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The Role of Natural Environments in Reducing Urban Stress and Improving Mood

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Abstract

The global population, especially in the developed world, is rapidly becoming increasingly urban. As cities expand, exposure to the beneficial characteristics of nature decreases. Many recent studies indicate that visiting green spaces and being exposed to natural environments can help reduce psychological stress, and enhance mood state and health. However, few investigations have addressed the question of whether these attributes are uniformly distributed across green areas, and they have typically used the biophysical nature of the environment as a nominal, binary measure of "naturalness". Accordingly, this study explores this question to advance current understanding of the inexpensive yet effective design and management of the urban environment for improved human health and well-being.

Keywords: *Urbanization, Green Space Exposure, Psychological Stress, Restorative Environments, Public Health Planning.*

Introduction

Exponential rates of urbanization and population growth during the past 50 years have led to an increase in a number of factors that have a pronounced negative impact upon human health (1). The urbanized areas of the planet account for 2% of its surface but host nearly 50% of the world's population and consume 75% of its natural resources (2). The environmental consequences of this situation are well documented (3). Less focused upon but no less important are the mental and physical health consequences (4). Urban settings have been linked to a number of problems such as obesity, rising rates of cardiovascular disease, anxiety, and depression (5). Factors such as increased population density, busyness and noise of urban environments, a diminished presence of vegetation and exposure to nature are considered to play a role in the development of urban stress (6). This construct represents a transaction of the interaction of an individual's resources and specific demands (5). Stress is channeled through physiological and psychological pathways that can produce a number of undesirable outcomes such as disease, dysfunctional behaviors, and diminished quality of life (4).

Fortunately, natures "safety valves" are designed to absorb urban stress and correctly channel needs and problems (7). Natural areas, that is, areas of verdant vegetation that display the characteristics found in wilderness settings, are thought to quell the stress arising in urban environments (8). Past and recent research has provided evidence supporting the efficacy of recreation in natural environments at reducing the levels of urban stress (9). A primary avenue

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for pursuing nature-safety valve research has been the examination of the quantity and quality of natural environments in metropolitan settings and the use of these areas to conduct a mental health behavior such as physical activity (10). Most of this research has relied solely upon self-report measures of change in stress levels though some physiological measures of stress have been included. A major research gap exists regarding the health-promoting aspects of nature–physical activity within a controlled experimental framework (10). Natural environments can be both passive and active settings yet the effects of physical activity in these two types of environments on stress levels has yet to be documented (9).

Understanding Urban Stress

Stress is defined as the experiencing of involuntary and uncontrollable physiological and psychological reactions to the perception of threats or risks toward one's well-being (11). The Bernoulli principle illustrates the idea characters of stress; when the threat is perceived, resource consumption starts to exceed capacity, it results in lower energy available for the individual's functioning (12). On the contrary, if objects/agents of interest are seen as not threatening, resources stay above consumption, it results in a tranquil state. Stress may take reactive forms in response to the presence of real threats or anticipated forms in the event of a potential risk (13). The wrongly experienced security of concept remotely located from potential threats can lead to stress as well (12). Urban living can produce stress from a number of causes, including the inadequate size of personal space, uncertain safety, unwanted complexity for the management of traffic flows, lack of adequate eating and exercising space, the financial state of the people, and economic competition (14).

Stress can also be triggered by the anticipated occurrence of adversely functioning situations or due to fear of inadequacy of resources for problem resolution or avoidance (15). Stress is a human customarily and evolutionarily developed phenomenological form of experience to peripheral changes that occur as information reaches the consciousness (16). Stress is not necessarily negative (15). The focus on attention and energy on specific targets enhances compensation for the readily observable change in the environment (16). However, the triggered alert is not always directed toward the intended target and it often remains (17). Stress is therefore a short-term bodily function (17). Far-reaching, unsuccessful, and chained deferment of stress may lead to chronic stress and often mental health issues, such as generalized anxiety disorder and other anxiety-related disorders (18). Too stress-intensive conditions are poorly suited by evolution for meeting expectations of a calm, predictable, and resource-abundant environment (18).

