Urban Green Space and Residents' Mental Health

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As an important part of urban built environment, urban green space has long been recognized in the fields of promoting residents' mental health. The mediators can be divided into environmental factors, outdoor activity, and social cohesion. From the perspective of heterogeneity, both individual characteristics (e.g., age and gender) and group characteristics (e.g., level of urban development and urban density) of residents are considered to be the cause of various mediating effects. Types of urban green space tend to affect residents' mental health through different paths.

Keywords: greenery ; urban forest ; psychological relaxation ; intermediary factors

1. Introduction

In recent years, the built environment and human mental health have attracted extensive attention from the international community. The World Health Organization has pointed out that the Healthy Cities movement has become a pioneer in urban development and transformation, providing an impetus to the creation of a healthier and friendlier urban environment as well as maintaining human mental health and well-being [1][2]. As an important part of urban built environment, urban green space has long been recognized in the fields of promoting residents' mental health.

In general, certain theoretical achievements have been made in the research on the correlation between urban green space and residents' mental health. A series of studies have confirmed that urban green space is closely related to the mental health of residents. Lee et al. [3] pointed out there is a causal link between various indicators of mental health and urban green space, according to the meta-analysis. Urban green space can improve residents' mental health by stabilizing emotions and releasing stress [4]. Using the national representative longitudinal samples of British residents, White et al. [5] found that residents living in urban areas with a relatively high greening level have a lower average mental stress and higher life satisfaction. Volker et al. [6] also obtained similar results on this topic in Germany.

Based on the benefits of urban green space on mental health, it is of great significance to clarify the mechanism of urban green space on mental health. The main challenges that still need to be addressed in this research field are the causes and mediators of green space's beneficial effects [7][8].

2. Current Insights

Through an analysis of a series of previous studies on green space and mental health, it is not difficult to find that studies of the same population often draw different conclusions, and the significance of each mediator is not the same in different studies. A green space is a geographical system with rich functions and a complex structure. Each country has different characteristics in terms of the climate, status of development, and living conditions. For example, in countries with poor sanitation, living in green spaces may be detrimental to mental health because such areas have a higher risk of infectious diseases [9]. On the other hand, in cities in low- and middle-income countries which are developing faster than high-income countries, mental health problems are almost ignored [4][10]. Apart from these, the various urban green space rates, tree species mixes, etc., are different, so their ecological health functions and impact on the health of urban residents are also different [11]. Consequently, researchers need to substantiate and clarify what exactly is the mediator between green space and mental health. Furthermore, it is necessary to fully consider differences in the heterogeneity of residents, green space quality, and measures of mental health.

2.1. Definition of Mediators

Based on Part IV of **Figure 1**, we summarized the mediating factors between green space and mental health into three aspects. However, the definition of mediators is not uniform. There is a lot of good research going on, and most articles consider the role of mediators. The way they look for mediators is to refer to historical studies, propose mediation

hypotheses, and verify the significance of the mediation through models. However, this approach is not able to ensure that these mediators are mutually exclusive and collectively exhaustive.

