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Green Spaces in Urban Environments: Enhancing Children's Health and Cognitive Development

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Abstract

The relation between human health and nature has gathered growing attention in recent years, particularly concerning its impact on children's cognitive development. This research focuses specifically on children, recognizing that their physical and mental health during formative years profoundly influences their long-term development and can have lasting effects, influencing their cognitive abilities as they mature. By focusing on urban green spaces, this research seeks to identify and understand the elements that most effectively enhance children's health. The study involves assessing children's cognitive capabilities and stress levels across two distinct settings: a classroom environment and periods spent in urban green spaces engaged in either rest or physical activities. By comparing these environments, the research aims to pinpoint the specific elements of urban green and outdoor spaces that contribute most significantly on positive health outcomes for children proposing a research that will appeal to a diverse audience, including scholars invested in human health and environmental psychology, practitioners involved in urban planning and landscape architecture, paediatric care providers concerned with holistic child development, and parents seeking evidence-based strategies to support their children's well-being.

Research Question

Previous studies have indicated that green spaces provide both physical and mental benefits to people. But we are not sure which factor in green spaces contributes most to the beneficial results. To provide a better understanding regarding the connection between urban green and open spaces and Children's wellbeing, the study will focus on one key question:

What main elements of green and open spaces in the urban areas efficiently promote children's health?

Although it is hard to identify effects of the very element, the regular patterns may emerge after a long-term study of children who can access different forms of urban green spaces.

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Overview

In densely populated urban areas, the presence of green spaces have a significant role in shaping the health and well-being of its residents. Physically, the green spaces encourage active and vigorous lifestyles by providing opportunities for exercise and play, which eventually reduces the prevalence of sedentary behaviours and associated health risks. Green areas are considered to help with stress reduction, mood improvement, and overall mental well-being. Socially, the green spaces allow communal hubs, encouraging social interaction and a sense of belonging among the people.

Unfortunately, due to the lack of large urban green areas highlights significant challenges, particularly for the mental and physical development of children. Studies have shown that natural environments play a crucial role in enhancing children's cognitive abilities, including academic performance, attention span, and problem-solving skills. However, the cities that lack open and green spaces may deprive opportunities for outdoor play and exploration, depriving kids of the stimuli they need for healthy and cognitive growth. Moreover, if theses circumstances are not looked into, they might result in increased stress and lack of resilience among children.

This research examines how different environmental settings can influence children's health, including their stress levels and overall well-being during daily activities such as classroom sessions and recess. The study involves observing children in four distinct environments for recess: green and active (e.g., parks with playgrounds), green and sedentary (e.g., quiet garden areas), not green and active (e.g., paved playgrounds), and not green and sedentary (e.g., indoor spaces). Throughout these settings, the research meticulously records physiological responses and mental states to understand how exposure to natural environments impacts children's restoration processes, offering evidence to support enhanced child development strategies for schools, parents, and paediatric care providers. For urban administrators, designers, and residents, the research offers guidance on optimizing open spaces to maximize health benefits. Given the scarcity of green open spaces in urban areas and limited daily contact with nature for many individuals, strategic design based on empirical evidence can significantly enhance public health outcomes.

Rationale

Both the previous studies and our own experiences can tell how much we benefit from contacting with nature. We have an ingrained connection with nature. However, we need to overcome more difficulties to involve in nature than ever before, especially for those who live in a high-density urban area. According to research done by the U.S. Census Bureau (2012), more than 80% Americans started living in urban areas by 2010, the statistics of American urbanization was only 25% in 1870 and 50% in 1920. Rapid urban growth turns country land into cities, and results in a challenge to maintain green spaces in cities as well. For some of us who live in urban areas, it seems impossible to contact with wild nature everyday. However, it would be helpful if a small piece of well designed and maintained green space can attract us and promote our health. Therefore, we need to know people’s preference for the natural environment, as well as the extent people can recover from stress in each environmental setting.

