



RESEARCH REPORT

The Health Benefits of Parks and their Economic Impacts

A Review of the Literature

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Executive Summary

Parks and green spaces¹ have intrinsic value, but they also provide a range of direct and indirect benefits that support healthy, productive lives and resilient, cohesive communities. Many of these health and resilience benefits are quantifiable and well documented and can be expressed in terms of their economic impacts on individuals and communities. Measuring, understanding, and communicating the economic health benefits of park equity will help park leaders, community advocates, and other stakeholders make informed decisions about park and green space investments.

Evidence suggests that parks and green spaces have significant benefits for their users, with additional benefits accruing with investments in park and green space access and quality. This is fueled, in part, by a growing recognition of the broader utility and value of parks for individuals and communities. Park leaders and advocates are identifying ways to unlock the full potential of parks to spur economic benefits for neighborhoods and residents, foster belonging and collective identity, and provide health benefits for users.

Health benefits can be measured as both direct contributions as well as averted health expenditures. But the benefits of parks have not traditionally accrued to all. To ensure equitable access to high-quality parks, policymakers and local leaders must acknowledge the legacies of slavery, racial violence, redlining, and other forms of oppression that have prevented people of color from experiencing parks and green space. Evidence on health benefits highlight the importance of contextualizing who has access to parks and green spaces and whether that access is equitable.

This document advances this process by situating parks within broader conversations on equity and access and providing a comprehensive summary of the research on the health equity benefits of parks. Four dimensions of health are discussed in this report—physical, mental, social, and environmental—to demonstrate the range of health benefits from parks and green space, and where possible, the economic impacts of these contributions. This report presents the evidence described in recent, relevant literature to support local leaders, park professionals, advocates, and others to advance the field of park and green space health equity with more strategic investments.

There is moderate to strong evidence, qualitative and quantitative, showing that parks have a substantial contribution to health across all four dimensions. The strongest evidence establishes parks' benefits on physical health. Several studies highlight the link between time spent in parks and physical activity and the correlation between that activity and positive health outcomes, such as a reduced risk of cardiovascular disease, diabetes, cancer, and heart disease. Research suggests that park usage also

positively affects mental health by reducing stress levels and improving mood, with onward benefits from those outcomes to decreased use of mental health services and increased job productivity. With regards to social health, research suggests an association between parks and social cohesion and belonging whereby users experience greater community attachment with exposure to, and activities or programs in, local green spaces. Studies also suggest that time in the natural environment promotes prosocial behavior and builds social capital. Finally, parks and green spaces strengthen environmental health as measured by air quality and climate adaptations, such as temperature (including urban heat island effect) and the impact of adverse weather-related events on communities. As natural infrastructure, they encourage disaster planning and social resilience by fostering neighborhood connections and community ties, particularly following a disaster. These environmental health benefits can in turn generate other health benefits (e.g., improved air quality leading to reduced incidence and severity of juvenile asthma).

A variety of tools and metrics are currently used to quantify some of these health benefits, but nothing robust exists for the field that combines all four health dimensions. Additionally, although the park equity research is strong, fewer studies focus specifically on linking the health benefits of equitable access to parks with their economic impact. In this report, we review a few of the more prominent tools available for park leaders and advocates and examine methodologies for measurement, including hedonic modeling, benefits transfer, and benefits tools.

The existing research presents several key takeaways that need to be considered when estimating the health benefits of parks:

1. The literature is strongest in connecting the quantifiable value of parks for physical activity and physical health impacts and the value of green space for mental health well-being and environmental impacts.
2. Disentangling the actual causal relationship between parks and outcomes is challenging given the number of other factors, the variation in methodologies, and the range of characteristics different parks present.
3. Although individual- and even community-level impacts are moderately well understood, additional research is needed to understand the connection between parks and larger health systems.

These considerations and opportunities for future research notwithstanding, the existing and growing body of research provides a sufficient foundation from which to estimate the health benefits of

equitable access to quality parks. The challenge for researchers and communities is to identify a workable tool that considers this nuance while producing estimates of parks' benefits that are meaningful, clear, and sufficiently rigorous. Additionally, policy and practice solutions have to consider quality and access, urban versus nonurban contexts, park or green space size, and perception and actual safety. Park leaders, advocates, and allies can build from this framework to demonstrate how parks and green spaces are more than “nice to have” amenities; rather, they should be considered critical civic infrastructure that can promote equity for communities.

Introduction

Green space is critical for outdoor physical activity and a key driver of improvements in overall physical health. Proximity and exposure to trees and greenery can promote mental health by providing psychological relaxation and stress alleviation. At the community level, parks can contribute to disaster recovery and resilience planning and provide several environmental benefits. Additionally, parks foster opportunities for individuals to gather, connect, and socialize with their neighbors and other park users.

The COVID-19 pandemic has underscored the importance of accessible green space in a way that no event has before. Parks have played a critical role in supporting mental and physical health and have provided essential space for social gatherings and community events.

Parks have a substantial impact on health equity. Parks are often the only free, publicly accessible areas for physical activity. In communities with limited access to places to walk, roll, and bike safely or to amenities such as gyms or private green spaces, many of the health benefits associated with physical activity are only accessible through parks and public green spaces. In some urban spaces, parks and planned green spaces can also serve as an access point to nature, which can promote restfulness and improve mood.

However, not every household has equal access to quality green spaces, and in fact, access is often constricted along racial and socioeconomic lines. Formerly redlined² communities have the least access to green space (Nardone et al. 2021). Data show that parks in Black and brown neighborhoods are smaller in size and are more crowded (Trust for Public Land 2020). Lack of economic resources, racism encountered in park space, policing of park spaces, historical racial covenants, current segregation patterns, and placement of Black and Brown communities have all limited access to park space for people of color (Scott and Lee 2018; Yañez et al. 2021). Ensuring that all people are able to use and enjoy safe, quality, and accessible green space will mean dismantling systemic barriers that prevent some from feeling welcome.

This research summary will explore the evidence for health benefits associated with parks and green space. But evidence suggests that these health benefits cannot be untangled from issues of access and equity. The research reviewed will focus not just on what health benefits exist but also on who is able to access them and how can that access be made more equitable. The burgeoning “park justice” movement is highlighting the idea that to build a beautiful, engaging park is by itself not enough. To develop equitable, quality parks, policymakers and local leaders must confront the systemic disinvestment embedded in the history of these spaces. These policies and practices have entrenched

the stark opportunity gaps for Black and brown people, preventing them from receiving the many benefits of parks.

BOX 1

Studying the Health Equity Impacts of Parks

This research summary is the first step in a larger project commissioned by the National Recreation and Park Association to understand and communicate the economic impacts of local parks based on their health benefits. The goal of this work is to better equip local park and recreation professionals and advocates with the evidence to make a health-based case for the value of parks. We hope this research will also inform efforts to make parks more accessible and equitable so that the health benefits accrue to the entire community and all park users. An advisory committee composed of park and recreation professionals, health experts, and equity experts are informing the work, and the project will culminate in an adaptable and practical tool for measuring the health equity impacts of parks at a local level.

Methodology

We used a snowball sampling strategy to identify documents for review. We began with a set of 15 key documents from the National Recreation and Park Association's (NRPA's) extensive existing reports on parks, green space, and health, as well as 15 documents identified as critical pieces of literature by the Urban team. From this initial sample, we expanded our review to examine citations from these sources as well as papers that cited them. We sought to include not only academic literature but also practitioner reports and guidance documents from the field.

From the initial set of documents, we identified where there were gaps in the literature. We used keyword searches to pull in additional documents focused in the four topic areas (physical, mental, social, and environmental health). From that body of literature, we focused on documents published between 2000 and 2021, with exceptions for a few key sources. We concluded with 102 reference documents that include journal articles, practitioner documents, and book chapters sourcing quantitative analyses, secondary data reviews, literature scans, surveys, case studies, toolkits, and other methodologies.

We discussed our preliminary findings and methodology with experts from the field through the NRPA advisory committee, NRPA staff, and senior Urban advisors. These perspectives helped supplement our research review by grounding the findings and strengthening our process.

BOX 2

Terminology

Park

An open outdoor space. Incorporates amenities such as playgrounds and courts as well as green space. This document will refer exclusively to public parks unless otherwise noted. Used jointly with green space within this document; where we mean parks specifically, it will be noted in the text.

Green space

Land that incorporates greenery such as grass, tree cover, shrubs, etc. This document refers to publicly accessible green space unless otherwise noted. At points in this document, the research will refer to specific types of green spaces (e.g., tree cover). Used jointly with parks within this document; where we mean green space specifically, it will be noted in the text.

Access

Encompasses multiple measures of the usability of parks and green space. Proximity, density, quality, safety, and amenities are all measures of park access. Equitable park access focuses on eliminating barriers along these measures for all potential park visitors.

Note: Terminology is based on MacCleery, McConville, and Hammerschmidt (2021).

Park Characteristics

Parks and green spaces affect health outcomes in many ways. Understanding their impact on health requires an understanding of the variety of parks and park contexts. Park size, quality, amenities, and composition all have implications for how parks affect health. Whether the park is rural or urban, is easily accessible or difficult to access, or includes amenities that the surrounding community desires are important inputs to any analysis of the health impact of park space. These factors can change who reaps the benefits of park spaces, how those benefits accrue, and level of the impacts.

A substantial amount of literature is available on accessibility and amenities in parks and how those factors affect outcomes such as physical activity, and the body of literature on the racial and economic disparities in park access is growing. In other areas, such as mental health impacts or environmental impacts, there is less focus on the park context. As this document reviews the literature on health equity impacts of parks, keep in mind that the park context described in the research might impact the findings.

Quality and Accessibility

Access to high-quality park space in the United States is inextricably tied to the country's history of racism and white supremacy. Many of the health benefits we will discuss are contingent on community access to park space and on the quality of that space. Unfortunately, park spaces are inequitably distributed. Policies, procedures and decisions for parks and green space have been designed to concentrate quality parks and park programming in predominately white and higher-income neighborhoods, leaving people of color and low-income residents lacking the same quality of amenities as white people (Yañez et al. 2021).