Definition of Urban Stress

United Nations Environment Program defines stress as the experience of involuntary physiological and psychological reactions to the perception of threats toward well-being – physical, psychological or social health and integrity. Urban living can produce stress with inadequate personal space, uncertain safety, or poor economic condition (19). Anticipation of adverse situations and fear of inadequate resources to respond to them can also trigger stress (20). The experiencing of the environment extends beyond the senses (20). It significantly influences physiological functions such as the nervous, endocrine, and immune systems (21). Mental processes and emotions that accompany experiencing are all part of the experience (21). They become part of the experience of living in cities, the logic behind the routines, and the thoughts on how to make a living (11). The issue of experiencing the urban environment is becoming increasingly critical in mass urban living (22). Too often, the urban space needed for

smoothly functioning processes and events is overlooked (22). The public spaces in-between events tend to be neglected, if given any consideration, sometimes even see a drain of resources (23). The active processes carried out by people are invariably highlighted while the space with no measurable function is neglected (23). These spaces become blank slates, ready for any activity and opportunity (24). Pressure builds up to make it livable, workable, and thinkable (24). The experiencing of the environment tends to be stressful and often uncomfortable (25). People travel from event to event, and the experience in-between is polluted with stress and anxiety – the agony of traffic congestion, limitations of parking availability, poor pedestrian considerations, etc (25). All of these contribute to the feeling of loss of control and powerlessness (26). People arrive depleted, reducing performance ability and overall well-being (26). Far more experiences trigger unpleasant responses opposed to pleasant (27). This is largely because the urban environment is built around the function of automobiles, from thoroughfares to the city center (27). Over-dependence on automobiles have fostered unattractive streets for pedestrians (25). This severely cripples the ability to walk, cultivating obesity and a host of other related illnesses (24). Compounding on top of the detrimental side-effects on physical health, the automobile has steered the creation of inhospitable landscapes for pedestrians and active lifestyles (12).

Causes of Urban Stress

The natural environment has played a significant role in shaping human evolution (28). For a majority of evolutionary history, human beings lived predominantly in the outdoors (28). However, as civilizations emerged, humans began building cities which soon became overcrowded and polluted (18). Urban living can produce stress if perceived amount of personal space is inadequate, safety is uncertain, feasibility of mobility is low, or economic condition is perceived as poor (16). Stress can be triggered also by the anticipation of adverse situations and the fear of inadequate resources to respond to them (29). Considered generally, stress represents the dichotomy between individual resources and specific demands (29). Stimuli in the environment that demand more physical or psychological effort than an individual possesses to respond can be considered stressors (30). The perceiving experiences in the environment also extend beyond the senses through which they are normally realized (30). Experiences influence not only perception but also physiological functions such as nervous, endocrine, and immune systems (21). Such physiologically intimate experiences of the environment can be perceived to be stressful and often uncomfortable (31).

The automobile was invented as a magical device to liberate humanity from the confinement of the city (32). Ironically, it has steered the creation of inhospitable landscapes for its intended users (33). The capacity of the automobile to enhance mobility and the subsequent demand for peace, security, and functional efficiency has been realized at the detriment of the pedestrian scale of the city and in consequence the demise of active and active lifestyles (32). The externality of the automobile on built environments is manifold (33). Cityscapes proliferate with sprawling and stagnant lawns on privately occupied lots and parking spaces (34). Such wide open and sterile settings though obviously less capable in supporting capacity for activity, open space provision seems to satisfy the requirement of public open spaces (33). Urban vegetation seems sparse and neglected (34). As a part of degraded landscapes, crime and vandalism enhance fear of safety in the environment (35). In such settings therapeutic gardens may be offered as retreat from a stressful urban life (35). The effectiveness of exposure to nature and gardening treatment intervention strategies has been demonstrated to improve attention span, short-term memory (36).

Effects of Urban Stress on Mental Health

Stress represents the dichotomy between individual resources and specific demands that can result in a number of undesirable physiological, psychological, behavioral, or social outcomes (37). Stress is an increasing global health problem that, in cities, can lead to increased rates of disorders such as anxiety, depression, and cardiovascular problems (23). The physiological stress response involves an intricate web of feedback loops between the autonomic nervous system and the endocrine system (38). Secondary responses aimed at restoring homeostasis are generally slower and may take minutes to hours before they are fully active (38). Therefore, short-term stress may be beneficial but prolonged activation of the stress response can have negative implications for social, cognitive, emotional, and health outcomes (37). Air pollution, noise, and a lack of restorative environments are more profound in cities than in rural areas, a condition that leads to stress symptoms in a significant portion of urban populations (39). Urbanization is predicted to double over the next 30 years, stress will most probably increase in city dwellers (40). Urbanization fragmentation and reduction of urban green spaces are problematic because green spaces reduce stress and increase well-being (40).

Exposure to urban green spaces can generate cognitive, affective, and psychophysiological benefits that reduce stress and attention fatigue (41). This theory suggests that visiting natural environments such as urban green space and parks reduces stress by stimulating involuntary attention and thereby reducing directed attention (42). Restoration from directed attention fatigue is necessary for efficient attention functioning (42). If environmental stimuli are intriguing or fulfilling, they will automatically capture attention, which releases the directed attention mechanism and thus promotes restorativeness (43). Previous studies have reported that viewing nature scenes can enhance pupils' recovery or stress reduction during high stress (43). Owing to the rapid urbanization and lifestyle changes, the high-density population in cities has affected people's well-being, and the associated health problems have been broadly studied (44).