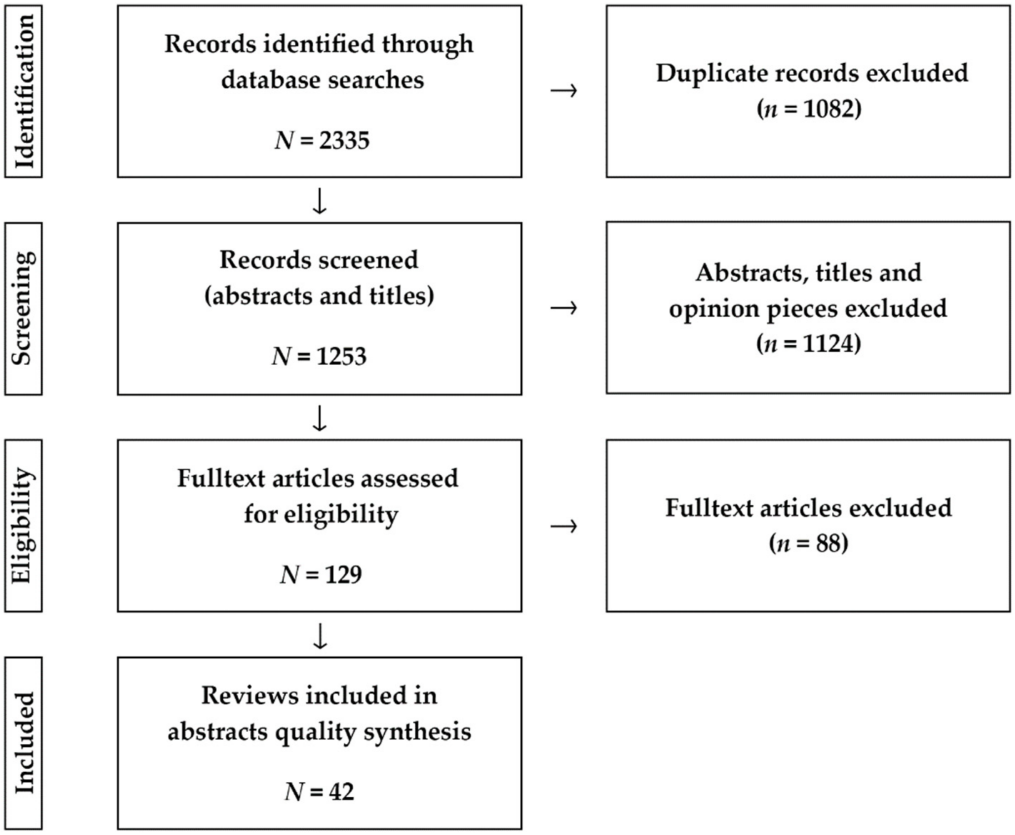

Figure 1. Article selection process.

The problem is that the factors identified in this way are not necessarily mediations, which, in many literatures, overlap with the concepts of green space and mental health. For example, the concept of loneliness may be included in the measurement of mental health [12]. It is a dimension to describe mental health. The same goes for stress [13]. Even different studies disagree on whether stress is a mental health issue. Similarly, mediation overlaps with green space. Some researchers take the use time of green space as a mediating variable, which seems to be a measure of the use rate of green space (many related papers take it as an independent variable). Additionally, if we continue to ask why the more time we spend in green space the healthier our psychology, we still need to continue to solve the mediation problem. Some studies contend that greening quality is also a possible mediating variable. However, since it is not related to any greenbelt index, and it is not easy to measure.

2.2. The Individual and Social Characteristics of Residents

There are many aspects of heterogeneity. Various influencing factors, such as individual characteristics and social characteristics of residents, should be considered comprehensively to reduce random errors to the greatest extent, so as to clarify the mediator of green space on mental health. In the future, the correlation between urban green space and residents' mental health should be demonstrated in a broader space–time scope. Researchers should try to avoid the existence of confounding factors in sample screening, and long-term follow-up observations should be conducted on participants' mental health to improve the effectiveness of the results. Therefore, we need to fully consider the individual characteristics and social characteristics of the residents in the research process to ensure the accurate analysis of how the mediator works. This corresponds to Part IV of **Figure 1**.

The individual characteristics of the residents need to be included in the category of research variable control. In most studies, the analysis' object is an individual. Only in a few "time–activity" detection studies has a specific area been taken as the research object [14]. Therefore, the research sample can only exclude some medical prerequisites, and there are always uncontrollable potential confounding factors between subjects, such as individual differences (health prerequisites, mental conditions, etc.) [15].

The social characteristics of the sample population need to be included in the category of research variable control. Some studies have found that the health benefits of green spaces can be modified by variables such as education level and socioeconomic status [4][16]. For example, a British study found that the risk of emotional problems among poor children

aged 3–5 was related to the surrounding green environment, but not among children from a higher social status [16]. For example, people with different levels of education perceive the effect of green space differently. Pun et al. indicated that there was a significant negative correlation between green space and perceived stress in highly educated people. Because these people spend more time near the home, they use and interact with their surroundings more frequently [17]. As mentioned above, people with a lower socioeconomic status seem to benefit more from green space, and few studies have focused on the impact of urban nature on vulnerable people, that is, the issue of “environmental injustice” [15].

Stratified analysis can be conducted according to social class, education level, age, and gender. These factors may change the direction and extent of the impact of green space on mental health, which means different mediators and influencing mechanisms.