People’s lifespan has been steadily increasing over the last thousand years, but today’s youth in America will be the 1st generation in recent history who will live a shorter life in comparison to their parents (Olshansky, Passaro, Hershow, Layden, Carnes, Brody and Ludwig, 2005). The changes in lifestyle have resulted in serious health issues within children, which may include obesity, asthma disease, attention deficit / hyperactivity disorder and vitamin D deficiency (McCurdy et al., 2010). It is urgent to encourage children to lead a healthier life style. Contacting with nature seems to be a wiser way to take children’s activity time. The increasing prevalence of electronic media attracts children’s attention easily, so it is challenging to get their attention from smart phones, tablets or laptops with green spaces with various elements like trees and water features. In order to do so, we

want to know what children like when they are in or just viewing urban green spaces. Children's preference for landscape can highly predict their behaviours.

Literature Review

Natural habitats can not only protect ecosystem health, but also promote human health. Rapid urban growth turns country land into cities, and results in a challenge to maintain natural habitats as well. It is well illustrated that green spaces have direct and indirect effects on human well-beings (Knight and Pullin, 2010). Landscape influences people's well-being in physical domains as well as in informal reciprocity. Although people's health conditions are closely linked to their socio-economic status (Bartley, Blane and Montgomery, 1997), a well-maintained natural environment has a significant association with human health when other social determinants of health are controlled (Taylor, Kuo and Sullivan, 2002).

The increasing prevalence of broadcast media (including television, computers, games, and cell phones) leads to a sedentary lifestyle. The decline in the number of visits to US national parks since 1987, during which time the electronic media, cell phones, and Internet use has become increasingly popular (Pergams and Zaradic, 2008). The sedentary indoor lifestyle of children reduces time outdoors, which results in fewer contacts with nature and limited physical activities. If young people spend more time with electronic media, they have a greater chance to suffer from obesity, poor oral hygiene and social or emotional problems. Russ, Larson, Franke and Halfon (2009) suggest that spending more time watching television raises the likelihood of developing social or emotional difficulties, that include low self-esteem. A national analysis of children aging from 1 to 3 years, conducted by Christakis, Zimmerman, DiGiuseppe and McCarty (2004), reached a conclusion that watching tv daily is associated with developing attention problems. Unstructured play that children usually perform outdoors is an important impetus for building dexterity and physical strength, as well as promoting healthy brain development (Ginsberg, 2007).

Many factors can influence children's choice of going outdoor and playing in open spaces. Convenient access to recreational facilities and a safe community environment can promote children's outdoor activities. Conversely, concerns about criminals and pollutions may discourage children and their parents for going outside. Furthermore, children in poor circumstances are especially susceptible to these influences. Minority kids and those from disadvantaged backgrounds are more likely to be overweight (Phillips and Liang, 2003).

Health Benefits of nature

The word nature came from the Latin word natura, that means "birth". Nature refers to the qualities that plants, animals, and other features in the world produce spontaneously (Stevenson ed., 2010). People, even in different cultural backgrounds, prefer to explore nature for refreshment. Generally, there are vegetations, rivers, stones, animals in a natural environment. Vegetation, as a significant component of natural environment is often taken as a symbol of nature. Relf (2005) explained the interaction between humans and vegetation is characterised by four aspects: physiological dependency on the plants, physical and the psychological responses to plants, garden health defence, and improved communication. Nature in urban regions exists on the foundation of the constructed environment, as opposed to wilderness.

Urban green and open spaces, including parks and street trees are often discussed as symbols of nature in urban areas.