The Importance of Natural Environments

Research has pointed to the effectiveness of reducing stress through exposure to natural environments (45). The authors reviewed the important role of natural settings among a range of other environments in shaping such responses (1). They found physical activity performed in natural settings resulted in significant improvements in the mental health variables of self-esteem and mood (46). They found evidence of the direct and positive impacts on well-being and health from exposure to natural settings (46). Exercise in outdoor settings has been reported to be more restorative and stress-reductive than indoor exercise (47). Walking in greenspaces and other outdoor settings has been linked to increases in self-esteem and overall mood levels (47).

The previous discussion raises another line of inquiry pertinent to this research: whether outcome measures of emotions targeted previously can be detected from interaction with urban greenways (48). Stress is also known to cause cardiovascular disease and mental health disorders (22). A review of relevant journal articles that examined human well-being benefits from natural elements has provided scientific evidence to support that both passive and active interactions have positive effects (48). Natural environments have been widely studied in the field of environmental psychology due to their physiological and psychological benefits (49). The human body reacts intimately with its environment. In fact, the human body's autonomic nervous system consisting of the sympathetic and the parasympathetic system is finely in tune with the surrounding environment (50). Homeostasis, the body's ideal state, is achieved when these two systems are balanced (49). However, in disruptive and unpleasant environments, the

sympathetic system is intensively engaged in the 'fight-or-flight' mechanism (50). This imbalance induces stress and compounded with increasing stresses imposed by societal factors and transportation, people in urban environments are entrapped in frustration, distraction, and irritation (50).

Definition of Natural Environments

Surroundings refer to the atmosphere and are often called the "setting" of an event on Planet Earth (1). Places may refer to a small part of one's surroundings that one knows about and knows how to orient and navigate through (51). They may also refer to the community in which one works and lives, and envelops one's life experiences (51). Furthermore, environments can be described on different levels (52). They may be of several discrete and different types, e.g., natural environments or constructed environments (52). These may differ in their level of "naturalness," with some places being referred to as heavily or sparsely dominated by mankind (53). Such a level is typically examined and counted in terms of vegetation density, height, complexity, or total amount of green area (53). Built environments include all indoor places as well as urbanized or rural outdoor spaces (54). With regard to their spatial priorities, they can be considered to have several possible levels, ranging from the local to a wider perspective (54). The broader surroundings encompass all environmental influences including the natural environment. They are typically referred to in daily language as the environment (55). Various types include weather and climate (56). The terrestrial surroundings include everything bothering people on or in the ground, typically referred to as places or settings (55). Noise is one type (55). Road traffic, air, and water pollution are broadly considered hard factors (56). They influence city dwellers' characteristics and health either directly or indirectly via social networks and personal activity patterns (57). One may seek quiet places to work while avoiding noise, or seek and work in extremely noisy places, depending on one's lifestyle (58). A growing body of literature elucidates various important outdoor indicators of built environments and their effects on an individual's physical and psychological health (57).

Types of Natural Environments

Different types of natural environments are associated with differing levels of recovery from psychological distress (59). Stress response (heart rate), as well as positive and negative mood, was measured before and after a lunchtime visit to one of three environments (60). High levels of nature are associated with greater levels of physiological recovery and improved mood than built settings, consistent with prior research (61). Recent advances in the understanding of how the built environment influences health and well-being have suggested that natural environments promote health by providing opportunities for physical activity, reducing exposure to environmental stressors, and fostering social interaction (1).

Mechanisms of Stress Reduction

The effect of differing experiences of nature on stress has implications at both a personal and public health level (62). Increasingly, health professionals are advocating nature exposure for both physical and mental health benefits (62). As a result, urban authorities must develop green spaces to maximize health benefit (63). Future studies are needed to probe the specific natural environment characteristics and personal variables determining beneficial effects (63). In addition to educational campaigns to discourage built environments as exercise settings, built environments could be made more "natural" (64). The effectiveness of ecological restoration on urban areas to improve mood levels should also be explored (65). Past studies comparing natural

environments to urban environments have used physiological measures of stress primarily heart rate variability and cortisol (65). Similar findings were also noted in a study examining individual differences in preferences for nature using a similar methodology (1). However, in both studies, the urban setting was a street side without any plants, and the other conditions where parks in which the experience of nature may have been confounded with the experience of physical activity (64). In addition, two studies have used logistic regressions to analyze the influence of recovery environment on post-event positive and negative affect levels and time spent in recovery settings, but it has not been used with physiological data (66).

