

Biodiversity, Nature, and Human Health

A brief literature review

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Abstract

Some recent studies claim biodiversity has a positive effect on human health, whereas human alterations to the natural environment have unfavorable health effects. This brief literature review cites current research that endorses biodiversity for human health and examines the negative consequences of natural environment modification. The review focuses on the health benefits of biodiverse environments, outdoor activity, and plant interactions, as well as the negative health effects of human disturbances, climate change, and urban landscapes. Difficulties applying current research as a health assessment are also discussed. Using this information to educate integrative medical practitioners is valuable in encouraging nature interaction, biodiversity, and health. The natural medicine community can incorporate these concepts into their practices and teach patients about the preventative and therapeutic benefits that species diversity and nature interaction provide. Additionally, informing patients about these issues is essential in the aim to reduce species loss and promote conservation.

Introduction

Promoting a natural environment with an abundance of species may be beneficial in improving human physical and mental health. A diverse ecosystem, with its variety of life forms and individual species, provides resources to sustain mankind's life and health,¹ while the loss of biodiversity may reduce well-being.² Although research regarding the direct bearing of biodiversity on health is limited, recent studies suggest that preserving biodiversity can promote new medicines, vaccines, nutritious food, clean air, drinkable water, and many other health fundamentals.^{1,3-9} Furthermore, the relationship between biodiversity and health is more than just human interaction with nature. Researchers have discovered that outdoor physical activity may lead participants to engage in outdoor environmental activities,¹⁰ and natural environment engagement can sponsor nature preservation.¹¹ The goal of this literature review is to examine the influence of biodiversity and nature on human health.

Investigating the value of biodiversity exposes the human impact on natural environments and is needed to restore ecosystems, inspire conservation, and increase well-being. In the modern world, humans are significant contributors to biodiversity loss, causing many species to adapt habitats, adjust life cycles, or develop new physical traits.¹² These forced adjustments are detrimental to ecosystems and most likely would not have occurred naturally. Studying current research and theories can bring awareness to biodiversity and has the potential to drive synergetic human and nature interactions forward.

The Importance of Biodiversity and Nature

Natural and biodiverse environments

Natural environments can have a positive impact on psychological, emotional, and spiritual healing.⁷ Studies show that spending time in natural spaces may sponsor physical and mental wellness, prevent health problems, increase general health, reduce stress, and yield quicker recovery time from illness.^{4,13,14} Mitchell¹⁵ and Taylor and Hochuli¹⁶ note that nature immersion can rejuvenate people who are suffering from stress and mental fatigue. Cognitive well-being is also enhanced by surrounding green space elements,

including clean air, noise reduction, increased physical activity, and enriched microbial environmental input.¹⁷ A study by Fuller et al¹⁸ shows that plant species abundance improved participant mood, concluding that biological complexity is important to psychological well-being. Similarly, a study by Adjei and Agyei³ concludes that wider biodiversity yields greater human happiness as a result of increased wellness and perception of naturalness. An aquatic study mentioned in a literature assessment by Sandifer, Sutton-Grier, and Ward⁹ shows that improved moods and decreased heart rates were seen in participants viewing aquariums with a variety of species when compared to less diverse tanks. As demonstrated by these studies, the benefits biodiversity has on health can be accomplished by a range of human activities, from simple viewing to active participation.

Outdoor activity

Biodiverse environments are appealing and may promote physical activity and reduce sedentary lifestyle choices by offering suitable space for activities.¹⁹⁻²¹ By creating a relationship with nature, people are more likely to be active outdoors and achieve health benefits.^{16,22,23} Physical activity in natural environments reduces the likelihood of poor mental health and yields more restorative effects than activity in other settings.¹⁵ Green space engagement has been shown to reduce obesity, lower blood pressure, and increase life span.²¹ Researchers Thompson Coon et al²⁴ conducted a systematic evaluation of whether physical activity in nature was more beneficial to well-being than indoor activity. Outdoor exercise was found to be correlated with revitalization, less tension, reduced confusion, reduced anger and depression, increased energy, and immediate improvement in self-reported mental well-being. Increased enjoyment and satisfaction from outdoor activity also suggests a greater likelihood of repeating the healthy activity in the future.^{14,23} Bowler et al²⁵ conducted an analysis comparing studies in which exercise was performed in natural environments versus artificial environments. Their investigation found self-reported emotional benefits (eg, revitalization, reduction in anxiety or anger) from exercising in a natural environment. While research shows that exercise in natural environments may be more beneficial than exercise in artificial environments, the addition of direct contact with increased species richness, habitat diversity, and ecosystem integration has the potential to foster an even more favorable result on psychological and physical health.⁹

