly. First of all, in daily life, compared with other age groups, the elderly usually has more free time and willingness to move freely. However, due to the degradation of their body functions, the blue and green factors in the surrounding living environment are more likely to affect them. In addition, due to the growing aging population in the social system, more attention should be paid to the physical and psychological needs of the elderly. The current research on the mental health of the elderly have practical significance. Therefore, this section mainly analyzes the promotion effect of blue-green space on the mental health of the elderly, to comprehensively study the current situation of the mental health of the elderly affected by BGS.

The impact of BGS on promoting the mental health of the elderly can be divided into two aspects: the promotion of individual psychology and neighborhood interactions. From the perspective of promoting personal mental health, BGS can have a positive impact on improving the mobility of the elderly, increasing the sense of security around them, and reducing the elderly's perception of nearby noise. In the specific process of action, environmental benefits of BGS provide an "environment-physiology-psychology" impact on the mental health of the elderly. First, the easy-to-reach blue-green scene makes it easier for nearby residents to get outside for physical activities. Similarly, this also stimulates the elderly's desire and behavior for exercises, which in turn promotes the positive development of mental health. Secondly, the blue-green factors help reduce the urban heat island effect of the city, reduce the temperature of nearby areas, and thus make the local climate more suitable. At the same time, the surrounding vegetation would absorb nearby noise. By creating a healthier living environment for the elderly, combined with attention restoration theory, this environment improves the elderly's perception of landscape quality, thereby affecting their mental health [7]. Finally, since the elderly's social interactions are mainly limited to neighborhood interactions, BGS can provide a more suitable and comfortable environment for such interactions. This promotes older adults' social engagement and sense of belonging to their neighborhood, which in turn improves their mental health.

Some related research models have confirmed this argument to some extent. The research of Yue, Y. F. et al. [7] selected a community with a high proportion of elderly people, conducting a questionnaire survey, and used machine learning to identify BGS on nearby street view images. Subsequently, they established hierarchical linear models and multilevel structural equation models to analyze the data obtained. The research by Yue, Y. F. et al. [7] indicated that there is a high correlation between mental health and green viewing rate, plant index, and vegetation diversity, which is significant at the 0.01 level. The correlation coefficient between mental health and water index is 0.385, which is significant at the 0.05 level. By measuring more specific indicators of mental health, it can be concluded that green vision rate has a significant positive effect on environmental perception and social cohesion.

BGS also shows a preventive and therapeutic effect on depression in the elderly. Through the environmental benefits of BGS and other mental health effects on the elderly, BGS can play a role in preventing depression in later life. Helbich, M. et al. [8] used deep learning to analyze the characteristics of questionnaire data. This study showed that there is a negative correlation between the probability of depression and the distribution of blue-green space.

### 3.2. Young People

It is also meaningful to study and analyze the mental health of contemporary young people. First of all, since young people are in the early stage of life, they are of great significance to the construction and development of the future society. Therefore, exploring the impact of blue-green characteristics on young people's mental health is not only related to their personal growth and realization, but also crucial to future productivity development and the protection of human resources. In addition, in some areas, due to the influence of social and environmental factors, young people, especially college students, commonly face problems such as anxiety and depression, which has become a social issue worthy of attention.

The method for measuring the impact of blue-green space factors on young people's mental health was similar to that used in previous studies on the elderly. These indicators can be divided into three aspects: environmental, personal spirit perspective and ability [5]. From an environmental perspective, similar to the impact on the elderly, BGS has a positive effect on physiological factors by reducing disturbing factors in the surrounding environment, such as noise and air pollution, thereby promoting the mental health of young people. From a personal mental health perspective, exposure to and perception of blue-green elements improves attentional recovery and reduces stress. In terms of ability, this indicator combines the perspective of activity ability and social interaction in the elderly's mental health research, and mainly measures the promotion effect of blue and green space on young people's outdoor exercise and social interaction. In addition, there are other indicators used to assess the mental health of young people, including academic or work stress and sleep disorders. These findings have important implications for workplace and school facility planning.

Regarding the impact of BGS on the personal mental abilities of college students, it can refer to a study on the influence of blue-green factors on the mental health of college students during the COVID-19 epidemic. The study conducted a questionnaire survey on randomly and non-randomly sampled universities, analyzed valid questionnaire data, and established a generalized linear model. The research results of Du, Z. et al. [9] showed that during the lockdown period, college students who were indoors without plants indoors were more likely to experience depression, anxiety, and excessive perceived stress than college students who were also in an indoor room with detectable plants during the lockdown. The probability of psychological problems is lower. This shows that indoor green factors provide a certain protective effect on the mental health of college students.