Identification of important personal or individual characteristics that modulate the experience of natural environments stressing aligning health recommendations with functioning in public health (67). In the case of stress, health detection promotion packages focused on exercise, physical activity, or green exercise have little effect in terms of attracting more sedentary individuals or those in more stressful environments (19). Individual characteristics or preferences such as resistance to boredom, attention styles, and likelihood of seeking nature should be examined in future studies (67).

Psychological Mechanisms

Williams and others have suggested that natural environments enhance mood by enhancing self-esteem, reducing negative emotions, slowing anger feelings, and increasing feelings of tranquility and relaxation (68). Found no changes in excitement and attentiveness to the environment in individuals changing to much greener, whereas feelings of artfulness in the environment increased (69). It is commonly assumed that access to views of trees and greenery will help reduce stress and improve the mood of municipal building workers and bespoke post office clerks (68).

Natural environments may help reduce stress and improve mood levels (52). The major goal of the paper is to introduce and construct a conceptual framework for a workplace monitoring and evaluation system based on the findings from the literature review. Others offered a comparable approach for studying and developing settings in natural environments and suggested three levels: (1) traditional nature; (2) settings in natural environments; and (3) setting-related nature (70). It is assumed that settings developed at the third level, in which people enter nature in the workplace and directly interact with it, will have more therapeutic and ameliorative effects on stress response compared to two other levels (71).

Three sub-categories associated with each level were identified (72). Walking to the space where nature is present may enhance recovery from stress faster than driving, but commuting and socializing at work outdoors may lead to more reductions in negative mood levels than doing such activities indoors (73). Short walks in natural settings were more restorative than in comparable urban settings (72). Running outdoors has been found more effective at reducing negative emotions experienced beforehand than running on a treadmill (74). Corporate visits to forest environments have been reported beneficial for individuals suffering from various ailments, particularly unproductive mind wandering and learning disabilities (74). With a similar duration and intensity of walking, greater fatigue-improved and restoration levels were found after a walk in national parks than urban settings (75).

Physiological Mechanisms

The maintenance of homeostasis in biological systems inevitably leads to the gradual accumulation of wear and tear, termed allostatic load (76). Biological systems must frequently

modulate their internal environments via adaptations to external environmental changes (54). The interplay of physical, biological, and social environments will often lead to disruptions in homeostasis, termed challenges or threats to stability (57). Such allostressors have been examined at varying levels of analysis and length of exposure (76). In modern industrialized nations, one of the most important sources of chronic physiological and psychological stress has been urban environments (57). Early human ancestors were primarily social mammals existing in small groups within natural environments characterized by dense vegetation and few predators (61). However, population growth and competition for resources led to the advent of pre-industrial towns and cities, which were radically altered environments by the construction of infrastructure and buildings as well as the loss of existing vegetation (1).

With increased population density came increased competition for resources, resulting in greater social inequities and a wider array of stressors (78). These may include physical structures that can restrict the movement or visibility of the urban floor, infrastructure such as roads that disconnect habitats and strain social networks, and a loss of vegetation and fauna (79). With continued urbanization comes greater urban density, size, and formalization (65). In response to this, there is a movement towards "nature" or "natural" cities or towns, which recognize the inherent benefits of natural environments for reducing stressors and maintaining human health and well-being (70).

Empirical Evidence

Flowing water, waterfall, and whispering wind sounds in the Office Window Parks can be used as a pilot scale for urban stress reduction (45). Some urban green spaces, parks, or even home gardens with plants can help city dwellers reduce their stress, while more scientific research has the potential to provide solutions to provide better mental well-being for mankind (28).

Recently. similar results have been found for immersive virtual environments to develop biofeedback technique that can help design natural city settings to reduce stress, anxiety, and depression (1). Neurobiological mechanisms for stress recovery in natural settings are still rare, though declining levels of autonomic nervous system activity in response to natural scenes have been documented (80). Recently, it has also been shown that the modulation of brain neural activity correlating with increased theta activity occurred in natural settings compared with urban settings (81). At the same time, the role of analgesic hormones released by exposure to a natural setting is also mentioned (82). Studies included in this literature review are mainly conducted in the West (82).

