

# A Review of Studies on the Impact of Urban Ecosystems on Residents' Mental Health

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**Abstract:** While urbanization drives economic and social development, it also exacerbates residents' mental health issues. However, urban ecosystems play a significant role in alleviating emotional problems such as anxiety and depression. This study reviews the development stages, research objects, research methods, and impact mechanisms of mental health services provided by urban ecosystems. Research shows that the number of relevant achievements has increased year by year, with a particularly significant growth after 2017. The research topics have evolved from basic explorations to in-depth studies on the impacts of specific ecological elements and the complex relationships between systems. The research objects cover various communities and specific groups such as women, adolescents, college students, and low-income groups. The research methods mainly include neurological-level brain imaging analysis and behavior-based questionnaires, interviews. Urban ecosystems affect mental health through cumulative and comprehensive effects, via pathways such as sensory stimulation from the natural environment, promotion of physical activities, as well as social interactions and community support in the social environment. Current research has limitations, such as insufficient attention to specific groups and inadequate exploration of mechanisms. Future studies need to strengthen the comprehensive research on natural and social environments, analysis of differences among specific groups, and integration of ecological services with urban design.

## 1. Introduction

Ecosystem services refer to the various direct or indirect benefits provided by ecosystems to humans, including supply services, regulation services, cultural services and support services, etc<sup>[1-3]</sup>. With the deepening of ecological research, the assessment framework of ecosystem services has been widely used in policy formulation, urban planning and environmental management decisions<sup>[1, 4, 5]</sup>. Traditionally, research on ecosystem services has focused on biophysical services, especially the contribution to life support systems. However, in recent years, scholars have gradually realized the importance of cultural services, especially the impact of ecosystems on human mental health, in ecosystem services<sup>[2, 3]</sup>.

Recent epidemiological studies have shown that more than 40 % of urban residents show clinically significant emotional disorders<sup>[6]</sup>. At the same time, with the acceleration of urbanization, urbanization has brought economic development and social progress, but it has also brought new challenges including accelerated pace of life and environmental pollution, which will increase individual pressure and emotional adjustment difficulties, leading to the generalization of mental health problems<sup>[4, 5]</sup>. Therefore, how to effectively deal with mental health problems, especially how to use urban ecosystems to alleviate psychological stress and improve emotional regulation, has become a key issue in the field of public health.

In recent years, as people gradually realize the important role of ecological environment in mental health, urban ecosystem has been paid more and more attention. Studies have shown that natural spaces such as parks and water bodies in cities can effectively alleviate emotional problems such as anxiety and depression, and improve residents' resilience<sup>[2, 5, 6]</sup>. However, the existing

research focuses on a single ecological factor and lacks a systematic discussion of the synergistic effects of various factors. Especially for the city's unique resource inequality and other factors how to affect mental health at the ecosystem level, the current research is still insufficient.

## **2. Data and Methods**

### **2.1. Literature screening**

This paper reviews the peer-reviewed journal articles on urban ecosystem mental health services and mental health by using the method of systematic evaluation. Through a comprehensive screening of relevant literature, the scope and keywords of the review were clarified. Literature search was performed through the Web of Science database, and the keywords used included: (ecosystem service\*)OR(non-material service\*)OR(cultural ecosystem service\*)OR(ecosystem mental health service\*)AND(mental health\*)AND(city). Based on keywords, as of October 2024, a total of 241 related articles were retrieved. In order to ensure the relevance and quality of the literature, all the included literature were peer-reviewed journal articles, and the publication date, keyword frequency, and citation volume of the literature were further screened. In addition, the content and research methods of the literature must be consistent with exploring the relationship between urban ecosystems and mental health, and summarizing research trends in this field.

### **2.2. Bibliometric analysis**

CiteSpace software is a tool widely used in bibliometrics. It can efficiently perform keyword co-occurrence analysis, cluster analysis and publication analysis<sup>[7]</sup>, helping to reveal hot topics in the research field, development trends, and research participation in different countries or regions. This study used CiteSpace software to conduct a quantitative analysis of the collected literature data. Specifically, this study mainly uses keyword co-occurrence, cluster analysis, national publication analysis and other analysis methods. Among them, keywords with high frequency ( $\geq 0.03$  centrality) are selected.