Human and plant interactions

Plants benefit the human environment in ways that improve society by moderating temperature, reducing energy, decreasing noise, improving air quality, establishing habitats for wildlife, reducing storm water runoff, and improving soil and water quality.²⁶ Tree canopy has inspired beauty and a spiritual connection in some subjects²¹ and tree shade provides humans with UV protection from skin cancer, sunburn, and eye disease.²⁰ Increasing plant abundance can positively impact the human respiratory and cardiovascular system⁴ by reducing air pollutants and adverse health effects.²⁷ Urban green infrastructure and sustainable landscapes provide increased vegetation cover that supports biodiversity and ecological networks, which are also significant for the health of ecosystems and humans.²³ Plant diversity is beneficial in profusion of microbiota in soil, which can increase the diversity of microbiota on human skin and in the gut.²⁰ Increased diversity of microbiota can improve immune function, thus protecting against allergies, asthma, and other chronic illnesses.²⁰

Environmental Destruction: Biodiversity and Nature Loss

Human consumption, disturbances, and disconnect

Unsustainable human consumption and increased population sizes have modified the planet's ecosystems at an alarming rate.²⁸ Evidence suggests that land degradation has led to the release of toxins and increased

breeding grounds for disease by disrupting ecosystem balance.²⁹ Since ecosystems are all interconnected, this balance is critical in maintaining diversification and limiting the overpopulation or underrepresentation of a species. Natural systems, provisioning services, regulating services, supporting services, and cultural services are important for ecosystems as well as human health.⁵ Natural systems deliver nutrition, water purification, natural hazard protection, and have the ability to reduce natural disease.⁸ Provisioning services are the most important in relation to human health; the benefits from these ecosystems include food, water, shelter, medicine, fuel, and fiber.^{1,5} *Regulating services* refers to an ecosystem's ability to control pests, diseases, climate, and freshwater. *Supporting advantages* incorporate soil and nutrient reprocessing, while *cultural services* refers to ecosystem nonmaterial benefits that promote healing and cultural rites. Without these services, ecosystems and human health would be unbalanced.

Because of infringement and wildlife habitat degradation, humans have encountered new microbes and animal reservoirs, interrupting the ecosystem equilibrium and putting humans in contact with new and dangerous pathogens.^{2,6,8,30,31} An example of this phenomenon is the link between Ebola and human movement into forested ecosystems.⁵ Zoonotic pathogen transmission from bugs and animals to humans is correspondingly on the rise, a result of wildlife habitat degradation and human infringement.⁸ Deforestation, dams, and irrigation projects have increased encounter rates between pathogens and hosts to malaria and schistosomiasis in Asia and Africa, as well as other diseases such as Rift Valley fever, filariasis, leishmaniasis, dracunculosis, onchocerciasis, and Japanese encephalitis.^{2,8} Biodiversity may help regulate infectious diseases and reduce pathogen success by controlling pathogen host populations through competition and predatory interactions.¹ The “dilution effect” supports the idea that diversity of intermediate hosts dilutes the population of transmission hosts, decreasing vector-borne disease exposure.^{1,8} Biodiverse communities are also better equipped to support predatory species that regulate the prey population; as a result, pathogen levels fall if the prey species is the host. Biodiversity also creates competition and lowers host population growth and survival rate.¹

Increased food production and industrial farming similarly takes a toll on ecosystems by means of land usage and fragmentation, fertilizers, pesticides, and waste products.⁵ With the loss of nutritional food diversity and decreased varied crop pollination, human diets—both nutritional content and sustainable calories—are also impacted. Human disturbances to watersheds, rivers, and lakes interfere with the natural ecosystem and hinder the cycle and filtration of freshwater.³² In developed countries, there is the risk of bacteria, such as *Escherichia coli*, from farm runoff and cholera when algal blooms and warmed waterways increase the proliferation of zooplankton in aquatic ecosystems.⁵ Pesticides and other toxins in water systems can also harm human health.⁸ Water scarcity and reduced water quality not only negatively impact health; they can also increase the amount of energy needed to facilitate adequate sources.

Research indicates that a lack of contact with nature can have a detrimental effect on human health.⁷ This disconnect between humans and nature not only endangers health, but can be detrimental to the ecological environment as well.¹¹ Research shows that destruction of the natural environment can induce identity loss, depression, and emotional stress in humans.³³ Without the natural environment, people may lose their connection with the planet as well as their community, and life in artificial environments can lead to exhaustion and vitality loss.³⁴ Research illustrates that chronic negative mood, a potential effect seen in subjects as a result of natural environment loss,³³ may increase cardiovascular risks and type 2 diabetes mellitus.^{35,36} Furthermore, studies suggest that mental health is negatively affected by knowledge of environmental destruction and may lead to depression.^{33,37} Researchers found that loss of biodiversity can affect cultural values as well, in turn negatively affecting health by increasing stress and anxiety.⁴ Biodiversity loss might affect health through cultural pathways via psychological stimuli and cultural associations, while biodiverse environments may indirectly encourage psychological well-being through

cultural values associated with nature. These examples illustrate how biologically diverse surroundings may aid in evading detrimental health consequences.