2.3. Types and Qualities of Green Space

Urban green space includes neighborhood green space, urban forests, and parks, which corresponds to Part IV of **Figure 1**. There is currently no standardized approach to define green space, specifically, to define what we actually mean by surrounding greenness or exposure or access to green space [18]. This relates to the heterogeneity regarding green space assessment among different studies. Few studies have examined the association between mental health and the type and quality of green spaces, and only some researchers have studied the impact of environmental conditions on artificial and natural green spaces and the impact of improved and unimproved green spaces on participants’ mental health. For example, Butryn et al. [19] measured the emotional and sensory states of female long-distance runners, before and after running four miles on a natural or man-made urban route. The results showed that people’s emotional and sensory states were improved in both cases. Olszewska-Guizzo et al. used type of urban green space as a substitute for quality of green space. Specifically, parks were regarded as green spaces of higher quality than neighborhood green spaces [20].

The quality of green space should not be discussed in general in the research on green space and mental health. Instead, the different dimensions of green space quality should be explored according to the different tendencies and emphases of different mediators. The green space index (GSI) has been used by Occidental countries in recent years to quantitatively evaluate green infrastructure in designated sites. By superimposing the different weights of green space types, which have different ecological benefits, and by comparing them with the minimum value of the set index, a quantitative reference space can be obtained. Among them, ecological service, infrastructure spatial allocation, and maintenance of green space correspond to environmental factor, outdoor activity, and social cohesion, respectively.

Nowadays, cities around the world that have implemented the GSI have received favorable feedback from city managers, project builders, and the general public. Taking the Berlin habitat index as an example, relevant surveys have shown that, since its implementation, urban green infrastructure has achieved remarkable results in terms of regulating the urban ecological environment, improving the environmental quality of residents, and promoting the health of residents [21].

In a word, measuring the type and quality of green space from the perspective of mediators is more conducive to exerting its benefits, thus promoting the mental health of residents. The practice of urban green space-related policies has been widely carried out across the world, and the psychological health benefits of residents are relatively significant. There is an urgent need to fully consider mediators to distinguish types of urban green space and measure green space quality and to study the positive effects of urban green space on residents’ mental health from the perspective of type and quality of urban green space. The purpose is to ensure the comparability of related researches on urban green space.

2.4. Measure of Mental Health

Based on the measurement methods of mental health, empirical research was conducted on urban green space and the mental health of residents. With the help of specific measurement tools, the relationship between these psychological factors and environmental factor, outdoor activity, and social cohesion was further analyzed. Such methods are more diverse, focusing on the use of observation methods and interviews, while preferences and other behavioral social survey methods are based on scales. Mental health measures are mainly divided into three categories, including mental state measures, mood measures, and restoration measures. These three are correlated with the mediators, which is based on Parts III and V of **Figure 1**.

Environmental factors as a mediator mainly affect mental health from the level of recovery, such as improving air quality, reducing ambient noise, and increasing visual stimulation. Therefore, the mental health under this mediator is mainly measured by restoration. It refers to the relief of stress and psychological relaxation. The restorative outcome scale (ROS) is used to assess human recovery of forest environments [22]. The perceived restorativeness scale (PRS) measures how much mental alertness is restored in a given environment [23]. The Kessler Psychological Distress Scale (K10) measures

symptoms of psychological distress experienced by subjects [24]. Fan et al. [25] measured stress using the Perceived Stress Scale (PSS).

Outdoor sports often bring about interaction between residents and people or the environment. The effects on mental health tend to be direct in mood. Positive emotions are part of mental health. The most commonly used are the Center for Epidemiological Studies Depression Scale (CES-D), the Profile of Mood States (POMS), and the Depression Anxiety Stress Scale-21 (DASS-21). The Positive and Negative Affect Schedule (PANAS) is also used to evaluate the positive and negative feelings of participants, and it has already been applied in many studies [26][23][22].

Social cohesion refers more to the residents' subjective feelings about their living environment, so it often corresponds directly to the mental state scale. Some studies use the General Health Questionnaire (GHQ) [27][28] to measure the effectiveness of exposure to quiet and spacious green spaces in reducing the risk of poor mental health in women, and some studies use the Mental Health Scale (MHI) to measure mental health [13][29]. The short form health survey (SF) is also a valid instrument for measuring mental health [30][31][27].

Of course, this correspondence is not absolute. Some studies measure the impact of environmental factors and outdoor activities on mental health directly through mood. By recording the electroencephalography (EEG) signals of participants, Olszewska-Guizzo et al. [20] found that participants in green spaces produced higher frontal alpha asymmetry (FAA) values, which are generally associated with subjective motivation and positive emotions. By assessing children's internalization and externalization ability (basc-2), we can assess the general mood and behavior symptoms of adolescents [32].