Studies on Nature and Stress Reduction

A need to consider and further assess the extent to which the natural setting itself affects potential benefits (83). To investigate the extent to which the urbanness level of newly visited environments (natural, semi-natural, urban) influences stress recovery during a short visit period (20 minutes), used an experimental design in which participants were randomly assigned to one of three visit conditions consisting of a virtual walk in a nature, forested setting (N), semi-natural parkland (S), or urban setting (U) under controlled viewing conditions using computer-generated 360° images of the environments (17). Levels of physiological and psychological stress were between-measures using salivary cortisol and pre-and post-visit (D0 and D1) self-report measurements of the Negative Affect Scale (NAS) (19). Levels of naturalness had a self-sustaining positive relationship with Restorative Factors (RFR) and results of walk conditions were thus analyzed with post-hoc tests (76). As predicted, a bout of exposure to the natural,

semi-natural, and urban environments reduced levels of stress in all conditions relative to baseline levels (84). Visitation to areas with differing levels of naturalness (natural, semi-natural, urban) resulted in recovery of stress after 20-min visits (D0-D1) with interventions assessed in terms of physiological (cortisol) and psychological measures (NAS) (84). Results indicate that the urbanness level of environments plays a role in individuals' recovery of stress (1).

In terms of physiology, a similar pattern was observed whereby cortisol levels at D0-D1 in the urban condition showed a lesser reduction than in the natural and semi-natural conditions (38). Differences in stress recovery were statistically significant between conditions with respect to exposures to a natural setting showing the greatest benefit in stress reduction relative to an urban setting (85).

Designing Urban Spaces

Research demonstrates that the built environment can influence psychological responses such as mood, facilitation of attention, and stress restoration. However, laboratory experiments demonstrate more robustness yet have a limited ecological validity (85). Preliminary studies exploring how town squares and city parks impact mood use self-reports (86). This study will seek to explore a comparative analysis of restorative environments with varying biophilic characteristics—specifically, parks and parks with trees versus open squares, yards, and streets—on mood states (87). Moreover, an analysis of spatial components and stress perceptions will evaluate how restorative spaces affect health in urban contexts (64). The research will take place in Leon, Guanajuato, Mexico using psychometric tests for mood tenor, perception, preferred remediation, associated spaces, and evaluation of five spaces in/dependent variable recovery—restorative environments (open squares, parks with trees, gardens, yards, and streets) (independent variable) (88). Based on prior investigations, it will be hypothesized that the target environments will be restorative, and park elements can reduce stress, recuperate motivation, and foster good moods (87). Mexico's "Pichón" (big park with trees) will have exclusively positive bonds states and low stress (88). The first part will provide the foundations for an ecological perspective on the built environment's importance for public health (86). The second will develop the results and discussion based on the first fund (87). The study explores space illusions and computer-generated organisms and their role in urban environments, societal attitudes towards remote and technology-induced environments, and an inquiry into sea spaces (22). A comparison of pedestrian-oriented streets and spaces with water to conventional vehicle roads will be studied in the form of narrative psychosociological case studies and their impact on societal moods, motivation, attentiveness, and sense of community (89). What do sea spaces mean to society? Can pedestrian-oriented streets and spaces be transformed into places that nourish public health and an engaging sense of place through computer-generated organisms? (90). A comparative analysis of geospatial information systems based on public health, illurbanism, and urban blight will be financially and conceptually supported (91). The research will highlight spatial typographies that distinguish supportive health environments from restrictive illurbanism (90). Strategies will be explored to socially and economically mitigate the impact of inaccessible and underdeveloped environments in regions where such conditions exist at an extreme level (85).

Incorporating Nature into Urban Design

As seen throughout this paper, there is a large body of literature and research done to conclude that natural environments reduce stress levels and improve mood after stressful events or exposure to certain stressors (65). Methods of inducing stress often test the present effects of a

natural environment on mood state (74). Researchers tested the effects of nature on mood state immediately following a stressful event, showing stress levels to be reduced in those who viewed a nature scene after stress was induced as opposed to an urban scene (22). Other studies showed the longer-term benefits of natural environments in urban areas by asking for reported stress levels and daily amount of time spent in nature. In these studies, urban natural spaces are shown to be used for stress relief and self-reported stress was lower in those who used urban nature (23). Although underrepresented in research, the effects of time spent in nature throughout a person's life, and the implications of urban change on this time and therefore their health, are important and warrant more focus (91).

Eight hypotheses regarding relationships between nature and human health pointed to other possible implications of a biophilic approach to urban design (82). Nature can provide venues for exercise as well as restorative environments for attention fatigue or stress relief (92). Increased access to urban natural green space could therefore contribute to addressing obesity, attention deficit disorder, and diminished mental health (92). If more attention were paid to the beneficial effects of nature on health, one possible outcome could involve the massification of urban greenspace on the scale of a Central Park or Golden Gate Park (57). If the vegetation density and segmentation of urban green space increased dramatically, many more urbanites would be able to receive the positive benefits of nature (93). Additionally, many designs for buildings and public spaces are more imitative of industrial forms and anthropocentric perspective wherein nature is not properly considered; greater attention to restorative environments and preferably dynamic processes could lead to a flourishing of environmental designs (93).