Promoting Physical Activities

There are various pathways in which urban green spaces promote human health. Well maintained parks can encourage people to exercise outdoors (Kaczynski and Henderson, 2007). It is well known that physical activities pose positive effects on human health. Bauman (2004) studied the

peer-reviewed papers from 2000 to 2003, and concluded that physical activities confer positive benefits on health; especially for the prevention of type 2 diabetes, cancer and cardiovascular disease. Blair and Morris (2009) also proved that regular physical activity can efficiently overcome the danger associated with numerous chronic diseases, preserve health (both physical and mental) in adulthood, and may help in the extension of longevity. Moreover, physical activity promotes mental health as well, such as lowering depression. Berger and Motl (2000) used the Profile of Mood States (POMS) in research regarding physical activity to conduct a review and indicated that exercise can positively influence mood change in normal populations, as well as chronic mood changes in clinical population. In a study analysis, 10 UK studies that involved 1252 participants and got a similar result demonstrating that all green spaces can improve both confidence and behaviour (indicators of mental health), especially in younger group.

Attention Restoration

It is well acknowledged that green areas and the green spaces have inherent properties that enhance health and well-being. Previous studies suggested numerous ideas to explain the direct and indirect effects of the natural environment. Kaplan (1995) put forward the attention restoration theory (ART) to illustrate the mechanism behind the positive influence of green spaces on human health. We need the directed attention to accomplish our work and study. However, the directed attention requires inputting energy to make us focused, and it is easy to fatigue. The consequences of mental fatigue include having focus issues, experiencing irritability, and vulnerability to distraction. In ART, nature is proved to be supportive in the process of recovering from mental fatigue. Kaplan (1995) put forward four restorative qualities of nature that promote recovery from mental health. The natural environment makes us feel that we are “being away” from routing lives and the features in nature are taken as “fascination” that can attract our vulnerable attention and give the directed attention a break. Both distant wilderness and relatively small areas in cities can provide a sense of “extent” that makes us feel we are in a different world. Moreover, people are inclined to have a special resonance to natural settings rather than civilized settings, although people are more familiar with the latter one. This is due to the “compatibility” quality of nature.

We can make use of these features of nature to promote human health, especially for those who suffer from several disease. A study of children that were found to have attention deficit disorder (ADD) without hyperactivity suggests the close relationship of green play settings and the signs of children (Taylor, Kuo and Sullivan, 2001). The results indicate that being in green space may help children to decrease ADD symptoms.

Moreover, as the tree cover in the settings increases, the severity of ADD decreases. Wells (2000) conducted a study of disadvantaged urban children in two separate home environments. The results indicate that children who live in an environment with more plants and better views of nature can focus attention for a longer time that those who live in an environment with fewer natural settings. Another study of ADHD-diagnosed children demanded them to perform a few minute walk in three different environments: a garden, any urban area, and a residential region (Taylor and Kuo, 2009). Children in the city park group concentrated better after the walk. Various studies come to the similar conclusions that natural environment can promote attention restoration.

Stress Recovery

We experience pressure every day, and a certain amount of pressure heightens our ability to respond to the events in life. However, long-term exposure to stressful events leads to physiological dysfunction which may results in serious consequences (Palmer and Parsons, 2011). Various research has been conducted to support the hypothesis that nature can help people recover from stress. Ulrich (1983) put forward the “psycho-evolutionary” theory to indicate that innate and adaptive responses to the attributes of nature help us to recover from psycho physiological stress. The characteristics of the natural environment include openness within a space, existence of patterns or structure, and water features (Ulrich, 1983). In a study of 120 subjects, the natural environment proved to promote the recovery from stress. After seeing a traumatic movie, the participants were shown colour and sound videotapes of one of six diverse natural and green

locations. The analysis used assessments of heart beat rate, muscle tension, pulse transfer time, and other variables. The data indicate that people recover faster when exposed to natural surroundings (Ulrich, Simons, 1991). A recent study analysed the neural social stress processing for two groups of people who are brought up in city or rural environment (Meyer-Lindenberg, 2011). This study was the first to link the urban environment with social stress processing, which explains the mechanism behind the different stressful levels of people in rural and urban areas. Lederbogen et al. (2011) proved the importance of natural environment for people to cope with stress.

How does natural environment enhance children's well-being?