Research comparing present day green space with the Home Owner's Loan Corporation maps that formed the basis for redlining show that formerly redlined areas have less green space (Nardone et al 2021). Using propensity score matching, Nardone and colleagues (2021) controlled for other demographic and economic factors and compared areas one grade apart. They found a statistically significant decrease in green space as grades decreased. This research builds on prior evidence connecting the legacy of racism and segregation with lack of access to urban green space and urban heat islands. One study found that formerly redlined areas have less green space and more nonpermeable surfaces and are on average 2.6° C (36.68° F) hotter than nonredlined areas (Hoffman,

Shandas, and Pendleton 2020). Similar associations appear in research about racial equity and park quality. An analysis using park audits found that as a neighborhood's share of people of color increased, the number of disamenities (e.g., dangerous spots, excessive litter, waste and noise, poor maintenance, vandalism) in parks increased and amenities (e.g., benches, trails, drinking fountains, and lights) decreased (Hughey et al. 2016).

The conversation about racial equity in park access is critical because research has suggested a link between measures of park access (proximity to parks and park quality) and higher rates of park use and physical activity. Park proximity can be measured by distance to the closest park or by amount of park space in the surrounding area. Park quality is a more subjective measure, but the Urban Land Institute offers five criteria for considering park quality; their framework measures whether a park is well-maintained, accessible, well-programmed, relevant to community, and flexible (MacCleery, McConville, and Hammerschmidt 2021). Considering park congestion level (i.e., number of people per park acre if each person were to utilize the nearest park) is also important in framing who has quality access. Research shows that Latinx Americans, and to some extent Black Americans (including lower-income householders) were most likely to live closest to congested parks (Wolch et al. 2014). This correlation is driven in part by which neighborhoods people of color tend to live in.

Some debate exists within the literature about the impact of self-selection on where a person chooses or is able to live, but proximity to park space remains a key driver of park access. The literature is inconclusive about whether distance to nearest park space or density of surrounding park space has a more significant effect on physical activity; both have been associated with higher park use and physical activity (Kaczynski and Mowen 2011; Mackenbach et al. 2018). This correlation holds true even among those who put low importance on park space (Kaczynski and Mowen 2011). A survey of Kansas City, Missouri, households found a significant relationship between self-reported use of park space for physical activity and the amount of park space within one mile (diversity of park amenities was also associated with higher rates of use; see Kaczynski et al. 2014). Interestingly, distance to closest park space was not significantly associated with use.

Empirical evidence suggests that perceptions of park quality are positively associated with park use and subsequently with higher rates of physical activity among those with positive park perception (Bai et al. 2013). This association is also present among youth; a study in Baltimore among predominately Black high-school students showed a positive effect for self-reported perceptions of park quality and availability on park usage, with a more tenuous link between perceived availability and physical activity (Ries et al. 2009). Several quasi-experimental studies have suggested that making improvements to

park features and amenities is associated with an increase in park usage for both youth and adults (Heath and Bilderback 2019; Veitch et al. 2012).

Urban versus Rural

Much of the literature on the effects of parks on health tends to focus on urban and suburban areas. Because of the nature of urban development, access to unplanned green space is limited, necessitating the intentional creation of park space. This leaves several gaps in the literature on the impact of parks and green spaces. First, the term “urban areas” encompasses a broad range of cities based on region, geographic size, and population. Further, it can encompass areas that might be colloquially considered suburban. Smaller cities may lack the funding for parks that larger cities are able to marshal, but larger cities may face distinct gentrification pressures and rapidly changing neighborhood demographics (Eldridge, Burrowes, and Spauster 2019). The inequities in access to quality park space may also align with urban/suburban divides. Parks in dense center city areas have considerably less acreage per person than more suburban areas (Rigolon 2016). These center city parks were also more likely to be in predominately Black neighborhoods, although patterns of gentrification complicate efforts to use set neighborhood definitions.

Further, research focused on urban parks may not be directly applicable to parks in rural areas. Observational evidence suggests that rural parks may be utilized differently than urban ones, with visitors in rural areas more likely to engage in sedentary activities and less likely to be engaged in moderately vigorous exercise (Roemich et al. 2018). A survey of residents in rural Iowa found a statistically significant relationship between feelings of access to recreational and walking space and community satisfaction overall (Payne and Schaumleffel 2008). But conflicting evidence from a survey of California youth suggested that perceived park quality and access is correlated with physical activity among urban youth but not rural youth (Babey et al. 2008).

Similar to urban areas, rural areas are diverse and have a multitude of differing characteristics. Comparative analyses or typologies of rural areas as they relate to parks and green spaces are a gap in the literature.

Size of Park or Green space

Early conversations with the advisory committee identified park size as a potentially important component to contextualize park impact. As referenced previously, dense urban areas are more likely to feature smaller parks with fewer amenities. Communities might use smaller parks differently from larger ones in ways that might affect health benefits. There is evidence that larger parks with more amenities may have a more direct impact on physical activity (Kaczynski, Potwarka, and Saelens 2008).

Beyond the connection between quality and diversity of amenities and usage, there is little research specifically on small urban park spaces. One study using survey data on residents near pocket parks found a similar positive effect on physical activity for these small parks as larger neighborhood parks (Cohen et al. 2014). Other research is largely observational, noting the types of usage for small parks. One study used observation and follow-up surveys to classify how users were engaging with small parks. The most common uses were either socializing (31 percent) or resting (31 percent). A study using images of small parks to gauge perceived likelihood for restoration (positive impact on mood) found that the share of ground surface covered by grass, visible tree cover, and park size were most correlated with restorative impact (Nordh et al. 2009). This anecdotal evidence suggests smaller parks may retain some of the positive impacts on mental health and well-being and social connectedness of larger parks, but additional research is needed to clearly delineate the impact of small parks and green spaces.

A much smaller body of research focuses on trails and has shown similar physical activity benefits for proximity to trails relative to parks and other green spaces. Particularly in rural areas and smaller towns, trails have been associated with increased physical activity (Abildso et al. 2012; Brownson et al. 2000). Evidence suggests that length of trail and material (i.e., pavement) have the most significant impact on use (Brownson et al. 2000).

Safety in Park spaces

Parks and green spaces generate more benefits when they are accessible and usable and when users have a general sense of safety. When parks are perceived as unsafe, users miss out on the positive outcomes of green spaces (Williams et al. 2020). Research shows that parks that are well maintained are safer, encourage community building, and promote civic trust (MacCleery, McConville, and Hammerschmidt 2021).³ Parks can drive safety by being welcoming community assets and public spaces, providing calm, and reducing crime (Burgess et al. 1988; MacCleery, McConville, and Hammerschmidt 2021; NRPA 2019). The larger the number of park users, the lower the number of

antisocial and unsafe behaviors (Citizens' Taskforce on the Use and Security of Central Park 1990). People increase their use of parks the safer and more welcome they feel, which evidence shows is impacted by park design, the presence of trees, and inclusiveness for multiple demographics.

People's perceptions of safety and their willingness to use a space can be affected by the design and maintenance of a park. It is well documented that the urban and architectural design of built and natural environments that maximize visibility, encourage activity, and improve accessibility can reduce crime and the fear of crime (Stanley 1977). The distribution of amenities such as lighting, call boxes, signage, and other features can eliminate deserted areas and reduce senses of loneliness (MacCleery, McConville, and Hammerschmidt 2021).

Further, lack of maintenance contributes to the perception of unsafety. The presence of garbage, damaged equipment, and damaged trees deter park users, and on a 2020 survey, respondents did not feel safe visiting parks with these concerns (Lopez, Kennedy, and McPhearson 2020). Understanding this relationship, New York City's Park Inspection Program conducts audits to determine the condition of these features, and the Parks Without Borders program targets strengthening safety through maintenance. Similarly, the Metro Action Committee on Public Violence Against Women and Children, based in Canada, has implemented a safety audit procedure to monitor and correct safety concerns in parks.

Even landscaping, such as trees with higher canopies and features that reduce blocked sections of the park, can contribute to an improved perception of safety (MacCleery, McConville, and Hammerschmidt 2021). Parks often provide large concentrated areas of greenery, which have positively contributed to community and individual public safety. As demonstrated in Chicago, an increase in tree canopy can result in a decrease in neighborhood crime rates, particularly for violent crime (Schusler et al. 2018). In a later study in Chicago (Herrnstadt et al. 2021), researchers found that tree canopy can improve air quality and general physical health through a causal link between air pollution and violent crimes.

But design and landscaping alone cannot address the challenges of safety in parks (Zavadskas et al. 2019; NRPA 2019). Strategies for improving safety include removing barriers to access both physical and mental (e.g., isolated spaces, limited entry points, and perceptions of unsafety) that prevent users from feeling welcome. Parks must appeal to a wide diversity of users, including people of color, youth, seniors, varying abilities, and LGBTQ+ people to be safe and accessible (MacCleery, McConville, and Hammerschmidt 2021; NRPA 2019).

Physical Health

Connections between Parks and Physical Activity

Park access is associated with increased levels of physical activity across several studies. Evidence shows that proximity to and use of parks, green space, and tree cover are all correlated with greater levels of physical activity (Eichinger et al. 2015; Pretty et al. 2005). Studies of physical activity have emphasized that park density (the amount of park space in proximity) is highly correlated with physical activity (Roemmich et al. 2018; Roux et al. 2007; Wendel-Vos et al. 2004). An analysis in New York City, NY; Baltimore, MD; and Forsyth County, NC, found that when analyzing individual survey respondents by density of nearby park space at 1-mile, 2-mile, and 5-mile radii, those in the highest quartile of park density were significantly more likely to engage in physical activity (Roux et al. 2007). Amount of park space in proximity has been shown to have a significant positive relationship with physical activity among youth (Epstein et al. 2006; Veitch et al. 2012; Yi et al. 2021). A longitudinal analysis that followed impact on physical activity among a cohort of youth showed that the magnitude of this relationship lessens as youth age (Yi et al. 2021).