Benefits of Green Infrastructure

Restoring the stress/recovery cycle can be achieved through the presence of an intricate network of natural environments in urban areas, which will be beneficial under the circumstances of urban life and climate change (94). The levels of nature most directly related to urban settings are examined, focusing primarily on the individual level of experience of nature as the easiest level to independently modify (1). Urbanites can benefit from ecological design methods, drawing on insights from environmental psychology (61). It can be hoped that this will allow urbanites to effectively reduce their stress levels and help the worldwide distress with climate change (42). Addressing profound issues such as climate change might be daunting (2). However, at least for urban dwellers, reframing the minutiae of life into nature will assist with coping immediate stressors (10).

Restoration from stress can take place at different levels or scales of nature, from small-scale landscapes, such as potted plants and terrariums, to large-scale environments, such as sprawling wildernesses and open prairies (85). Broadly, these landscapes can discussively range along with two dimensions of abstraction: intentionally designed versus unintendedly resilient; and ecological operation: anthropocentric versus biocentric (95). Notably, through both dimensions, it is added that the continuous increase of the city size and infrastructure complexity throughout history has provided appropriate opportunities for desirable, closely-knit bounds of civilization to be shaped and to flourish (70). However, this same, exponentially-increasing complexity can also foster conflicts between species (96). It is undeniably fortunate that civilization is a dynamic process of gradual evolution localized within the city and on Earth, enabling human adaptation through self-reflection and proactive adjustment of behavior, physiology, social system, and culture towards yet unfamiliar surrounding embodiments (97).

Community Engagement

Many interventions intended to increase people's time spent in natural public green spaces (PGS) have been promoted in many cities to promote health and well-being, especially among deprived urban communities (98). Policies have included the creation, tweaking, and promotion of PGS, free public events in PGS, projects to enable local communities to create or improve their own PGS or community gardens, and much more (99). Many of these measures are driven by a vision of a society with a serious, long-lasting commitment to make use of green spaces as a health-promoting environment (98).

Now, hardly anyone can doubt the health benefits through contact with nature. An ever-growing body of evidence documents health benefits from many types of natural environments spanning very different timescales from hours to a lifetime, landscape differences from small to vast areas, and health benefits from physical, mental, social, and environmental health to economic and cultural benefits (1). Recent strong evidence of positive effects of exposure to nature on neurobiological functions constituting stress responses has pushed this body of research into a whole new area with fast-growing momentum (100). In society, local and national policymakers increasingly recognize health benefits from environmental determinants in general and natural environments in particular, and such measures to improve natural environments are ubiquitous in many countries (101).

However, despite clear visions, big ambitions, time and effort put into it, substantial budgets, and many local initiatives and projects of many diverse types, feedback on such actions and projects are often very sparse and tend to be limited, with participant recruitment challenges, design difficulties, inconsistent investigation, lax scrupulosity, and few long-term tender follow-ups (102). Thus, there is an urgent and timely need to ask whether and how we might better utilize it, at much lower costs. The long-duration impact of enhanced access to woodlands or PGS on health inequalities has been hypothesized, but no strong evidence has explicitly investigated this (103).

Promoting Access to Natural Spaces

Natural environments in urbanized areas are vitally important to creating happier and healthier societies (104). Through the provision of settings for physical activity and moderate intensity exercise, stress-reductive health benefits from natural environments are exhibited (105). However, this benefit has been measured against that of urban environments (105). Exploring what this means for the worth of built environments in planning has prompted this investigation (53). Urbanization, defined as movements from rural areas to cities, and the global population shifts that ensue, is inextricably linked to the modern human condition (106). Living in cities is viewed as an institutionalized state that has brought about large turnover changes in human society (1). Yet, city living presents challenges to happiness and health not faced in rural environments (106). Population density, noise, air pollution, architectural uniformity, work intensity, and taxation are just some of the urban responses that negatively pervade the everyday experience of city dwellers (107). Conversely, nature has been widely branded as 'the cure' to these urban ailments (107).

Challenges and Barriers

Research has identified some variables influencing the use of natural environments regarding its therapeutic effects as compared to built environments (35). For instance, having a non-positive state of health is an inhibiting factor that has been otherwise confirmed across studies; yet,

individuals with better self-efficacy and quality of neighborhood visit natural environments more often (1). Furthermore, walking in nature is more restorative than walking in urban surroundings (36). In another study, running outdoors was more effective at reducing negative emotions than running on a treadmill (37). Visitation to forest environments can benefit individuals suffering from ailments such as metabolic syndrome (38). On the other hand, the effectiveness of health-promoting interventions can influence the use of natural environments (108). Concluding a number of studies, engaging in physical activities in natural environments led to greater levels of restoration than in urban settings (109).