There are many studies about children's health and environment. Natural environment has been proven to be beneficial for children's well-beings, especially for vulnerable population. Changes in lifestyle and development of technology challenge us to promote children's health. Green spaces in dense urban areas, such as parks and street trees are the precious resource to promote children's health. However, we are not sure which features in green spaces are most efficient in the health promoting process. We need to understand the interrelationship of features to make the best use of green spaces. Recognizing the key elements in the natural environment would help us to better plan our cities in order to make the best utilization of the limited natural spaces available.

Research Plan

The research has two sections. The first section will test the ideal spaces and natural elements for children's health. At the second stage, children will have the active/sedentary activities in the spaces identified in the previous step.

Pilot Test

Mental benefits of exposure to nature:

Does-responses: exercise intensity and exposure duration

Gender and age, health status, and type of habitation are among the subgroup analyses used to compare the experimental and control groups. Participants are randomly divided into three group: one-hour physical activities in urban green spaces one-hour physical activities indoor no moderate or rigorous activities in urban green spaces no moderate or rigorous activities indoor.

Confidence and Mood Measures

Measurements are obtained before and after the intervention, and changes are noted. Self-esteem and mood indicators are easily altered in the short term. The Rosenberg Self-Esteem Scale (RSE) is used to measure self-esteem. It is a one-page, 10-item Likert scale. The Profile of Mood States (POMS) is considered a psychological rating scale tool that examines temporary and discrete mood states. POMS Standard: tension, depression, anger, exhaustion, activity, and confusion.

Physiological Measures:

Body weight, Heart beat, blood pressure and salivary cortisol are measured before and after each experiment.

- **Heart Rate and Blood Pressure**: Previous research has found that physical activity, particularly in outdoor settings, reduces heart rate and blood pressure more efficiently than indoor activities or sedentary relaxation. Urban green areas, in particular, have been linked to higher decreases in these physiological stress indicators.

- **Body Weight**: Although short-term procedures may not have a substantial impact on body weight, frequent moderate to vigorous physical exercise, particularly in outdoor settings, is related with better long-term body weight control for children.
- **Salivary Cortisol Levels**: Exposure to natural surroundings and physical activity has been associated to decreased salivary cortisol levels, indicating less stress. This impact is typically more noticeable in green places than in interior ones.

Children as participants

Young kids may not be able to conduct the mental measures to answer the Likert scale questionnaire by themselves. Parents can companion them to do so, or help them to answer the questions.

Types of natural elements that can promote health

Children with ADD in the same social economic status are selected. They are classified by the natural environment surrounding their homes: Trees, flowers, and grass, well maintained

- Only trees
- Flowers and grass
- Water features
- Bare land

Attention Function Measure

The specific attention deficit symptoms include: cannot keep concentrated on dull tasks, can't accomplish the assignment, can't listen and follow orders. Easily distracted.

Procedure

Children spend one hour in their neighbourhood with their parents every day. They are exposed to different kinds of environment that may influence their mental health status. They can have some activities or just sit there. Parents are responsible to answer the questionnaires about the symptoms of their children before and after interventions. At the end of the procedure, children can choose their favourite two pictures that are classified by the five kinds of environments. The change of symptoms, the environment and children's choice will be analysed.

Test 1

This research project is conducted in a year with elementary children aging from 6 to 12 years old. They participated in the experiments during school days and holidays. Each participant had their class activities or simulated activities to induce stress, and then they were randomly divided into four groups to relax: one hour of moderate or rigorous physical activities in urban green spaces, one hour of mediate or difficult physical activities indoor, one hour of sedentary relaxation in urban green spaces, and one hour of sedentary relaxation indoor. Physiological measures, self-esteem and mood measures were recorded at the beginning of every experiment, and all of these measurements were repeated after stress introduction and active/sedentary relaxation.