3. Implications for Green Space Planning

Green space plays an increasingly significant role in residents' life. More and more urban policy makers are including green space in urban planning and considering the coordination between green space and building in order to maximize the health benefits of green space. The planning and design of urban green infrastructure is the mainstream policy practice in urban green space construction. According to David Ross, an American Landscape Architecture Planning scholar, green infrastructure is an internally connected green space ecological network which is formed by combining the natural environment and artificial environment [33]. This network can perform a series of urban ecosystem functions and improve people's health, especially mental health, by creating more green spaces. Community is the basic unit of social governance. To solve the problem of community green space is to meet residents' demands for green space from the micro perspective. The green space of the community should be planned according to the environmental characteristics of the community in a people-oriented way [34]. For this reason, and in consideration of green space quality and heterogeneous demand, the policy implications of green space planning are put forward at different levels of mediation by drawing on the experience of other countries.

3.1. Implications on Environmental Factor

The mediating effect of green spaces' environmental factors is the direct harm reduction and the physical gain to residents. Green space, such as the plants in the streets and office buildings, works by reducing air pollution and environmental noise and increasing green visual stimulation. Therefore, urban planning needs to ensure that there is enough green space between buildings and roads.

To be specific, the construction of green and gray infrastructure should be coordinated. Grey infrastructure is the traditional municipal public infrastructure which has a single function, such as roads and bridges. Green infrastructure is a green space system, which should be connected with grey infrastructure. The accelerated development of urbanization leads to green infrastructure not being able to play its role in promoting health independently, which creates the necessity for networked support of gray infrastructure. It is necessary for densely urbanized regions to apply a more environment and ecosystem friendly planning approach and system [35]. Urban administrators need to balance the two and promote the construction of green infrastructure to the maximum extent, while improving grey infrastructure. The practice in Cleveland, Ohio in the United States is a good example. The government advocated that relevant departments give priority to the development of green building standards when revising local gray infrastructure regulations, such as the construction of ecological botanical gardens and the expansion of residents' green activity spaces, which provided mental health benefits to local residents to varying degrees.

3.2. Implications on Outdoor Activity

The mediating effect of outdoor activities is that green space strengthens residents' behavior. In order to make it work, we must first ensure that residents have green space, want to have green space, and have access to green space. This involves three aspects of availability, security, and accessibility. In addition to the guarantee of the quantity of green space, we should also consider the improvement of quality. It is important to add facilities that enhance the quality of sports or social activities.

On the one hand, full consideration should be given to special groups, such as the disabled, the elderly, children, etc. Combined with heterogeneity, the different demands for green space should be fully considered from the perspective of all age groups, so that the green space can be reasonably allocated to all residents. For example, for the elderly and children, special activity areas can be set up, and corresponding entertainment facilities, fitness facilities, and rest seats can be added. For the disabled, sloping passageways can be designed to ensure green space accessibility. In addition, the open vision of green space should be fully considered in order to improve the sense of security of residents' while they undertake activities in the green space.

On the other hand, regarding the quality of the green space, we should not only consider whether the green rate is up to the standard, but also fully consider the accessibility and convenience in terms of actual use. First of all, community green space is the most frequently used activity space for community residents. In order to ensure its use, it is necessary to make public green space more attractive to residents as much as possible. Therefore, the design of community public green space should be more beautiful and interesting in order to increase the frequency of residents using it. Secondly, the greening design should fully integrate the spatial structure of the community and the behavioral habits of residents in order to ensure the availability and accessibility of the green space and, thus, minimize any negative effects on the convenience of residents' life.

3.3. Implications on Social Cohesion

The mediating effect of community cohesion is to increase residents' sense of belonging and satisfaction with the surrounding environment. Policy makers need to organically combine the urban production environment and green space. Meanwhile, as a kind of environmental resource, monitoring and maintenance of green space also needs to be considered.

The connection between green infrastructure and the local environment is deep. In the planning and design of green space, we should pay attention to the regional concept, preserve the natural landscape, and reduce the damage to the original ecological landscape. The transition between the buildings and the surrounding green space should be considered at the same time. For example, with the help of the tributaries of urban rivers, the continuity principle was adopted to build an ecological park in Louisville, Kentucky, USA. The project of Queen's Square Park in the United States involved the use of a large number of green plants to green the dangerous intersection, which is integrated with the characteristics of the natural area. The project not only ensured road safety, but also improved the health and well-being of residents. In Maryland, USA, rain gardens provided extended green spaces for urban residents. Because of the low costs of construction and maintenance and high health benefits, these gardens were widely adopted around the world.