Strong evidence suggests recreational programming and outreach and communication activities have significant impacts on usage and rates of physical activity in parks. Rigorous research on the impact of marketing training for park staff and funds for outreach shows that dual approaches that combine park improvements and outreach campaigns have a significant impact on physical activity in parks and green spaces (Cohen et al. 2013; Hunter et al. 2019). A meta-analysis of quasi-experimental studies found that in each study of the impact of parks and green space, this dual approach yielded statistically significant increase in park use and physical activity (Hunter et al. 2019).

Qualitative studies have corroborated the quantitative evidence (McCormack et al. 2010). Focus groups conducted among park users in Perth, Australia, indicated that proximity and accessibility of park facilities were important factors for physical activity (Giles-Corti and Donovan 2002). Qualitative research focusing on Latinx, Black, and immigrant populations all indicated that their proximity to park space, their ability to access park space without driving, and greater density of their surrounding parks improved their ability to engage in physical activity (Griffin et al. 2008; Ries et al 2008; Roux et al. 2007).

Some studies have found a connection between access to leisure time and perceived neighborhood safety and physical activity in park spaces (Eichinger et al 2015). However, other research has found no direct connection between perceived or objective measures of crime and physical activity in parks (Ries et al. 2009; Zhang et al. 2019). This suggests that additional evidence is needed to understand the connection of neighborhood conditions and physical activity in parks.

Physical Activity and Health Outcomes

Research on the connection between physical activity and health has consistently found strong positive associations. Physical activity is correlated with a range of impacts on cardiovascular health, including reduced risk of cardiovascular disease and reduced risk of mortality because of disease (Myers et al. 2004; Warburton, Nicol, and Bredin 2006). Physical activity has been shown to reduce risk of mortality from all causes among men, women, and the elderly (Bijnen 1999; Myers et al. 2002; Oguma and Shinoda-Tagawa 2004). In one study of exercise habits in men, tests associated exercise with a 50 percent reduction in risk for cardiovascular disease (Myers et al. 2004). For those with existing cardiovascular disease, activity has been shown to reduce or attenuate effects of the disease (Warburton, Nicol, and Bredin 2006).

Physical activity has been shown to affect several additional health outcomes, including reductions in incidence of type 2 diabetes, with particularly strong impacts among those at highest risk (Helmrich, Ragland, and Paffenbarger 1994; Manson et al. 1992). One study associated moderate exercise with a reduction in diabetes incidence of 40 to 60 percent over three to four years for high-risk populations (Williamson, Vinicor, and Bowman 2004). Physical activity has similar effects on cancer incidence, particularly colon cancer, which is associated with a 30 to 40 percent reduction, and breast cancer, which is associated with a 20 to 30 percent reduction (Kampert et al. 1996; Lee 2003; Sternfield et al. 2009)

Just as physical activity conveys several health benefits, inactivity is associated with several negative health outcomes. A number of estimations at the national level and across countries have suggested the costs of physical inactivity are significant and include increased rates of noncommunicable disease and corresponding health care costs and lost life years (ISCA and CEBR 2015).

Health Impacts of General Park Usage and Green Space

Beyond the connection of parks and physical activity, usage of park services is associated with reductions in various negative health outcomes and illnesses. Spending even 120 minutes in green spaces has been associated with higher levels of reported good health and well-being (White et al. 2019). Evidence has associated time spent in parks and green spaces with reductions in complications caused by chronic diseases such as diabetes and heart disease (Bowler et al. 2010; NRPA 2015). Evidence from a large-scale Dutch survey suggests that proximity to green space has a positive effect on self-perceived general physical health, with a larger effect for the elderly, youth, and families with low incomes (Maas et al. 2006).

A significant body of evidence supports the connection between park and green space and children's physical health. A study using survey data of Latinx children in Houston, Texas, found that those living in areas with a higher density of tree cover had lower levels of obesity and a higher health-related quality of life (Kim Lee, and Sohn 2016). Similar studies using survey data of children found that park space had a more significant impact on health for urban and suburban children than for rural children (Tillmann, Clark, and Gilliland 2018).

Mental Health

Mental Well-Being

A wealth of research connects parks with positive effects on individual mental health well-being. Time spent in green space has been associated with improved mental health outcomes, including reduced stress levels (Capaldi, Dopko, and Zelenski 2014; Gidlow et al. 2016; James et al 2015; Roe et al. 2013). Evidence suggests that time spent in green space has a positive impact on general mental well-being and self-reported happiness (Capaldi, Dopko, and Zelenski 2014). Research using data from the RESIDential Environments Project in Australia suggests that proximity and density of green space is associated with positive impacts on mental health (Wood et al. 2017).

Physical activity is associated with improvements to measures of health such as mood and self-reported well-being. One study compared participants who exercised while viewing images of nature with who exercised without such exposure and found that the benefits of activity are stronger when in or viewing natural surroundings (Pretty et al. 2005). Interestingly, follow up studies with children and adolescents replicated the impact of exercise on mood, but there were no additional effects of exercise in either green space or while viewing natural environment images (Reed et al. 2013; Wood et al. 2013). In a large-scale survey of people registered across 104 entry points into the medical system, proximity to green space was associated with higher self-reported general health. This relationship was stronger for lower income groups, as well as the elderly, youths, and people with secondary education (Maas et al. 2006).

There is some evidence that the effect of parks on mood and happiness might be mitigated by the context the park is in. A study of parks in Singapore found that there was no significant connection between parks and increased happiness (Saw, Lim, and Carrasco 2015). This study, though hardly challenging the broader literature that supports the link between mental health well-being and park space, suggests that additional research is needed on how the link might be affected by different contexts.

Use of Mental Health Services

Some evidence suggests green space influences the usage of mental health services. Parks and green space have been noted as important parts of a well-functioning mental health system (Buckley and Brough 2017; Hosie et al. 2015). Communities with higher levels of green space and tree cover have lower usage of mental health services and treatments, controlling for demographics and economic status (Nutsford, Pearson, and Kingham 2013; Taylor et al. 2015). An analysis of street tree coverage in the United Kingdom associated a per unit increase in trees per km of street with a decrease of 1.18 prescriptions per thousand population, a relatively small but significant relationship (Taylor et al. 2015). A study of green space density and proximity and anxiety/mood disorder treatments across 3,149 small-area units (similar to census blocks) in New Zealand indicated that both green space measures were associated with fewer treatments (Nutsford et al. 2013).

There is extensive research on the economic impact of reducing mental health service use (Hosie et al. 2015; Lambert et al. 2015),⁴ so these findings, although not conclusive, could have implications for the economic health equity benefits of park spaces. In Buckley and Brough's (2017) review of the literature connecting parks and mental health, they offer a framework for evaluating economic value of parks on mental health. The framework includes three pathways that might yield economic mental health benefits: reduction in mental health service use, increases to productivity, and reductions in antisocial behavior.

Functioning and Productivity

As people experience poor mental health and general stress, their productivity is also affected. The literature available for review focuses on occupational stress and productivity, but these factors also likely affect personal productivity (Sauter and Murphy 1995). Several international studies have linked access to green space, whether through physical presence or views, to reduced stress levels. A study of office workers in Seoul, South Korea, found that those who had natural view from their windows had lower stress levels and higher job satisfaction. A case study in Belgrade, Serbia, found that the installation of a park within a business district had a direct impact on stress relief. The frequency, duration, and activity of open space usage reduced the stress levels and stress-related experiences of employees in the workplace as recorded by a self-reported questionnaire. Open space, including greenery and outdoor space, fostered overall improvements to employee health and well-being (Maric et al. 2021).

Social Health

Social Cohesion

Social cohesion refers to the social connections that exist among community members and how connected an individual feels to others (Kawachi and Berkman 2000). Social cohesion provides social benefits in terms of community connectedness but is also associated with other health benefits such as reduced levels of depression (Perez et al. 2015). Conversely, social isolation is associated with a number of negative health outcomes, such as being less healthy overall and being more susceptible to stress, depression, and cardiovascular issues (Jennings and Bamkole 2019).

Evidence suggests that parks have a positive effect on social cohesion and sense of belonging (a critical measure in surveys of social cohesion), and engagement with park spaces can facilitate attachment to communities (Peters, Elands, and Bujis 2010). A cross-sectional study of the RESIDential Environments Project surveyed 911 residents in Perth, Australia, using a survey based on the 12-item Sense of Community Index (an established survey instrument measuring connection to community) and found that the perceived quality of public open spaces was positively associated with higher community attachment (Wood et al. 2017). Parks are also connected with increased levels of social engagement (Jennings and Bamkole 2019; Kaźmierczak 2013). There is some evidence that multiethnic interactions in public spaces, such as parks, yield benefits to social cohesion in diverse areas (Perez et al 2015; Peters 2010). A multimodal analysis of five urban park spaces in the Netherlands involving a survey and observations and interviews found similarities in park usage across ethnic groups and that urban parks facilitate interethnic interactions (Peters 2010).

A study comparing the impact of vegetation levels in neighborhoods with park space found that general vegetation was positively correlated with reduced stress but negatively correlated with social support, as measured by self-reported surveys (Fan et al. 2011). Park spaces, however, were significantly correlated with positive impacts on both measures, suggesting that programmed park space may have a greater impact on overall health than general levels of neighborhood vegetation (Fan et al. 2011).

Social Capital

If social cohesion is the degree to which a community is connected, then social capital is the access to resources and ability to act socially and effect change (Putnam 1993). Natural environments have been shown to impact social actions. Participants in a study of college students who were shown natural environments were more likely to engage in cooperative and prosocial behavior in subsequent game testing (Zelenski 2015).

How parks are activated has a significant impact on their contribution to social health. Environmental education programs, volunteer programs, and community-led stewardship are associated with increased levels of social capital (Krasny et al. 2015). Urban parks can serve as an access point to social participation through nature-based recreation that might otherwise be inaccessible, particularly to people in lower-income neighborhoods (Baur and Tynon 2010; Graham and Glover 2014).