Urbanization Pressures

While cities offer many advantages as centers of social, economic, and cultural activity, they also carry with them burdens that affect health and well-being (42). Urbanization is often accompanied by population growth, with transitory urban migration being a notable phenomenon (110). Cities gain in density, leading to crowded living conditions, competing interests for space, and increasing pressure on transport systems and public services (111). Stress and tension in urban environments can arise from noise, pollution, overcrowding, criminality, and transport (1). Stressors embed themselves in the brain and body, becoming metabolized and producing a well-known chain reaction that culminates in a general adaptation syndrome symptomized by a progressive loss of weight and predisposition to ulcers, hypertension, diabetes, stroke, and psychosis (22). In urban environments, housing is usually built of concrete, glass, and metal, which physically and psychologically isolate the individual from nature (110). Nature is not integrated into the home environment, nor is it readily available for recreation. Stressors and urbanization pressures are best countered by exposure to nature, where natural elements can be experienced either passively as part of the landscape or actively through physical exercise (111). The presence of the primary elements of nature—earth, water, fire, and air—as well as greenery, trees, animals, and natural patterns like rhythmic flows and non-linearity tend to affect physical and psychological states favorably. Stress is known to be a cause of health problems, with an increasing number of scientific studies reporting the illness-inducing effects of urbanization (112). Intelligence and social standing decrease with urbanization, and annihilation tendencies escalate, as evidenced by higher probabilities of post-traumatic stress disorder among urban populations (112). Cities lack community, and social alienation through permafrost interactions with strangers leads to erosion of ingrained habits and behavioral patterns in favor of homogeneous reaction and interaction patterns, resulting in breakdown of the system through crime and increased social patrols, zookeepers, and corrective devices (113).

Maintenance of Natural Spaces

Natural environments can play an important role in the maintenance of one's mental health (114). This is due to the fact that there has been a long history of urbanization, and as a result many people live in areas devoid of natural spaces. But there also has been some motivation to bring green and blue spaces into cities (1). Therefore, what happens when humans are removed from their natural state? (47). Answering this question will provide insights into how these systems can influence neurophysiological stress (115). This question can be understood by integrating complex systems models (14). The maintenance of natural ecosystems can be influenced based on these insights, and as a result, they can be useful in their attempts to reduce their levels of stress (115).

Providing peoples with access to natural areas or green spaces may help in reducing mood disorders and stress related issues (42). Empirical evidence suggests that mood disorders and

stress are related to green space availability and accessibility (116). For agency people experiencing mood disorders should find it especially beneficial to get their area of residence stocked with green spaces (116). In addition, according to the trails and pathways model, selected access routes to such areas may be of paramount importance (69). For example, in the Prague area many rivers are positively related to long distance cycling (117). Unfortunately, the data does not show how many green spaces are available within the residential area of people that participate in this inquiry (42). So possible limitations may be presented (78). Fortunately, these sites can be generated (39).

We now understand that in order for the brain to function optimally, there has to be some type of stimulations in the complex level (38). One approach to stress reduction is to introduce stimuli into the CBP (118). Stress reducing scenes are generally viewed and tend to elicit a shock lowering response (118). However, since many presentations of stress are urban in nature, the natural, or unbuilt, environment is presented as being most informative in this regard (41). In addition, specific emphasis is placed on the role of sound in reducing stress levels (119). Other dimensions of the environment may be equally effective or even more so (119).

Future Directions

The effects of nature on the restoration, mood and stress levels of urban dwellers are clearly documented in the literature (38). This study confirmed that individuals who were exposed to higher levels of nature (forest threshold spaces) experienced greater recovery rates from urban stress (52). When urban dwellers were given guided walks, recovery levels were sharper and increased in magnitude, supporting the argument that environments carrying a wider variety of specific features may offer greater therapeutic benefits (65). It is recommended that future research examines the potential modulating factors contributing to the effectiveness of the natural environments (89). For example, the level of urban stress may establish a cap on the maximum level of recovery via exposure to natural environments, as the slope of curves in the linear context cannot be extended infinitely upwards to meet the medicinal properties of nature (120). At some point, the urban stress would be too great to negate (120). Engagement with nature is seen as paramount to well-being by ecotherapy advocates, who point to hundreds of studies conducted over decades showing the therapeutic power of nature (1). Visitation to parks and forests, trail walking or hiking, gardening, exposure to aquascapes, pets, etc., are regularly prescribed and thoroughly justified within the context of specific diseases, including Attention-deficit/hyperactivity disorder, asthma, hypertension, depression, obesity, diabetes, and those recovering from injury or illness (121). Operationally, few studies have sought to quantify the impact of longer term natural exercise on the mental health of healthy individuals (121). Grassroots research has investigated the wider benefits of Vitamin G (e.g. improved creativity, cognitive ability, and increased overall well-being), while a small longitudinal study recorded increases in mood and self-esteem among children engaged in regular nature-walks (48). The previous understanding of this literature is limited to the lower-order effects of natural environments (91). Future studies are needed to examine the impact of such environments on other aspects of health and well-being such as the proprioceptive sense and neurophysiology (99). Urban dwellers are marred by societies that are constantly becoming more urban (110). The corresponding notion of nature deficit disorder argues for the inherent value and absolute necessity of experiencing close contact with the biophysical environment—natural or otherwise—to sustain health, development, and general well-being (115).