Regarding work and study pressure, existing application scenarios have shown the alleviating effect of BGS. For college students and young people who have just started working, BGS can provide them with a place for leisure and entertainment. Meanwhile, BGS also acts as a mentally soothing resource to balance or counteract stress generated in school or the workplace. The study by Herrera, Ronal. et al. [10] used NDVI as the evaluation index of urban greening and established a generalized estimating equation (GEE) based on geographical data and questionnaire data. The results show that within 500m from the residence, the stress level of work discontent and overloaded work decreases with the increase of greening degree, indicating that BGS has a positive impact in relieving stress.

## 4. Factors Affecting the Function of BGS

### 4.1. Seasonal Factors

Studying from a seasonal perspective can help to further explore the conditions under which BGS works. In mid-latitude continental regions, seasonal changes are pronounced and urban communities have large populations. Therefore, exploring the impact of BGS on mental health in different seasons can provide a better reference for greening planning of urban communities in relevant areas.

However, dynamism is an often-overlooked feature of blue-green spaces. As the seasons change, the blue-green landscape will show obvious changes, which will lead to differences in perception. In addition, other natural factors in different seasons, including temperature, wind speed, natural light, etc., will also affect human perception of blue and green spaces.

In terms of seasonal research, the blue space shows a more obvious seasonal effect, while the green space also has seasonal differences, but the effect is not significant. Zhou, Y. et al. [4] took a tourist attraction in Wuhan as the research area and established three verified structural equation models based on seasonal differences to explore the impact of scenic spots in different seasons on tourists. In winter, blue space has no significant effect on mental health and social interaction, but in summer, blue space hinders human activities. The green factor only has a positive impact on the activity in summer, and the impact on individual paths is not obvious, but it has a significant impact on the whole.

Overall, season is a factor that can clearly impact the mental health benefits of BGS. Moreover, this effect will have certain differences between blue space and green space. During summer, blue spaces act as a hindrance to human activity, while green spaces act as a facilitator. However, unlike summer, there was no significant impact or difference in the impact of blue-green space on human activities during the winter.

## 4.2. Self-distribution

In the process of exploring the influence of blue-green space on human mental health, studying the influence of its internal distribution characteristics on mental health will help to provide useful guidance for the design of urban BGS more effectively. The spatial characteristics of the self-distribution of blue-green space can be analyzed from four dimensions: blue viewing rate, green viewing rate, complexity and openness. In addition, according to the specific situation, BGS can also be divided into forest view, mountain view, water view, wilderness and other types. By synthesizing different analysis dimensions, the blue-green spatial distribution characteristics that are beneficial to mental health and attention recovery can be more easily obtained.

Although more researchers focus on green space and vegetation distribution, blue space also has an important impact on mental health recovery. Similar to the previous discussion, the restorative role of blue spaces has focused on promoting water activity willingness, serving as therapeutic places for mental health, and promoting social interaction and community cohesion. In addition, another conclusion about blue space is that the perception of blue space through vision has a more significant impact on mental health than direct contact [3].

In addition, natural scenes have a more significant recovery effect on mental health than artificial scenes. According to the theory of perceptual restoration, Zhu, X. Y. [3] collected feedback from subjects on three different scene pictures of seascapes, inland natural waterscapes and urban artificial waterscapes through scales and skin-wearing conductance devices. Among it, seascapes and inland natural waterscapes have more natural features, while urban artificial waterscapes have stronger artificial features. The difference in the specific score data is shown in Table 1. The four restorative characteristics (being away, fascination, extent and compatibility) respectively represent the respondent's evaluation of different scenes. Higher scores indicate that respondents feel more strongly about the indicator, which means that recovery of mental health is more effective. When measuring the restoration benefits of these three scenarios through four restorative characteristic dimensions, the scores of natural scenes and artificial scenes are significantly different. As shown in table 1, it can be concluded that natural scenes are more effective for stress recovery. Among them, sea view spaces have better mental health recovery effects than inland natural water bodies.



Table 1: Comparison of the difference scores of the restorative feature dimensions of the four pictures in the three scenes [3].