Environmental Health

Air Quality

Urban parks have an established impact on air quality. Urban areas generally have lower air quality than surrounding areas; one study put the disparity at 5 to 25 times more gaseous pollutants (Heidt and Neef 2008). As a major source of tree cover in urban settings, parks have a role in removing pollutants from the air and sequestering carbon (Paoletti et al 2011). The storage of carbon alone has been estimated to have a \$2 billion impact in urban areas (Nowak et al. 2013). A study in the Taipei metropolitan area shows that higher green space density (aggregating green space) has demonstrated reduced air pollution. Lower emissions influence the microclimate, such as through cooler temperatures and smaller distributions of rainfall (Liu and Shen 2014).

Although the evidence supports the finding that urban green space and tree canopies improve air quality overall, the literature is less unanimous on the direct impact of tree coverage on asthma. Some evidence suggests a limited impact of park space on rates of environmentally sensitive health conditions such as asthma and suggests that prevalence of tree cover may be associated with higher allergy prevalence (Lovasi et al. 2013). Using data from a birth cohort of Black and Dominican children in New York City, they found a positive connection between tree canopy coverage and asthma rates (Lovasi et al. 2013). However, literature examining the value of a “green prescription” by comparing the tree canopy with rates of health conditions found a limited but significant relationship with lower rates of asthma (Ulmer et al. 2016).

There is a relationship between exposure to air pollution and higher cardiovascular mortality and an association between green space and a reduction in air pollution. However, studies mostly examine how green space at varying densities can reduce cardiovascular risk factors; links between the size of green space, time spent in green space, improvements to air quality, and cardiovascular physiology are more tenuous (Lanki et al. 2017; Plans et al. 2019; Seo et al. 2019).

Climate Adaptations

Climate change has impacted the environment across geographic areas. Urban areas have experienced a well-documented increase in temperatures (McPherson 1994; Whitford, Ennos, and Handley 2001).

This effect has been exacerbated by densification as cities have more impervious surfaces and less greenery to provide shade and absorb heat (Heidt and Neef 2008; Myint et al 2010). As temperatures rise in urban areas, so too does the demand for, and cost of, electricity, with some 5 to 10 percent of electricity demand related to increased urban temperatures (Akbari, Rosenfeld, and Taha 1990; Akbari, Pomerantz, and Taha, 2001).

The presence of a developed tree canopy can counteract some of the temperature increases caused by this urban heat-island effect (Akbari, Pomerantz, and Taha 2001). Additionally, decreasing the amount of impervious surface area (e.g., pavement) and increasing the amount of grassy and vegetative surfaces can contribute to decreases in temperature as well (Taha 1997). A case study of four sites in Merseyside, UK, found that among several indicators of ecological performance (surface temperature, carbon sequestration and storage, hydrology, and biodiversity), more affluent areas performed better across each indicator because of higher quantities of green space and tree cover (Whitford, Ennos, and Handley 2001). Critically, much of this literature looks at urban green space broadly, including public and private spaces.

Climate change has also led to an increase in the numbers of adverse weather events. Thus, discussion has increased about mitigation and adaptation to reduce the risks associated with such events. Parks and green spaces can serve as natural ways to increase urban hazard resiliency. Green space can serve a crucial role in protecting against flood risk by reducing runoff. Case studies of parks that act as natural infrastructure show that these spaces can improve water filtration and curb runoff (Chadsey and Grenfell 2020). Surfaces such as pavement and gravel do not absorb water, whereas soil, grassy areas, and wetlands act as natural absorbent materials for runoff water during storms (Depietri, Renaud, and Kallis 2012; Taha 1997).

Disaster Planning and Social Resilience

Public green space is critical for improving environmental health but can also support building more socially resilient communities as they foster social connections and neighborhood ties, which are particularly key for disaster planning and recovery. Research examining the psychological connection humans have with nature after a natural disaster finds that people seek resilience through green spaces (Campbell et al. 2016; Tidball 2012). Disasters cause physical damage but also cause psychological damage and trauma, strain social connections, and damage livelihoods. Faced with increased social and psychological strain, emerging research indicates people seek out parks and green spaces as restorative resources (Campbell et al. 2016; Wolf and Rozance 2013). As the COVID-19 pandemic has

demonstrated, parks and green spaces allow people to build community and strengthen social structures for disaster relief and recovery (Campbell et al. 2016; Slater, Christiana, and Gustat 2020; Wolf and Rozance 2013). Studies reinforce that following a disaster, communities with strong social ties and connectedness demonstrate pathways toward community recovery (Wolf and Rozance 2013).

The literature on the connection between green spaces (including parks) and psychological and social disaster resilience is mostly grounded in research on the psychology of environment, research on responses after specific disasters, and research attributing the inherent value of nature as refuge in a general context. A mixed-methods study of New York City parks following Hurricane Sandy demonstrated that although the social and environmental benefits of parks are clear, there is limited understanding of how these benefits affect non-park users following a disaster (Campbell et al. 2016).

There may be opportunities to measure some sociocultural impacts, such as spiritual and religious value, aesthetic value, and recreation and ecotourism (Millennium Ecosystem Assessment 2005). But there are several other social resilience benefits that are harder to quantify, and the literature has not adequately assessed these measures. For instance, few social impact assessments include a resilience framework, and other metrics often focus on global or community-level benefit instead of individual well-being (Campbell et al 2016).

Economic Impacts of Park Health Benefits

There is a rich literature assessing the economic impacts of parks and green spaces, but fewer studies focus on linking economic impacts with the health benefits of equitable access to parks. This section focuses on studies that explore the economic impact of specific benefits across the various dimensions of health; throughout, we reference research on other economic impacts where relevant for a health-focused analysis.

A significant body of literature quantifies the environmental benefits of parks and green space, much of which also references other associated health benefits. The Trust for Public Land (2013) used evidence on the environmental benefits of specific land types to estimate that for every \$1 invested in conservation of green space, Massachusetts yields \$4 in natural goods and services. Many of these natural goods and services, including reductions in flood risk, and mitigation of climate effects, have impacts on health. The report also estimates that parks and green spaces contribute physical health benefits equivalent to about \$2 billion in reduced health costs related to lack of physical activity in Massachusetts (Trust for Public Land 2013), demonstrating the connection between parks and economic development.

Further, several studies have quantified parks' economic contributions through their function as a key buffer against airborne pollution. One estimate indicated that urban tree cover accounts for 700 million metric tons of carbon storage and a sequestration rate of 22.8 million metric tons a year, with a net cost benefit of \$14.76 billion (Nowak and Crane 2002). A Parks Health Benefits Calculator developed by the Trust for Public Land measures impact on air quality through tree canopy metrics (including type of tree cover), as well as the flow of pollutants using concentration data from the Environmental Protection Agency (Harnik and Welle 2009). This measurement is then multiplied by the median externality value for each pollutant to calculate the overall cost benefit.

The iTree Landscape⁵ is a web application based on peer-reviewed research from the US Department of Agriculture Forest Service. The application identifies tree benefits and helps users prioritize areas for planting and planning decisions in a specific location. The tool quantifies the value and risk of new tree plantings, such as effects on temperature, health, water quality, and variables of climate change. iTree Landscape also provides comparison areas to determine priorities.

Studies have also estimated the economic impact of parks and green space on water quality improvement. An economic analysis of the Washington State park system, for instance, included an estimation of ecosystem services, featuring water quality, wildlife habitat, and aesthetic quality (Schundler et al. 2015). This study used a benefits transfer methodology to estimate economic valuation using prior studies of the economic impact of similar green spaces. They found that the 35 million annual visits to Washington State parks contribute an estimated \$1.4 billion a year from expenditures such as purchase of outdoor equipment, the buying and selling of goods, business transactions from park products, and respend income earned in or from the park. Additionally, the Washington State parks generate between \$500 million and \$1.2 billion a year in ecosystem service value, measuring aesthetics, habitat for wildlife, and natural water filtration to sustain local water systems (Schundler et al. 2015).

Comparatively, although a wealth of literature quantifies the benefits of improved mental health, comparatively little research isolates the economic impact of the mental health benefits of parks and green spaces. A research framework from Buckley and Brough (2017) identifies some of the key causal pathways for quantifying mental health benefits of parks, focusing on decreased mental health care costs, improved workplace productivity, and avoided costs of “antisocial” behavior, but it does not estimate the economic benefit of these three pathways. Their analytical framework includes a three-step process: quantify park users and uses along a set of categories, quantify proportional changes to mental health along those categories, and use national data on economic benefits of mental health to estimate the economic value of parks in mental health. The framework described would require three datasets: park use patterns, mental health outcomes, and national economic values.

This approach aligns with similar conceptual frameworks proposed for measuring the economic impact of parks and green space on physical health (Bedimo-Rung, Mowen, and Cohen 2005). This physical health framework proposed measuring the impact of user characteristics and park amenities and features on park use (Bedimo-Rung, Mowen, and Cohen 2005). Then, using park usage and types of use, the framework could identify rates of physical activity and estimate the impact on physical health (Bedimo-Rung, Mowen, and Cohen 2005). Finally, economic values could be attached to the physical health impact using national data on health care costs (Bedimo-Rung, and Mowen, and Cohen 2005). A simplified version of this analysis features in several attempts to quantify health impacts by counting park users under and over the age of 65, then using a cost modifier (the average difference in health costs between an active person within that age range and an inactive person) to estimate cost benefits (Harnik and Welle 2009).⁶

Methods for Quantifying the Economic Impacts of Park Health Benefits

The evidence for quantifying the specific health impact of parks and green space is an emerging field of study with fewer examples of rigorous research. Despite that, there are promising models both emerging from the park health field as well as from other aspects of park impact.

Hedonic Modeling

A substantial amount of literature measures parks' and green space's impact on property values using methods such as hedonic modeling (Crompton 2001; Harnik and Welle 2009; Jim and Chen 2010). Hedonic models use property transactions to control for the characteristics of a given property and their contribution to the final sale price. Proximity to park space has been shown to be a significant variable affecting sale price and future outcomes on property value. Although these models have not been used to explicitly reference health, they do capture the perceived benefit of parks to a homebuyer, of which perceived health benefits are a part.