In addition, community green space should be constantly transformed and maintained. Managers should combine practical experience and pay continuous attention to the green space of the community. According to the change in residents' demands, the green space and related facilities should be restored and updated regularly. On the basis of reasonable planning, the management of community green space should be strengthened. For example, private occupation of public green space and malicious damage to the green environment by some residents should be prevented.

References

1. WHO European Healthy Cities Network. Available online: http://www.euro.who.int/en/health-topics/e-nvironment-and-health/urban-health/who-european-heal-thy-cities-network (accessed on 20 December 2019).
2. Agency USEP. What Is Open Space/Green Space. Available online: http://www3.epa.gov/region1/eco/uep/openspace.html (accessed on 20 December 2019).
3. Lee, A.C.K.; Maheswaran, R. The health benefits of urban green spaces: A review of the evidence. J. Public Health 2010, 33, 212–222.
4. World Health Organization. Mental Health Action Plan 2013–2020; World Health Organization: Geneva, Switzerland, 2013.

5. White, M.P.; Alcock, I.; Wheeler, B.; Depledge, M.H. Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data. Psychol. Sci. 2013, 24, 920–928.
6. Völker, S.; Kistemann, T. Developing the urban blue: Comparative health responses to blue and green urban open spaces in Germany. Health Place 2015, 35, 196–205.
7. Zhang, Y.; Mavoa, S.; Zhao, J.; Raphael, D.; Smith, M. The Association between Green Space and Adolescents' Mental Well-Being: A Systematic Review. Int. J. Environ. Res. Public Health 2020, 17, 6640.
8. Dzhambov, A.; Dimitrova, D. Urban green spaces′ effectiveness as a psychological buffer for the negative health impact of noise pollution: A systematic review. Noise Health 2014, 16, 157–165.
9. Gruebner, O.; Khan, M.M.H.; Lautenbach, S.; Müller, D.; Krämer, A.; Lakes, T.; Hostert, P. Mental health in the slums of Dhaka—A geoepidemiological study. BMC Public Health 2012, 12, 177.
10. Grinstein-Weiss, M.; Yeo, Y.; Anacker, K.; Van Zandt, S.; Freeze, E.B.; Quercia, R.G. Homeownership and Neighborhood Satisfaction among Low- and Moderate-Income Households. J. Urban Aff. 2011, 33, 247–265.
11. Kanelli, A.A.; Dimitrakopoulos, P.G.; Fyllas, N.M.; Chrousos, G.P.; Kalantzi, O.-I. Engaging the Senses: The Association of Urban Green Space with General Health and Well-Being in Urban Residents. Sustainability. 2021, 13, 7322.
12. van den Berg, M.M.; van Poppel, M.; van Kamp, I.; Ruijsbroek, A.; Triguero-Mas, M.; Gidlow, C.; Nieuwenhuijsen, M.J.; Gražulevičiene, R.; van Mechelen, W.; Kruize, H.; et al. Do Physical Activity, Social Cohesion, and Loneliness Mediate the Association Between Time Spent Visiting Green Space and Mental Health? Environ. Behav. 2017, 51, 144–166.
13. de Vries, S.; van Dillen, S.M.; Groenewegen, P.; Spreeuwenberg, P. Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. Soc. Sci. Med. 2013, 94, 26–33.
14. Kondo, M.C.; Low, S.C.; Henning, J.; Branas, C.C. The Impact of Green Stormwater Infrastructure Installation on Surrounding Health and Safety. Am. J. Public Health 2015, 105, e114–e121.
15. Kondo, M.C.; Fluehr, J.M.; McKeon, T.P.; Branas, C.C. Urban Green Space and Its Impact on Human Health. Int. J. Environ. Res. Public Health 2018, 15, 445.
16. Flouri, E.; Midouhas, E.; Joshi, H. The role of urban neighbourhood green space in children's emotional and behavioural resilience. J. Environ. Psychol. 2014, 40, 179–186.
17. Pun, V.C.; Manjourides, J.; Suh, H.H. Association of neighborhood greenness with self-perceived stress, depression and anxiety symptoms in older U.S adults. Environ. Health 2018, 17, 39.
18. Gascon, M.; Triguero-Mas, M.; Martínez, D.; Dadvand, P.; Forns, J.; Plasència, A.; Nieuwenhuijsen, M.J. Mental Health Benefits of Long-Term Exposure to Residential Green and Blue Spaces: A Systematic Review. Int. J. Environ. Res. Public Health 2015, 12, 4354–4379.
19. Nichani, V.; Dirks, K.; Burns, B.; Bird, A.; Morton, S.; Grant, C. Green Space and Physical Activity in Pregnant Women: Evidence from the Growing Up in New Zealand Study. J. Phys. Act. Health 2016, 1, 1341–1350.
20. Olszewska-Guizzo, A.; Sia, A.; Fogel, A.; Ho, R. Can Exposure to Certain Urban Green Spaces Trigger Frontal Alpha Asymmetry in the Brain?—Preliminary Findings from a Passive Task EEG Study. Int. J. Environ. Res. Public Health 2020, 17, 394.
21. Annerstedt, M.; Östergren, P.-O.; Björk, J.; Grahn, P.; Skärbäck, E.; Währborg, P. Green qualities in the neighbourhood and mental health—Results from a longitudinal cohort study in Southern Sweden. BMC Public Health 2012, 12, 337.
22. Bielinis, E.; Bielinis, L.; Krupińska-Szeluga, S.; Łukowski, A.; Takayama, N. The Effects of a Short Forest Recreation Program on Physiological and Psychological Relaxation in Young Polish Adults. Forests 2019, 10, 34.
23. Takayama, N.; Morikawa, T.; Bielinis, E. Relation between Psychological Restorativeness and Lifestyle, Quality of Life, Resilience, and Stress-Coping in Forest Settings. Int. J. Environ. Res. Public Health 2019, 16, 1456.
24. Astell-Burt, T.; Feng, X.; Kolt, G. Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: Evidence from 260,061 Australians. Prev. Med. 2013, 57, 601–606.
25. Fan, Y.; Das, K.V.; Chen, Q. Neighborhood green, social support, physical activity, and stress: Assessing the cumulative impact. Health Place 2011, 17, 1202–1211.
26. Janeczko, E.; Bielinis, E.; Wójcik, R.; Woźnicka, M.; Kędziora, W.; Łukowski, A.; Elsadek, M.; Szyc, K.; Janeczko, K. When Urban Environment Is Restorative: The Effect of Walking in Suburbs and Forests on Psychological and Physiological Relaxation of Young Polish Adults. Forests 2020, 11, 591.
27. Triguero-Mas, M.; Dadvand, P.; Cirach, M.; Martínez, D.; Medina, A.; Mompart, A.; Basagaña, X.; Grazuleviciene, R.; Nieuwenhuijsen, M.J. Natural outdoor environments and mental and physical health: Relationships and mechanisms. Environ. Int. 2015, 77, 35–41.