Space type	Being away	Fascination	Extent	Compatibility	Total
Urban waterfront space	2.82	2.76	2.78	2.96	11.37
Inland natural water scenery	4.06	3.80	3.25	3.70	14.88
Sea view	4.28	3.94	3.22	3.88	15.32

In addition, from the perspective of visual acuity, scenes with low blue visual acuity and high green visual acuity have a positive effect on the recovery of mental health and the reduction of stress. From a visual perspective, a higher blue vision rate often means that the landscape is monotonous, and the observer is already close to the water, which can easily cause fear in the observer. A higher green vision rate generally means a higher plant coverage rate. The environmental benefits caused by this can not only have a positive impact on the observer's mental health by affecting the physiological condition of the observer but can also bring stress relief and the feeling of returning to nature to the observer. The study by Zhu, X. Y. [3] used experimental methods and data collection methods similar to the above-mentioned studies to evaluate scenes with different levels of blue-green viewing rates. In the evaluation of the psychological benefits of different rate scenarios, the results of the respondent interview and the perceived recovery evaluation scale showed the observers' preference for the low blue rate scenario. On the contrary, in similar studies on green vision rate, the test results showed that high green vision rate has the most significant positive impact on mental health than medium and low green vision rate.

## 5. Suggestion

### 5.1. BGS Planning Based on Communities with Different Average Ages

Based on the overall review of the literature, the positive significance of BGS for human mental health can be determined. However, for groups of different ages, more targeted BGS construction planning is needed.

The physical functions of the elderly have deteriorated. Therefore, for areas with a high distribution of elderly people or communities with a high average age, such as nursing homes and universities for the elderly, it is more important to emphasize the accessibility of blue and green spaces. It is suggested that the perceived blue and green Spaces can be built in the streets or parks inside or around the community. In addition, adequate areas and activity spaces should be prepared for the elderly to exercise and socialize. At the same time, the construction of these blue and green spaces should follow the principle of not being too complicated and twisty, and the roads should be smooth and obstacle-free to avoid unnecessary accidents.

The living conditions of young people are characterized by great pressure from study and work, and sometimes they are over-reliant on technology, which has led to a reduction in outing activities for them. Therefore, for areas with a large number of young people, such as enterprises, schools and some communities with a younger average age, indoor blue-green factor planning and layout should be carried out to strengthen the spatial distribution of BGS in work or study scenes, so as to have a positive impact on the psychology of young people.

### 5.2. BGS Self-distribution Planning Based on Season

After related analysis, the blue-green distribution ratio in the blue-green space will have different effects on the viewers. This effect varies with the seasons. First, the effects of summer blue and green spaces are different. Blue spaces have a hindering effect on human social and physical exercise

activities, while green spaces have a positive impact on activities. From this, urban planning recommendations can be made for relevant regions with different climates. Based on the previous analysis, for cities with a warmer and humid climate, more green factors should be considered when building BGS and less water body layout planning should be considered. Since winter has no obvious impact on the result, a more balanced blue-green distribution can be considered for colder areas. At the same time, in the specific construction process, in order to expand the psychological health benefits of landscaping, more landscaping layouts with low blue vision rate and high green vision rate should also be considered.

## 6. Conclusion

Researches on different age groups have found that in terms of human mental health, the impact of BGS follows the principle of “environment-physiology-psychology”. The impact of BGS transitions to human feeling benefits through environmental benefits, and then affects mental health. Due to the deterioration of their physiological functions and limited mobility, the elderly feels lonelier. Therefore, the sense of security and social benefits that BGS brings to the elderly are more important. For young people, their mental health problems are mainly related to work or study pressure. At the same time, due to schedule constraints, young people lack sufficient time to contact natural landscapes compared with seniors. Therefore, the first step to improve the mental health of young people through BGS is to increase the perceived scale of the indoor landscape. In addition, in the process of planning and arranging the landscape, it is necessary to consider increasing the green visual rate and reducing the blue visual rate to achieve greater psychological benefits.

Overall, this study can provide more reasonable and effective urban planning suggestions by analyzing the psychological impact of BGS on people of different situations and ages. This is of positive significance for the overall research of BGS on the benefits of mental health. However, there are still some limitations in this research. Discussions in this paper do not cover all aspects, which need to be further expanded in future research. In the age-class discussion, this article does not analyze how BGS affects the mental health of children or middle-aged adults. In addition, the discussions about influencing factors of BGS mental health benefits, lack of exploring the psychological benefits of BGS in different climates. In future researches, age levels can be more finely divided and different regions under different climate conditions can be considered to expand the sample size to achieve further analysis and provide larger-scale global urban construction planning recommendations.

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