Distance and quality of park space is a key determinant in hedonic value: both proximity to a park and that park's characteristics (such as users' perception of its safety and the park's programming) can increase or reduce overall benefit for the user (Trust for Public Land 2013). This in turn impacts the user's ability to obtain physical, mental, and social health benefits that can be gained from time spent in a park or green space. In Dallas-Fort Worth, Texas, and in Portland, Oregon, homes adjacent to or within 1,500 feet or less of park space had higher property values than those located within a half-mile of a park (Crompton and Nicholls 2020). This was similarly observed for single-family homes sold between 1990 and 1999 in Greenville, South Carolina (Espey and Owusu-Edusei 2001). Moreover, households are willing to pay more in housing costs to live close to a park or green space (Harnik and Welle 2009; McConnell and Walls 2005). However, capturing the assessed value of parks in singularity can be challenging because of inconsistency in the data and methodology of hedonic assessments and subjectivity concerning the localities studied (McConnell and Walls 2005; Trust for Public Land 2013).

Further hedonic modeling offers a means of analyzing the negative economic impacts associated with gentrification. Evidence suggests that new parks can contribute to gentrification where equitable development practices are not incorporated (Jelks et al. 2021; Kim and Wu 2021). Although multiple studies have quantified the positive side of increased property values caused by park space (through

additional wealth flowing to homeowners and increase tax revenue), no studies have rigorously quantified potential economic harm caused by gentrification and displacement.

Benefits Transfer

A common technique within the environmental literature is the concept of benefits transfer. This method uses past rigorous research on the monetary benefits of environmental qualities to estimate the benefits of these same qualities in other contexts. This method has been used to estimate the economic value of parks and green spaces based on the composition of the space, meaning the types of land included (Trust for Public Land 2013). This method allows an estimation of impact where there is research on similar land types and where a reasonable argument can be made for the transferability of the monetary benefits to a new context; more complex analyses control for differences in the conditions and socioeconomic context of the analysis site (Colombo and Hanley 2008). Research on the validity of this methodology has underlined the importance of having equal benefit functions, meaning the benefits in both sites have similar effects (Brouwer and Spaninks 1999).

Benefits Tools

A few attempts have been made at providing tools to calculate the benefits of parks and green space. A prominent example is the Florida Recreation and Parks Impact Calculator, which includes health and environmental benefits. This tool uses fairly broad assumptions. Health benefits are calculated by counting the number of park users over age 65 and those under age 65, then using a multiplier based on national data on the health savings associated with park use (\$2,406 for over age 65, \$1230 for under age 65).

The Oregon Parks and Recreation Department developed outdoor recreation metrics to quantify the contribution of physical activity to averted health care costs. They include 30 outdoor activities (such as biking, walking, and jogging on trails) to assess how environmental intervention correlates to health impacts in the state. They created an Outdoor Recreation Health Impacts Estimator tool that measured 503 billion kcals of energy used and \$735 million to \$1.416 billion in cost of illness savings associated with eight chronic illnesses affected by physical activity (Rosenberger and Dunn 2018).

Such tools and metrics have to balance ease of use (availability of data, complexity of assumptions) with the rigor of the outputs.

Considerations for a Health Equity Framework

The field of park and green space equity has been growing as the value of these critical civic assets, and the importance of access to them, is more widely recognized. Capturing their value through quantitative and qualitative measures can help demonstrate and translate their benefits in ways that resonate with local communities and individuals. Assessing the contribution of parks to different dimensions of health can be complex and will require an intentional and comprehensive health equity framework for the variety of benefits derived from parks and green space. There are several key implications in approaching this framework and opportunities for consideration.

The Literature Is Strongest for Quantifying Physical, Mental, and Environmental Health Outcomes in Parks

By far, the areas with the most substantial literature base are that park space is associated with an increase in physical activity, that interactions with green space have a wealth of mental health benefits, and that green spaces are associated with many positive environmental health outcomes. In these areas there is a wealth of existing literature to pull from, and that literature is conclusive.

However, research is ongoing and developing about the mechanisms that underlie these connections that may affect the framework. For instance, several studies suggest that density of park space is strongly associated with higher rates of physical activity, but other studies indicate that the proximity of the nearest park space is also associated with physical activity. Studies on the impact of the natural environment on mood suggest a connection for adults, but evidence is inconclusive that this impact holds for youth. The framework will need to consider the various mechanisms that drive these impact areas.

Confirming the Actual Relationship between Parks and Outcomes Is Challenging

A key framework goal is to identify and quantify the actual impact of parks on health equity. In some cases, there are direct links between parks, park access, and proximity of green space and health

outcomes. The health benefits associated with activity is an area of the literature where the connection between park access and awareness and health benefits is clear. Parks provide space for physical activity, and that activity has been shown to provide health benefits. However, other areas, such as the impact of parks on social cohesion, may be heavily affected by park context. For instance, if a park is not viewed as safe and welcoming, if certain racial groups or economic classes lack access to park space, or if other factors exogenous to the park itself hinder social interaction, the park's impact on social cohesion may be limited.

The framework will need to focus on how to tease out, whether through park typologies, amenity checklists, or some other means, which impacts, and to what extent those impacts, can be reasonably attributable to any given park, given the wide range of size, type, and quality of park space and the range of community contexts.

Additional Research Is Needed to Understand the Connection between Parks and Larger Health Systems

The nature of the academic literature on health outcomes trends toward the individual-level impacts that parks have on health outcomes. Individual health measures and self-reported outcomes have data and are easier to study. However, parks are small parts of larger health systems, and focusing on individual outcomes could obscure some of the downstream effects of park space. Hospital systems, state departments of health, primary care providers, neighborhood and economic conditions all impact individual health outcomes. Isolating the magnitude of the impact of green space on health is an ongoing challenge.

Further, examining the individual impacts of parks can miss some of the systems-level impacts on particular groups. For instance, although parks have clear positive impacts on mental health and self-reported happiness, parks are also less likely to be sited in predominately Black and brown neighborhoods and neighborhoods with lower income levels. In turn, these neighborhoods face higher rates of negative mental health outcomes. The framework must account not only for expected impacts on a general population but also for specific impacts given the population with access to the park.

As localities use their community- or individual-level measurements to better understand the value of parks, there will be increased data available for summarizing large-scale impacts across park networks and geographical regions. Expanding the field through examining health-based impacts can strengthen the narrative of park benefits and their contribution to thriving communities.

Notes

- ¹ Throughout this report, we often link the terms parks and green space, but we recognize they may have nuanced definitions. We note in the text where we mean only parks or only green spaces. Further, in all instances in this report, parks and green spaces refer to public spaces unless otherwise noted.
- ² Redlining is a process by which the Home Owner's Loan Corporation assigned areas a grade (A, B, C, or D) that was highly correlated with the area's racial or ethnic composition. The areas with the lowest grades, and therefore considered the most undesirable, were predominantly communities of color.
- ³ Project for Public Spaces, "What Role can Design Play in Creating Safer Parks?" December 31, 2008, <https://www.pps.org/article/what-role-can-design-play-in-creating-safer-parks>.
- ⁴ "Position Statement on Medical Professionalism," Australian Medical Association, 2010, https://ama.com.au/sites/default/files/documents/Medical_Professionalism.pdf.
- ⁵ iTree Landscape and the suite of tools. <https://landscape.itreetools.org/>
- ⁶ Florida Recreation and Parks Impact Calculator. <https://www.frpa.org/calculator>.

References

- Abildso, Christiaan G., Sam J. Zizzi, Steve Selin, and Paul M. Gordon. 2012. "Assessing the Cost Effectiveness of a Community Rail-Trail in Achieving Physical Activity Gains." *Journal of Park & Recreation Administration* 30 (2).
- Akbari, Hashem, Arthur H. Rosenfeld, and Haider Taha. 1990. "Summer Heat Islands, Urban Trees, and White Surfaces." Proceedings of the 1990 ASHRAE Winter Conference, February 10–14, Atlanta, GA.
- Akbari, Hashem, Melvin Pomerantz, and Haider Taha. 2001. "Cool Surfaces and Shade Trees to Reduce Energy Use and Improve Air Quality in Urban Areas." *Solar Energy* 70 (3): 295–310.
- Babey, Susan H., Theresa A. Hastert, Hongjian Yu, and E. Richard Brown. 2008. "Physical Activity among Adolescents: When Do Parks Matter?." *American Journal of Preventive Medicine* 34 (4): 345–48.
- Bai, Hua, Sonja A. Wilhelm Stanis, Andrew T. Kaczynski, and Gina M. Besenyi. 2013. "Perceptions of Neighborhood Park Quality: Associations with Physical Activity and Body Mass Index." *Annals of Behavioral Medicine* 45 (suppl. 1): S39–48.
- Baur, Joshua W.R., and Joanne F. Tynon. 2010. "Small-Scale Urban Nature Parks: Why Should We Care?" *Leisure Sciences* 32 (2): 195–200.
- Bedimo-Rung, Ariane L., Andrew J. Mowen, and Deborah A. Cohen. 2005. "The Significance of Parks to Physical Activity and Public Health: A Conceptual Model." *American Journal of Preventive Medicine* 28 (2): 159–68.
- Bijnen, Fransje CH, Edith JM Feskens, Carl J. Caspersen, Nico Nagelkerke, Willem L. Mosterd, and Daan Kromhout. 1999. "Baseline and Previous Physical Activity in Relation to Mortality in Elderly Men: The Zutphen Elderly Study." *American Journal of Epidemiology* 150 (12): 1289–96.
- Bowler, Diana E., Lisette M. Buyung-Ali, Teri M. Knight, and Andrew S. Pullin. 2010. "A Systematic Review of Evidence for the Added Benefits to Health of Exposure to Natural Environments." *BMC Public Health* 10 (1): 1–10.
- Brouwer, Roy, and Frank A. Spaninks. 1999. "The Validity of Environmental Benefits Transfer: Further Empirical Testing." *Environmental and Resource Economics* 14 (1): 95–117.
- Brownson, Ross C., Robyn A. Housemann, David R. Brown, Jeannette Jackson-Thompson, Abby C. King, Bernard R. Malone, and James F. Sallis. 2000. "Promoting Physical Activity in Rural Communities: Walking Trail Access, Use, and Effects." *American Journal of Preventive Medicine* 18 (3): 235–41.
- Buckley, Ralf C., and Paula Brough. 2017. "Economic Value of Parks via Human Mental Health: An Analytical Framework." *Frontiers in Ecology and Evolution* 5: 16.
- Burgess, Jacquelin, Carolyn M. Harrison, and Melanie Limb. 1988. "People, Parks and the Urban Green: A Study of Popular Meanings and Values for Open Spaces in the City." *Urban Studies* 25 (6): 455–73.
- Capaldi, Colin A., Raelyne L. Dopko, and John M. Zelenski. 2014. "The Relationship between Nature Connectedness and Happiness: A Meta-Analysis." *Frontiers in Psychology* 5: 976.
- Campbell, Lindsay K, Erika S. Svendsena, Nancy F. Sontib, Michelle L. Johnson. 2016. "A Social Assessment of Urban Parkland: Analyzing Park Use and Meaning to Inform Management and Resilience Planning." *Environmental Science & Policy* 62: 34–44.
- Chadsey, Matt, and Maree Grenfell. 2020. *Building Urban Resilience with Nature: A Practitioner's Guide to Action*. Tacoma, WA: Earth Economics.
- Citizens Task Force on the Use and Security of Central Park. 1990. *Central Park: The Heart of the City: The Report of the Citizens Task Force*. New York: Citizens Task Force on the Use and Security of Central Park.