### **2.3. The development stage of urban ecosystem mental health services**

Based on the number of literature published, the change of keyword centrality and the evolution of research topics, this study divides the development of urban ecosystem mental health services into four stages, and each stage presents the progressive characteristics from basic exploration to refined research(See Table 1 for details).

The first stage (2006-2013) is the basic exploration stage. At this stage, the related research is in the initial stage, and the number of literatures is small. The research at this stage is mostly phenomenon observation and concept correlation, and lacks the subdivision discussion of specific ecological elements and action paths. However, the established “ecosystem service-mental health” correlation basis provides a key theory and terminology network for follow-up research.

The second stage (2014-2015) is the period of factor differentiation. The number of papers published in this stage has increased compared with the previous stage. The research has begun to shift from macro-correlation to the distinction and comparison of specific ecological factors, showing a clearer sense of problem, which lays a foundation for variable subdivision for subsequent mechanism analysis. Among the high-frequency keywords, the centrality of 21 keywords is  $\geq 0.03$ , reflecting the improvement of the focus of the research topic.

The third stage (2016-2021) is the mechanism exploration period. The research in this field has entered a period of rapid growth, and the annual number of publications has increased significantly. The research focus has shifted from the description of elements to the mechanism of the complex relationship between “urban ecosystem-mental health”.

The fourth stage (2022-2024) is a refined research period. At this stage, the number of publications remains stable and high-yield. The research topics show the characteristics of “diversification and subdivision deepening”, from the focus on “the overall ecosystem” to the in-depth analysis of specific scenarios and specific elements. At this stage, there are no keywords

with centrality  $\geq 0.03$ , which is not a decline in research influence, but reflects the “decentralization”, “refinement” and “diversification” of research fields.

Table 1 High-frequency keywords from 2006 to 2021.

Stage	Keywords	Count	Centrality	Year
stage I (2006-2013)	cultural ecosystem services	19	0.21	2013
	ecosystem services	127	0.08	2012
	mental health	82	0.18	2009
stage II (2014-2015)	exposure	23	0.12	2015
	green infrastructure	22	0.12	2015
	biodiversity	28	0.24	2014
stage III (2016-2021)	urban green spaces	11	0.03	2021
	air pollution	18	0.1	2017
	environmental justice	13	0.03	2018

### 3. Research objects of urban ecosystem mental health services

Urban ecosystems can meet the differentiated needs of different groups by providing diverse mental health services. The existing research objects can be divided into two categories, one is to compare and analyze the characteristics and mental health benefits of various community types, and the other is to focus on the adaptability of the psychological needs of specific groups to ecosystem services. The specific groups with high attention in the current research include women, adolescents and low-income groups<sup>[2, 3, 8]</sup>.

The mental health of female groups is susceptible to the superposition of physiological cycle and social role pressure, which has higher requirements for environmental safety and ecological resource accessibility<sup>[9]</sup>. Adolescents are in a critical transition period of psychological development. About 20% of the group faces problems such as emotional regulation disorders and behavioral adaptation difficulties. Their psychological pressure mainly comes from academic competition, peer relationship and self-identity conflict<sup>[8]</sup>. Urban low-income groups are the vulnerable groups in the city. Relevant research shows that the mental health problems of low-income groups are significantly related to the income level. Low income often means poor living conditions and may aggravate mental illness.<sup>[10]</sup>

### 4. Research methods of urban ecosystem mental health services

The current research analyzes the relationship between urban ecosystem and mental health through interdisciplinary means. The method system can be divided into two categories, nervous system level and behavioral performance level(See Table 2 for details). The nervous system level mainly uses the technology of neuroscience and other disciplines to analyze the response of the brain nervous system after natural experience and its mechanism of influence on mental health. Studies have shown that certain regions of the brain are closely related to mental health<sup>[11]</sup>. For example, the anterior cingulate cortex is considered to be a key structure for depression, and the sub-prefrontal cortex shows significant activity in the processing of sad emotions<sup>[11]</sup>.