Climate change

Climate change is altering ecosystems and the basic necessities to sustain human health.⁵ For example, variations in weather, sea levels, and temperature may adversely impact essential health needs like breathable air, safe drinking water, nutritious food, shelter, and therapeutic plants. Climate change has also resulted in the reduction of species population sizes and has led to the loss of potential sources of pharmaceuticals and experimental disease models for research.⁸ High ozone concentrations and airborne particulate matter also have possible negative effects on respiratory and cardiac function.²⁷ Allergies, asthma, and inflammatory diseases are linked to lack of human exposure to diverse natural habitats and bacteria, which is important in maintaining the human immune system.⁹ Sandifer et al⁹ also claim that lack of exposure to microbes is detrimental to the body's immune defense, especially in the gut and respiratory tract. Additionally, water scarcity and food insecurity as a result of climate change have potential negative effects on the digestive system.⁵ Furthermore, events such as drought and flooding have been associated with increased levels of distress, post-traumatic stress, depression, and anxiety.³⁸ Changes in temperature and precipitation can cause heat stress, which can lead to heat stroke, illness, or even death.⁶ While it may be impossible to state that the loss of biodiversity as a result of climate change is solely responsible for decreased wellness, there is strong evidence that it does contribute to health in some form.

Urban landscapes

City living has been associated with increased anxiety and stress, increased cases of neurotic disorders, and adverse personal and social consequences.¹⁴ The physiological effects of stress include sleep loss, decreased immunity, high blood pressure, cardiovascular disease, stroke and diabetes, as well as mental health effects. Mental illness, including depression and anxiety, has been linked to urbanization.^{22,39} Taylor and Hochuli¹⁶ suggest that biodiversity and ecosystem integration are important factors in urban planning and human well-being. Natural spaces are vital in urban settings, not only to sustain and protect the environment, but also for socio-ecological health.⁴⁰ Urban green infrastructure and sustainable landscapes provide increased vegetation cover that supports biodiversity and ecological networks, which are significant for ecosystem and human health.²³ A study by Bratman et al³⁹ found that study participants who completed a 90-minute nature walk that included grassland, trees, and shrubs had lower levels of rumination. These participants also demonstrated reduced neural activity in the subgenual prefrontal cortex, a region of the brain associated with mental illness, when compared to those who walked in an urban setting.

Difficulties With Current Research

Although many suggest that the natural environment has a positive influence on human health, very few in-depth, evidence-based studies and systematic reviews have been conducted on the topic. Difficulties with conducting these types of studies/reviews include the possibility of synergistic outcomes, differing participant characteristics and methodologies, international differences in assessment, and inconsistent research questions. Poor design and methodological quality are also difficult to overcome.²⁴ The complexity and overlap of factors involved in health benefit assessment makes it difficult to separate the role of each variable and introduces bias. It is difficult to establish a direct relationship without factoring in economic, social, environmental, and demographic influences. Future studies may benefit from improved variable control and increased scale to prove study causality. Some researchers suggest duration, frequency, and experience type be further evaluated before determining the exact benefits nature has on health.^{15,39}

Conclusion

The biodiversity and health connection is a relevant issue in both the ecological and healthcare world. Unfortunately, the evidence associating biodiversity and health provided by scientists, sociologists, ecologists, and psychologists is often unincorporated and overlooked by medical practitioners.¹⁶ To counter this, the relationship between researchers, healthcare providers, and patients needs to be more conducive to translating the evidence that supports the health benefits of nature and biodiversity into practical health goals. In addition, policy makers, planning bodies, and residents should encourage reasonable ways to accommodate the health of both humans and plants in an ecosystem that respects the symbiotic relationship we have developed.⁴¹ Encouraging proactive and preventive healthcare, improving supplemental treatments that include nature and biodiversity, using advanced technologies, and enhancing urban design can significantly improve human lives.⁴² Homeopathic therapies are becoming significant supplements in healthcare, supporting the desire to have nature and green space as a viable therapy for overall well-being. Nature integration can be prescribed as a side-effect free therapy or as a supplement to traditional therapies.

Respecting how essential nature, and biodiversity, is to the health of humans as individuals and societies is the first step in preventing the loss of biodiversity on the planet. Educating integrative medical practitioners on the value of green spaces, nature engagement, and biodiversity can influence their recommendations for improving mental and physical health. Practitioners can use this information to prescribe outdoor/nature time to benefit their patients' mental and physical wellness, to advocate for healthcare policy changes, to support public health and urban design projects, and to endorse conservation efforts to maintain healthy ecosystems. The natural medicine community is uniquely positioned to weave these concepts into their practices and educate their patients on the preventative and therapeutic benefits of nature. Small changes in preventing environmental destruction can eliminate undesirable consequences on health and encourage species well-being. It is crucial that humans are not contributors to the erosion of biodiversity and instead do what is best for the environment and their health, and the health of generations to come.

Acknowledgements

I would like to thank fellow Miami University students who helped with the review of this paper. This work was conducted as a part of graduate work through Project *Dragonfly* at Miami University in Oxford, Ohio and Chicago Zoological Society. Special thanks to Deborah Hall and Kathayoon Khalil for advice and inspiration.

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