- Cohen, Deborah A., Bing Han, Kathryn Pitkin Derose, Stephanie Williamson, Terry Marsh, and Thomas L. McKenzie. 2013. "Physical Activity in Parks: A Randomized Controlled Trial Using Community Engagement." *American Journal of Preventive Medicine* 45 (5): 590–97.
- Cohen, Deborah A., Terry Marsh, Stephanie Williamson, Bing Han, Kathryn Pitkin Derose, Daniella Golinelli, and Thomas L. McKenzie. 2014. "The Potential for Pocket Parks to Increase Physical Activity." *American Journal of Health Promotion* 28 (3 suppl.): S19–26.
- Colombo, Sergio, and Nick Hanley. 2008. "How Can We Reduce the Errors from Benefits Transfer? An Investigation Using the Choice Experiment Method." *Land Economics* 84 (1): 128–47.
- Crompton, John L. 2001. "The Impact of Parks on Property Values: A Review of the Empirical Evidence." *Journal of Leisure Research* 33 (1): 1–31.
- Crompton, John L., and Sarah Nicholls. 2020. "Impact on Property Values of Distance to Parks and Open Spaces: An Update of U.S. Studies in the New Millennium." *Journal of Leisure Research* 51 (2).
- Depietri, Yaella, Fabrice G. Renaud, and Giorgos Kallis. 2012. "Heat Waves and Floods in Urban Areas: A Policy-Oriented Review of Ecosystem Services." *Sustainability Science* 7 (1): 95–107.
- Eichinger, Michael, Sylvia Titze, Bernd Haditsch, Thomas E. Dorner, and Willibald J. Stronegger. 2015. "How are Physical Activity Behaviors and Cardiovascular Risk Factors Associated with Characteristics of the Built and Social Residential Environment?" *PLoS One* 10 (6): e0126010.
- Eldridge, Matthew, Kimberly Burrowes, Patrick Spauster. 2019. "Investing in Equitable Parks and Green Spaces." Washington, DC: Urban Institute.
- Epstein, Leonard H., Samina Raja, Samuel S. Gold, Rocco A. Paluch, Youngju Pak, and James N. Roemmich. 2006. "Reducing Sedentary Behavior: The Relationship between Park Area and the Physical Activity of Youth." *Psychological Science* 17 (8): 654–59.
- Espey, Molly, and Kwame Owusu-Edusei. 2001. "Neighborhood Parks and Residential Property Values in Greenville, South Carolina." *Journal of Agricultural and Applied Economics* 33 (3): 487–92.
- Fan, Yingling, Kirti V. Das, and Qian Chen. 2011. "Neighborhood Green, Social Support, Physical Activity, and Stress: Assessing the Cumulative Impact." *Health & Place* 17 (6): 1202–11.
- Gidlow, Christopher J., Jason Randall, Jamie Gillman, Graham R. Smith, and Marc V. Jones. 2016. "Natural Environments and Chronic Stress Measured by Hair Cortisol." *Landscape and Urban Planning* 148: 61–67.
- Giles-Corti, Billie, and Robert Donovan. 2002. "The Relative Influence of Individual, Social and Physical Environment Determinants of Physical Activity." *Social Science & Medicine* 54 (12): 1–20.
- Graham, Taryn M., and Troy D. Glover. 2014. "On the Fence: Dog Parks in the (Un) Leashing of Community and Social Capital." *Leisure Sciences* 36 (3): 217–34.
- Griffin, Sarah F., Dawn K. Wilson, Sara Wilcox, Jacqueline Buck, and Barbara E. Ainsworth. 2008. "Physical Activity Influences in a Disadvantaged African American Community and the Communities' Proposed Solutions." *Health Promotion Practice* 9 (2): 180–90.
- Harnik, Peter, and Ben Welle. 2009. *Measuring the Economic Value of a City Park System*. San Francisco: The Trust for Public Land.
- Heath, Gregory W., and John Bilderback. 2019. "Grow Healthy Together: Effects of Policy and Environmental Interventions on Physical Activity among Urban Children and Youth." *Journal of Physical Activity and Health* 16 (2): 172–76.
- Heidt, Volker, and Marco Neef. 2008. "Benefits of Urban Green Space for Improving Urban Climate." In *Ecology, Planning, and Management of Urban Forests*, edited by Margaret M. Carreiro, Yong-Chang Song, and Juanguo Wu, 84–96. New York: Springer.

- Helmrich, Susan P., David R. Ragland, and RALPH S. Paffenbarger Jr. 1994. "Prevention of Non-insulin-dependent Diabetes Mellitus with Physical Activity." *Medicine and Science in Sports and Exercise* 26 (7): 824–30.
- Herrnstadt, Evan, Anthony Heyes, Erich Muehlegger, and Soodeh Saberian. 2021. "Air Pollution and Criminal Activity: Microgeographic Evidence from Chicago." *American Economic Journal: Applied Economics* 13 (4): 70–100.
- Hoffman, Jeremy S., Vivek Shandas, and Nicholas Pendleton. 2020. "The Effects of Historical Housing Policies on Resident Exposure to Intra-urban Heat: A Study of 108 US Urban Areas." *Climate* 8 (1): 12.
- Hosie, Aram, Gillian Vogl, Joanna Carden, John Hoddinott, and Simon Lim. 2015. "A Way Forward: Equipping Australia's Mental Health System for the Next Generation." Pyrmont, Australia: ReachOut Australia and EY.
- Hughey, S. Morgan, Katrina M. Walsemann, Stephanie Child, Alicia Powers, Julian A. Reed, and Andrew T. Kaczynski. 2016. "Using an Environmental Justice Approach to Examine the Relationships between Park Availability and Quality Indicators, Neighborhood Disadvantage, and Racial/Ethnic Composition." *Landscape and Urban Planning* 148: 159–69.
- Hunter, Ruth Fiona, Claire Cleland, Anne Cleary, Mariël Droomers, Benedict W. Wheeler, Danielle Sinnett, Mark J. Nieuwenhuijsen, and Matthias Braubach. 2019. "Environmental, Health, Wellbeing, Social and Equity Effects of Urban Green Space Interventions: A Meta-narrative Evidence Synthesis." *Environment International* 130: 104923.
- ISCA (International Sport and Culture Association) and CEBR (Centre for Economics and Business Research). *The Economic Cost of Physical Inactivity in Europe*. London: CEBR.
- James, Peter, Rachel F. Banay, Jaime E. Hart, and Francine Laden. 2015. "A Review of the Health Benefits of Greenness." *Current Epidemiology Reports* 2 (2): 131–42.
- Jelks, Na'Taki Osborne, Viniece Jennings, and Alessandro Rigolon. 2021. "Green Gentrification and Health: A Scoping Review." *International Journal of Environmental Research and Public Health* 18 (3): 907.
- Jennings, Viniece, and Omoshalewa Bamkole. 2019. "The Relationship between Social Cohesion and Urban Green Space: An Avenue for Health Promotion." *International Journal of Environmental Research and Public Health* 16 (3): 452.
- Jim, Chi Yung, and Wendy Y. Chen. 2010. "External Effects of Neighbourhood Parks and Landscape Elements on High-Rise Residential Value." *Land Use Policy* 27 (2): 662–70.
- Kaczynski, Andrew T., Luke R. Potwarka, and Brian E. Saelens. 2008. "Association of Park Size, Distance, and Features with Physical Activity in Neighborhood Parks." *American Journal of Public Health* 98 (8): 1451–56.
- Kaczynski, Andrew T., and Andrew J. Mowen. 2011. "Does Self-Selection Influence the Relationship between Park Availability and Physical Activity?." *Preventive Medicine* 52 (1): 23–25.
- Kaczynski, Andrew T., Gina M. Besenyi, Sonja A. Wilhelm Stanis, Mohammad Javad Koohsari, Katherine B. Oestman, Ryan Bergstrom, Luke R. Potwarka, and Rodrigo S. Reis. 2014. "Are Park Proximity and Park Features Related to Park Use and Park-Based Physical Activity among Adults? Variations by Multiple Socio-demographic Characteristics." *International Journal of Behavioral Nutrition and Physical Activity* 11 (1): 1–14.
- Kampert, James B., Steven N. Blair, Carolyn E. Barlow, and Harold W. Kohl III. 1996. "Physical Activity, Physical Fitness, and All-Cause and Cancer Mortality: A Prospective Study of Men and Women." *Annals of Epidemiology* 6 (5): 452–57.
- Kawachi, Ichiro, and Lisa Berkman. 2000. "Social Cohesion, Social Capital, and Health." *Social Epidemiology* 174, no. 7 (2000): 290-319.
- Kaźmierczak, Aleksandra. 2013. "The Contribution of Local Parks to Neighbourhood Social Ties." *Landscape and Urban Planning* 109, no. 1 (2013): 31-44.