28. Sarkar, C.; Gallacher, J.; Webster, C. Urban built environment configuration and psychological distress in older men: Results from the Caerphilly study. BMC Public Health 2013, 13, 695.
29. Sturm, R.; Cohen, D. Proximity to urban parks and mental health. J. Ment. Health Policy Econ. 2014, 17, 19–24.
30. Richardson, E.; Pearce, J.; Mitchell, R.; Kingham, S. Role of physical activity in the relationship between urban green space and health. Public Health 2013, 127, 318–324.
31. Leslie, E.; Cerin, E. Are perceptions of the local environment related to neighbourhood satisfaction and mental health in adults? Prev. Med. 2008, 47, 273–278.
32. Dadvand, P.; Nieuwenhuijsen, M.J.; Esnaola, M.; Forns, J.; Basagaña, X.; Alvarez-Pedrerol, M.; Rivas, I.; López-Vicente, M.; Pascual, M.D.C.; Su, J.; et al. Green spaces and cognitive development in primary schoolchildren. Proc. Natl. Acad. Sci. USA 2015, 112, 7937–7942.
33. Choumert, J.; Salanié, J. Provision of urban green spaces: Some insights from economics. Landsc. Res. 2008, 33, 331–345.
34. Guha, M. Environmental Psychology. J. Ment. Health 2020, 29, 367–369.
35. Wang, Z.; Yang, T.; Liu, H.; Yuan, M.; Luo, J.; Li, C. Evaluation and Dynamic Mechanism of Ecological Space in a Densely Urbanized Region During a Rapidly Growing Period—A Case Study of the Wu-E-Huang-Huang Metropolitan Interlocking Region. Sustainability 2019, 12, 73.