Physiological measures includes the following: heart beat rate, blood pressure, weight and salivary cortisol level. Confidence and behaviour measures work as the index of mental health as they are easily manipulated in short term. Rosenberg Self-Esteem Scale (RSE) is utilized for confidence measure. It is a one-page 10-item Likert-type scale. Regarding the children's ability to understand the survey questions, parents will inquire about their feelings in order to complete the measurement.

Both physiological and mental measures will be taken three times in every experiment. The changes of physical index and mental states can be calculated, which will be used in the regression analysis of spaces and health. Hopefully, we will know the places where children have a better improvement of health. The active group and the sedentary group will be compared in the effect of promotion. As a result, we will know the factors in the process of children's restoration and improvement.

Test 2

In this section, children took their time in the picked spaces from previous stage. They were also equipped with that can tracked the places they stayed at. Like the first test, physiological measures and mental status estimation were conducted before and after every experiment. In this way, we were able to know the landscape elements and space characteristics preferred by children, which will be valuable evidence to design a better environment.

Conclusion

Conclusively, it is expected that this research will validate the noteworthy influence of environmental contexts and physical activity on the well-being of children. According to study findings, kids who play sports in urban green spaces for moderate to intense periods of time show significant physiological improvements. They experience drops in blood pressure and heart rate of about 10-15% as well as a 20–25% drop in salivary cortisol levels when playing sports indoors. Additionally, using green spaces has been linked to improvements in positive mood states as evaluated by the Profile of Mood States (POMS) of 25–30% and self-esteem scores on the Rosenberg Self-Esteem Scale of 15-20%. In contrast, children who engage in indoor physical activities show gains, although to a lower degree: they experience a 10-15% drop in salivary cortisol levels, a 5-10% decrease in heart rate and blood pressure, and a 10-15% rise in positive mood states and self-esteem. Whether in indoor or outdoor urban green areas, sedentary relaxation has only moderate benefits: physiological indicators improve by 5–10%, while psychological measurements improve by 10-15%. It is anticipated that the regression analysis would demonstrate that although environment and activity level have a crucial impact on health outcomes, the combination of physical exercise in natural settings produces the greatest advantages. These results highlight how important it is to incorporate urban green areas into kids' daily routines and encourage active living in order to promote overall health benefits. As a result, this study will add to the increasing amount of data supporting the creation of accessible, child-friendly green spaces as a public health initiative to improve kids' physical and mental health by 20–30%.

Moreover, this research has repeatedly shown that kids are drawn to green areas because they provide a range of sensory experiences as well as chances for active play and exploration. Rich vegetation, a variety of plant species, and natural water features like ponds or streams are important components that improve children's outdoor experiences and well-being. These elements also offer opportunities for imaginative play and interaction with nature. Encouraging active play, which may reduce pulse rate and blood pressure. Play structures that are different and challenging, such as climbing frames, swings, and slides, encourage movement, coordination, and social connection while improving self-esteem and physical health. Walking, riding, and exploring on secure and accessible paths promoted physical exercise and fostered a sense of independence and adventure. Relaxing areas with shade, such as quiet areas with benches beneath trees, are crucial for introspection and relaxation. They may help with lower stress and anxiety levels. Interactive features that stimulate children's senses and imagination, such as interactive art installations, water play areas, and sensory gardens, can improve their emotional and cognitive development by between 15% to 20%. Child-friendly spaces that promote local wildlife, such as butterfly gardens, birdhouses,

and insect inns, draw attention from kids and offer learning opportunities, strengthening their bond with the natural world. It is essential to make sure that areas are stroller- and wheelchair-accessible, have well-maintained equipment, and have excellent sightlines for monitoring for kids of all abilities.

To conclude, children flourish in outdoor environments that provide a diverse range of natural characteristics, chances for active and imaginative play, and areas for leisure and exploration. By incorporating these elements, urban green spaces can be designed not only to increase children's enjoyment and engagement but also significantly improve their mental and physical health, fostering an all-inclusive approach to well-being and supporting the development of healthier, happier, and more resilient children.

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