- Kim, Jun-Hyun, Chanam Lee, and Wonmin Sohn. 2016. "Urban Natural Environments, Obesity, and Health-Related Quality of Life among Hispanic Children Living in Inner-City Neighborhoods." *International Journal of Environmental Research and Public Health* 13, no. 1 (2016): 121.
- Kim, Seung Kyum, and Longfeng Wu. 2021. "Do the Characteristics of New Green Space Contribute to Gentrification?" *Urban Studies* 59 (2).
- Krasny, Marianne E., Leigh Kalbacker, Richard C. Stedman, and Alex Russ. 2015. "Measuring Social Capital among Youth: Applications in Environmental Education." *Environmental Education Research* 21, no. 1 (2015): 1-23.
- Lambert, Kelly G., Randy J. Nelson, Tanja Jovanovic, and Magdalena Cerdá. 2015. "Brains in the City: Neurobiological Effects of Urbanization." *Neuroscience & Biobehavioral Reviews* 58 (2015): 107-122.
- Lanki, Timo, Taina Siponen, Ann Ojala, Kalevi Korpela, Arto Pennanen, Pekka Tiittanen, Yuko Tsunetsugu, Takahide Kagawa, and Liisa Tyrväinen. 2017. "Acute Effects of Visits to Urban Green Environments on Cardiovascular Physiology in Women: A Field Experiment." *Environmental Research* 159: 176-85.
- Lee, I-Min. 2003. "Physical activity and cancer prevention—data from epidemiologic studies." *Medicine and science in sports and exercise* 35, no. 11 (2003): 1823-1827.
- Lopez, Bianca, Christopher Kennedy, and Timon McPhearson. 2020. "Parks are Critical Urban Infrastructure: Perception and Use of Urban Green Spaces in NYC During COVID-19." (2020).
- Lovasi, Gina S., Jarlath PM O'Neil-Dunne, Jacqueline WT Lu, Daniel Sheehan, Matthew S. Perzanowski, Sean W. MacFaden, Kristen L. King et al. 2013. "Urban Tree Canopy and Asthma, Wheeze, Rhinitis, and Allergic Sensitization to Tree Pollen in a New York City Birth Cohort." *Environmental Health Perspectives* 121, no. 4 (2013): 494-500.
- Liu, Hsiao-Lan, and Yu-Sheng Shen. 2014. "The Impact of Green Space Changes on Air Pollution and Microclimates: A Case Study of the Taipei Metropolitan Area." *Sustainability* 6: 8827-55.
- Maas, Jolanda, Robert A. Verheij, Peter P. Groenewegen, Sierp De Vries, and Peter Spreeuwenberg. 2006. "Green Space, Urbanity, and Health: How Strong is the Relation?" *Journal of Epidemiology & Community Health* 60, no. 7 (2006): 587-592.
- MacCleery, Rachel, Megan McConville, and Sara Hammerschmidt. 2021. "Five Characteristics of High-Quality Parks." Urban Land Institute. (2021).
- Mackenbach, Joreintje D., Maria G. Matias de Pinho, Eline Faber, Nicole den Braver, Rosa de Groot, Helene Charreire, Jean-Michel Oppert et al. 2018. "Exploring the Cross-Sectional Association between Outdoor Recreational Facilities and Leisure-Time Physical Activity: The Role of Usage and Residential Self-Selection." *International Journal of Behavioral Nutrition and Physical Activity* 15, no. 1 (2018): 1-11.
- Manson, JoAnn E., David M. Nathan, Andrzej S. Krolewski, Meir J. Stampfer, Walter C. Willett, and Charles H. Hennekens. 1992. "A Prospective Study of Exercise and Incidence of Diabetes among US Male Physicians." *Jama* 268, no. 1 (1992): 63-67.
- Maric, Jelena, Djukic Aleksandra, Branislav Antonic, Danilo Furundzic, and Vladimir Parezanin. 2021. "The Effects of Open Space on Reducing Workplace Stress: Case Study of Business Park in the Post-Socialist Urban Setting." *Sustainability* 13, no. 1 (2021): 336.
- McConnell, Virginia, and Margaret Walls. 2005. "The Value of Open Space: Evidence from Studies of Nonmarket Benefits." Lincoln Institute of Land Policy Working Paper (2005).
- McCormack, Gavin R., Melanie Rock, Ann M. Toohey, and Danica Hignell. 2010. "Characteristics of Urban Parks associated with Park Use and Physical Activity: A Review of Qualitative Research." *Health & Place* 16, no. 4 (2010): 712-726.
- McPherson, E. Gregory. 1994. *Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project*. Vol. 186. US Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, 1994.

- Millennium Ecosystem Assessment. 2005. "Ecosystems and Human Wellbeing." Island Press. Vol. 5 (2005).
- Myers, Jonathan, Manish Prakash, Victor Froelicher, Dat Do, Sara Partington, and J. Edwin Atwood. 2002. "Exercise capacity and mortality among men referred for exercise testing." *New England journal of medicine* 346, no. 11 (2002): 793-801.
- Myers, Jonathan, Amir Kaykha, Sheela George, Joshua Abella, Naima Zaheer, Scott Lear, Takuya Yamazaki, and Victor Froelicher. 2004. "Fitness versus Physical Activity Patterns in Predicting Mortality in Men." *The American Journal of Medicine* 117, no. 12 (2004): 912-918.
- Myint, Soe W., Anthony Brazel, Gregory Okin, and Alexander Buyantuyev. 2010. "Combined Effects of Impervious Surface and Vegetation Cover on Air Temperature Variations in a Rapidly Expanding Desert City." *GIScience & Remote Sensing* 47 (3): 301-20.
- Nardone, Anthony, Kara E. Rudolph, Rachel Morello-Frosch, and Joan A. Casey. 2021. "Redlines and Greenspace: The Relationship between Historical Redlining and 2010 Greenspace across the United States." *Environmental Health Perspectives* 129, no. 1 (2021): 017006.
- National Recreation and Parks Association. 2015. "Parks and Improved Mental Health and Quality of Life." (2015).
- National Recreation and Parks Association. 2019. "Creating Safe Park Environments to Enhance Community Wellness." (2019).
- Nordh, Helena, Terry Hartig, C. M. Hagerhall, and Gary Fry. 2009. "Components of Small Urban Parks That Predict the Possibility for Restoration." *Urban Forestry & Urban Greening* 8, no. 4 (2009): 225-235.
- Nowak, David J., and Daniel E. Crane. 2002. "Carbon Storage and Sequestration by Urban Trees in the USA." *Environmental Pollution* 116 (3): 381-89.
- Nowak, David J., Eric J. Greenfield, Robert E. Hoehn, and Elizabeth Lapoint. 2013. "Carbon Storage and Sequestration by Trees in Urban and Community Areas of the United States." *Environmental Pollution* 178: 229-36.
- Nutsford, D., A. L. Pearson, and S. Kingham. 2013. "An Ecological Study Investigating the Association between Access to Urban Green Space and Mental Health." *Public Health* 127 (11): 1005-11.
- Oguma, Yuko, and Tomoko Shinoda-Tagawa. 2004. "Physical Activity Decreases Cardiovascular Disease Risk in Women: Review and Meta-analysis." *American Journal of Preventive Medicine* 26 (5): 407-18.
- Paoletti, Elena, Tommaso Bardelli, Gianluca Giovannini, and Leonella Pecchioli. "Air Quality Impact of an Urban Park over Time." *Procedia Environmental Sciences* 4, no. 0 (2011): 10-6.
- Payne, Laura L., and Nathan A. Schaumleffel. 2008. "Relationship Between Attitudes Toward Rural Community Parks and Recreation and Rural Community Satisfaction." *Journal of Park & Recreation Administration* 26 (3).
- Perez, Lilian G., Elva M. Arredondo, Thomas L. McKenzie, Margarita Holguin, John P. Elder, and Guadalupe X. Ayala. 2015. "Neighborhood Social Cohesion and Depressive Symptoms among Latinos: Does Use of Community Resources for Physical Activity Matter?." *Journal of Physical Activity and Health* 12 (10): 1361-68.
- Peters, Karin. 2010. "Being Together in Urban Parks: Connecting Public Space, Leisure, and Diversity." *Leisure Sciences* 32 (5): 418-33.
- Peters, Karin, Birgit Elands, and Arjen Buijs. 2010. "Social Interactions in Urban Parks: Stimulating Social Cohesion?." *Urban Forestry & Urban Greening* 9 (2): 93-100.
- Plans, Elena, Pedro Gullón, Alba Cebrecos, Mario Fontán, Julia Díez, Mark Nieuwenhuijsen, and Manuel Franco. 2019. "Density of Green Spaces and Cardiovascular Risk Factors in the City of Madrid: The Heart Healthy Hoods Study." *International Journal of Environmental Research and Public Health* 16 (24): 4918.
- Pretty, Jules, Jo Peacock, Martin Sellens, and Murray Griffin. 2005. "The Mental and Physical Health Outcomes of Green Exercise." *International Journal of Environmental Health Research* 15 (5): 319-37.