Compared with the nervous system research, the behavioral performance level research method is more common and feasible, mainly by observing the behavior changes of the subjects or collecting data through questionnaires<sup>[2, 12, 13]</sup>. Cross-sectional study design is usually used. The research objects are representative regions or specific groups. The research methods are more flexible and the cost is lower. Common research methods include self-rated health status scale, emotional state measurement and quality of life assessment<sup>[6, 14]</sup>. In addition, in-depth interviews are also a commonly used method to understand their mental health status, daily life stress, and perception of the ecological environment through face-to-face communication with the subjects<sup>[13, 14]</sup>. Some studies also used non-disturbing natural observation methods to capture the cognitive,

emotional and behavioral performance of individuals and groups on mental health in their daily lives.<sup>[8, 12]</sup>

Table 2 Main research methods of urban ecosystem mental health services.

Type	Method	Main tools / technologies
Nervous system level	Brain imaging analysis	Functional Magnetic Resonance Imaging, Electroencephalogram, Arterial Spin Labeling.
Behavioral performance level	questionnaire method	Positive and Negative Affect Scale, Self-rating Anxiety Scale, Social Support Rating Scale, etc.
	In-depth interviews	Semi-structured interviews.
	Natural observation method	Behavior records, text coding.

## 5. Impact of urban ecosystem on mental health

Mental health is influenced by both natural and social environment. In terms of the natural environment, elements such as parks, water bodies, and blue spaces all play an important role in the mental health of residents, improving mental health by regulating emotions, reducing stress, and providing restorative experiences<sup>[2, 3, 5, 6]</sup>. First, the natural environment has a positive impact on mental health through visual and sound stimuli, especially in alleviating anxiety and improving emotional regulation<sup>[13]</sup>. The colors, shapes and types of plant landscapes can stimulate visual perception and promote physical and mental health<sup>[6, 13]</sup>; second, urban parks can reduce air pollution, alleviate urban heat island effect and noise pollution, reduce the negative impact of environmental factors on urban residents and enhance happiness<sup>[3, 5, 14]</sup>. In addition, it also enhances the individual's sense of social support by promoting physical activity and social interaction, thus having a long-term positive effect on mental health<sup>[3, 5, 6]</sup>. At the same time, physical exercise in the natural environment can also effectively enhance the individual's psychological resilience and emotional stability<sup>[3, 5, 8, 14]</sup>.

In terms of social environment, factors such as social interaction, neighborhood relationship, social support, sense of belonging and respect in the social environment have significantly improved mental health. Studies have shown that ecosystems provide opportunities for social interaction, enabling residents to have stronger social interaction, community cohesion, and a sense of neighborhood attachment, thereby improving mental health<sup>[5, 6]</sup>. For adolescents, the ecosystem provides a space away from peer pressure and adult supervision, helping to reduce psychological stress<sup>[15]</sup>. In addition, people's sense of identity and belonging to a specific place can bring psychological relaxation, enhance self-esteem and self-efficacy, and thus increase overall well-being<sup>[5, 6]</sup>.

The effect of urban ecosystem on mental health is reflected in two aspects, cumulative effect and comprehensive effect. The cumulative effect refers to that the ecosystem needs long-term contact and also has a long-term positive impact. With the accumulation of participation times and time, mental health is gradually improved<sup>[5]</sup>. The comprehensive effect refers to the diversity of the ways in which the ecosystem affects mental health, including direct sensory experience, promotion of physical activity and social interaction, which helps to enhance psychological resilience and emotional stability<sup>[5, 6, 14]</sup>.

## 6. Conclusion

Through a systematic review of the relationship between urban ecosystem and residents' mental health, this study draws the following conclusions.

The research on urban ecosystem mental health services has gone through four stages of development, from the basic exploration in 2006-2013 to the distinction of specific ecological

elements in 2014-2015, and then to the preliminary discussion of complex relationships in 2016-2021, until the refinement and diversification of research in 2022-2024. The number of studies has increased significantly after 2017, and the theme has gradually shifted from broad to focused, reflecting the sustainable development and maturity of this field.

The research objects cover a variety of community types and specific groups such as women, adolescents, college students, and low-income groups, reflecting the differentiated needs of different groups for urban ecosystem mental health services. The research methods are divided into the nervous system level and the behavioral performance level. The two methods are complementary and provide multi-dimensional evidence for revealing the impact of ecosystems on mental health.

The green space, water and other elements in the natural environment improve the mood through direct effects such as sensory stimulation and physical activity. Social interaction and community support in the social environment indirectly enhance psychological resilience by enhancing the sense of social belonging. Both of them affect residents' mental health through cumulative effect and comprehensive effect.

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