Research Needs

The identified variables shaping the frequency and type of Natural Environment (NE) use are numerous (122). They reflect many valid theories and concepts in environmental psychology, health, educative, ecological, recreation, and urban planning fields (122). These studies point out the kinds of social and built environment attributes that are desired "in the context of urban planning and policy making" (123). The NE type had a significant effect on visit effectiveness across physiologic response, mood state, and level of restoration (123). This implies that the underlying assumption that NE is more therapeutic than built environments is valid (123). Visitation to less built areas which provide much more natural settings would maximize stress-reducing efficiency. Indeed, the challenge of how natural to make today's built urban environments either at a citywide scale or at a neighborhood level can lead to beneficial outcomes (124). This implies that future studies replicate the study using a different population group having a different degree of familiarity with NEs (124). For example, a group of tourists visiting new countries may evoke different visit effectiveness on access to different levels of NEs compared with the local population (125). This may provide additional theoretical understanding of the characteristics of NEs that contribute to the therapeutic effect across different cultural backgrounds (1).

Innovative Solutions for Urban Stress

Urbanization, a prevalent global development, has a profound impact on societies, ushering in scientific, industrial, and technological revolutions (39). However, urban centres have also been a breeding ground for stress (43). In the past two decades, stress has become a global health problem, particularly in big cities, leading to a growing emphasis on preventive, non-pharmacological treatments (105). Accordingly, nature exposure has garnered interest as a potential stress-reducing intervention (79). Research into the benefits of nature on the mind, mood, and body is an increasingly recognised field within psychology, medicine, and urban ecology (126). Nature exposure is shown to be associated with lower levels of stress (23).

This stress reduction is posited to occur as a result of lower levels of endocrine (cortisol) stress response and/or lower levels of sympathetic nervous system (heartbeat, heart rate, blood pressure, skin conductance) stress response following contact with nature (38). In an age where cities and nature are often presented as oppositional forces, reframing urban green space as a resource, as opposed to a problem, may go some way toward acknowledging the potential benefits of nature exposure, but it is only one facet of the major issue of urbanization (127). Too often, understanding of urbanization's social and ecological issues proceeds in a reactionary manner, focused either on restoration of former, lost natural conditions or on a reductive view of cities as merely grey, painful places (128).

Conclusion

The past decade has seen a growing interest regarding the potential mental health benefits afforded by the natural environments inherent to urban areas (47). Studies show that natural environments, such as trees and parks, can become places for rehabilitating effects to counterbalance the effects of stressors in daily life (129). There is also growing interest in how design can emphasize aspects of the surrounding natural environment (129). Furthermore, two main conceptualizations are proposed (130). First, natural environments in both their landscape qualities and in the patterns of exposure are described using a reconstruction methodology that seems promising for good reliability and validity measures (130). This methodology could

contribute to the investigation of the complex exposure–outcome relationships. Second, functionality, level of upkeep, and the presence of human use and commitment are proposed as useful indicators for researching questions related to people's health behaviors in urban settings involving the natural environment (1). Currently concerns over population growth, urbanization, and other anthropogenic impacts have raised the level of effort by research and policy in science, to create ideas for building more sustainable cities (118). The potential environmental role of increasingly populated and built-up cities in climate change, biodiversity losses and other ecoenvironmental problems has been increasingly recognized (86).

Although cities are known for their detrimental effects on the environment and health, they are also increasingly acknowledged as a key forum for more sustainable development. This transition to more sustainable cities requires understanding the complicated interactions between the social, economic, and ecological system in urban transition (22). While the need for integrated management of environmental, social, and economic sustainability in city planning and design will be acknowledged, such knowledge is rare due to the inherent difficulties in measurement and modeling of the complex system in urban science and planning (131). Recent research has highlighted that urbanization can be a harbinger of unsustainability, bringing caution to the rapid, elements within cities interact in complicated ways, with unintended outcomes that often question earlier policy assumptions, emphasizing local understanding (131).

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