- Putnam, Robert. "The Prosperous Community: Social Capital and Public Life." *The American Prospect* 13 (4).
- Reed, Katharine, Carly Wood, Jo Barton, Jules N. Pretty, Daniel Cohen, and Gavin RH Sandercock. 2013. "A Repeated Measures Experiment of Green Exercise to Improve Self-Esteem in UK School Children." *PloS One* 8 (7): e69176.
- Ries, Amy V., Joel Gittelsohn, Carolyn C. Voorhees, Kathleen M. Roche, Kelly J. Clifton, and Nan M. Astone. 2008. "The Environment and Urban Adolescents' Use of Recreational Facilities for Physical Activity: A Qualitative Study." *American Journal of Health Promotion* 23 (1): 43–50.
- Ries, Amy V., Carolyn C. Voorhees, Kathleen M. Roche, Joel Gittelsohn, Alice F. Yan, and Nan M. Astone. 2009. "A Quantitative Examination of Park Characteristics Related to Park Use and Physical Activity among Urban Youth." *Journal of Adolescent Health* 45 (3): S64–70.
- Rigolon, Alessandro. "A Complex Landscape of Inequity in Access to Urban Parks: A Literature Review." *Landscape and Urban Planning* 153 (2016): 160–69.
- Roe, Jenny J., Catharine Ward Thompson, Peter A. Aspinall, Mark J. Brewer, Elizabeth I. Duff, David Miller, Richard Mitchell, and Angela Clow. "Green Space and Stress: Evidence from Cortisol Measures in Deprived Urban Communities." *International Journal of Environmental Research and Public Health* 10 (9): 4086–4103.
- Roemmich, James N., LuAnn Johnson, Grace Oberg, Joley E. Beeler, and Kelsey E. Ufholz. 2018. "Youth and Adult Visitation and Physical Activity Intensity at Rural and Urban Parks." *International Journal of Environmental Research and Public Health* 15 (8): 1760.
- Rosenberger, Randall S. and Tara Dunn. 2018. *Oregon Outdoor Recreation Metrics: Health, Physical Activity, and Value. 2019-2023 Oregon Statewide Comprehensive Outdoor Recreation Plan Supporting Documentation. Part A: Health Benefits Estimates for Oregonians from Their Outdoor Recreation Participation in Oregon.* Oregon State University.
- Roux, Ana V. Diez, Kelly R. Evenson, Aileen P. McGinn, Daniel G. Brown, Latetia Moore, Shannon Brines, and David R. Jacobs Jr. 2007. "Availability of Recreational Resources and Physical Activity in Adults." *American Journal of Public Health* 97 (3): 493–99.
- Sauter, Steven L., and Lawrence R. Murphy. 1995. *Organizational Risk Factors for Job Stress.* American Psychological Association.
- Saw, Le E., Felix KS Lim, and Luis R. Carrasco. 2015. "The Relationship between Natural Park Usage and Happiness Does Not Hold in a Tropical City-State." *PloS One* 10 (7): e0133781.
- Schundler, Greg, Johnny Mojica, and Tania Briceno. 2015. *Economic Analysis of Outdoor Recreation at Washington's State Parks.* Tacoma, WA: Earth Economics.
- Schusler, Tania, Leah Weiss, David Treering, and Earvin Balderama. 2018. "Research Note: Examining the Association between Tree Canopy, Parks and Crime in Chicago." *Landscape and Urban Planning* 170: 309–13.
- Scott, David, and Kang Jae Jerry Lee. 2018. "People of Color and Their Constraints to National Parks Visitation." *George Wright Forum* 35 (1): 73–82.
- Seo, Sumin, Seulggie Choi, Kyuwoong Kim, Sung Min Kim, and Sang Min Park. 2019. "Association between Urban Green Space and the Risk of Cardiovascular Disease: A Longitudinal Study in Seven Korean Metropolitan Areas." *Environment International* 125: 51–57.
- Slater, Sandy J., Richard W. Christiana, and Jeanette Gustat. 2020. "Peer Reviewed: Recommendations for Keeping Parks and Green Space Accessible for Mental and Physical Health during COVID-19 and Other Pandemics." *Preventing Chronic Disease* 17.
- Stanley, Paul R.A. 1977. "Crime Prevention through Environmental Design: A Review." Toronto, Ontario: A.R.A. Consultants Ltd.

- Sternfeld, Barbara, Erin Weltzien, Charles P. Quesenberry, Adrienne L. Castillo, Marilyn Kwan, Martha L. Slattery, and Bette J. Caan. 2009. "Physical Activity and Risk of Recurrence and Mortality in Breast Cancer Survivors: Findings from the LACE study." *Cancer Epidemiology and Prevention Biomarkers* 18 (1): 87–95.
- Taha, Haider. 1997. "Urban Climates and Heat Islands: Albedo, Evapotranspiration, and Anthropogenic Heat." *Energy and Buildings* 25 (2): 99–103.
- Taylor, Mark S., Benedict W. Wheeler, Mathew P. White, Theodoros Economou, and Nicholas J. Osborne. 2015. "Research note: Urban Street Tree Density and Antidepressant Prescription Rates—A Cross-Sectional study in London, UK." *Landscape and Urban Planning* 136: 174–79.
- Trust for Public Land. 2020. "The Heat is On: With Temperatures Rising and Quality Parks Too Few and Far Between, Communities of Color Face a Dangerous Disparity."
- The Trust for Public Land. 2013. "The Return on Investment in Parks and Open Space in Massachusetts."
- Tidball, K. G. 2012. "Urgent Biophilia: Human-Nature Interactions and Biological Attractions in Disaster Resilience." *Ecology and Society* 17 (2): 5.
- Tillmann, Suzanne, Andrew F. Clark, and Jason A. Gilliland. 2018. "Children and Nature: Linking Accessibility of Natural Environments and Children's Health-Related Quality of Life." *International Journal of Environmental Research and Public Health* 15 (6): 1072.
- Ulmer, Jared M., Kathleen L. Wolf, Desiree R. Backman, Raymond L. Trethewey, Cynthia JA Blain, Jarlath PM O'Neil-Dunne, and Lawrence D. Frank. 2016. "Multiple Health Benefits of Urban Tree Canopy: The Mounting Evidence for a Green Prescription." *Health & Place* 42: 54–62.
- Veitch, Jenny, Kylie Ball, David Crawford, Gavin R. Abbott, and Jo Salmon. 2012. "Park Improvements and Park Activity: A Natural Experiment." *American Journal of Preventive Medicine* 42 (6): 616–19.
- Warburton, Darren E.R., Crystal Whitney Nicol, and Shannon S.D. Bredin. 2006. "Health Benefits of Physical Activity: The Evidence." *Cmaj* 174 (6): 801–09.
- Wendel-Vos, GC Wanda, A. Jantine Schuit, Raymond de Niet, Hendriek C. Boshuizen, Wim HM Saris, and D. A. A. N. Kromhout. 2004. "Factors of the Physical Environment Associated with Walking and Bicycling." *Medicine and Science in Sports and Exercise* 36 (4): 725–30.
- White, Mathew P., Ian Alcock, James Grellier, Benedict W. Wheeler, Terry Hartig, Sara L. Warber, Angie Bone, Michael H. Depledge, and Lora E. Fleming. 2019. "Spending at Least 120 Minutes a Week in Nature Is Associated with Good Health and Wellbeing." *Scientific Reports* 9 (1): 1–11.
- Whitford, Victoria, A. Roland Ennos, and John F. Handley. 2001. "City Form and Natural Process"—Indicators for the Ecological Performance of Urban Areas and Their Application to Merseyside, UK." *Landscape and Urban Planning* 57 (2): 91–103.
- Williams, Tim G., Tom M. Logan, Connie T. Zuo, Kevin D. Liberman, and Seth D. Guikema. 2020. "Parks and Safety: A Comparative Study of Green Space Access and Inequity in Five US Cities." *Landscape and Urban Planning* 201: 103841.
- Williamson, David F., Frank Vinicor, and Barbara A. Bowman. "Primary Prevention of Type 2 Diabetes Mellitus by Lifestyle Intervention: Implications for Health Policy." *Annals of Internal Medicine* 140 (11): 951.
- Wolch, Jennifer R., Jason Bryne, and Joshua N. Newell. "Urban Green Space, Public Health, and Environmental Justice: The Challenge of Making Cities 'Just Green Enough'." *Landscape and Urban Planning* 125 (2014): 234–44.
- Wolf, K.L., and M.A. Rozance. 2013. "Social Strengths - A Literature Review." In *Green Cities: Good Health*. College of the Environment, University of Washington.

- Wood, Carly, Caroline Angus, Jules Pretty, Gavin Sandercock, and Jo Barton. 2013. "A Randomised Control Trial of Physical Activity in a Perceived Environment on Self-Esteem and Mood in UK Adolescents." *International Journal of Environmental Health Research* 23 (4): 311–20.
- Wood, Lisa, Paula Hooper, Sarah Foster, and Fiona Bull. 2017. "Public Green Spaces and Positive Mental Health—Investigating the Relationship between Access, Quantity and Types of Parks and Mental Wellbeing." *Health & Place* 48: 63–71.
- Yañez, Elva, Manal J. Aboelata, Alessandro Rigolon, and Rachel Bennett. 2021. "Changing the Landscape: People, Parks, and Power." The Prevention Institute.
- Yi, Li, Tyler B. Mason, Chih-Hsiang Yang, Daniel Chu, and Genevieve F. Dunton. 2021. "Longitudinal Associations Between Neighborhood Park and Open Space Access and Children's Accelerometer-Assessed Measured Physical Activity: The Evidence from the MATCH Study." *Journal of Physical Activity and Health* 18 (9): 1058–66.
- Zavadskas, Edmundas Kazimieras, Romualdas Bausys, and Ingrida Mazonaviciute. 2019. "Safety Evaluation Methodology of Urban Public Parks by Multi-criteria Decision Making." *Landscape and Urban Planning* 189: 372–81.
- Zelenski. 2015. "Cooperation Is in Our Nature: Nature Exposure May Promote Cooperative and Environmentally Sustainable Behavior." *Journal of Environmental Psychology* 42: 24–31
- Zhang, Ru, Hagen Wulff, Yanping Duan, and Petra Wagner. 2019. "Associations between the Physical Environment and Park-Based Physical Activity: A Systematic Review." *Journal of Sport and Health Science* 8 (5): 412–21.

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