



## Green Space and Adult Obesity in the United States



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### ABSTRACT

This paper estimates the relationship between green space and body mass index (BMI) in the U.S. We find that accounting for the heterogeneity of green space matters: BMI is significantly lower in counties with larger forestland per-capita, but not in those more abundant in rangeland, pastureland or cropland. This is after controlling for state-specific heterogeneity, and a range of environmental and natural amenities, including the presence of state parks, proximity to national parks, and outdoor recreation resources in the county, all of which have the expected negative correlation with BMI. Hence, the findings suggest that forests, public recreation lands, along with publicly available outdoor recreation resources can be valuable resources to help reduce obesity and associated public health problems.

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### 1. Introduction

Natural land covers including healthy forests provide a suite of goods and services that are vital to help improve public health and wellbeing. Many of these goods and services - wildlife habitat, watershed services, carbon storage, and scenic landscapes, for example - are public goods whose contributions, lacking private markets, are often overlooked in public, corporate, and individual decision-making. In this context, estimating the economic and social value of ecosystem services can help improve decision-making and promote conservation. In this study, we focus on the public health benefits of green space associated with a reduction in body weight in the U.S.

Previous studies have found that the availability of green space in the residential surroundings is positively associated with mental wellbeing and life satisfaction (Kopmann and Rehdanz, 2013; Tsurumi and Managi, 2015; Smyth et al., 2008; White et al., 2013). For example, interactions with natural areas can help improve psychological wellbeing and recovery from illness (Grahn and Stigsdotter, 2003; Louv, 2008; Parsons et al., 1998; Ulrich, 1984). Green space offers significant public health benefits through noise abatement (Irvine et al., 2009), stress reduction (Van den Berg et al., 2010), and aesthetic value (Ulrich et al., 1991), all of which are considered to add into the livability of an area. Other, perhaps better understood, contributions of green

space to public health come through air and water purification (FAO, 1997), oxygen generation and carbon sequestration (Pataki et al., 2011; von Stackelberg, 2012), and by providing cooling services during extreme heat through both shading and evapotranspiration (Pataki et al., 2011; Whitford et al., 2001).

Green space could help improve public health by providing opportunities for physical activity. Forests and other public open spaces are among the most common places for physical activities and studies have shown that availability of these resources in the neighborhoods significantly increases the likelihood of engaging in physical activity (Boncinelli et al., 2015; Coombes et al., 2010; Giles-Corti et al., 2005; Maas et al., 2006; Roemmich et al., 2006).<sup>1</sup> Further, other types of green space (e.g., cropland) could offer significant public health benefits through providing opportunities to consume locally grown foods which are often fresh and healthy, and to engage local population in physically demanding jobs (e.g., the planting and harvesting/picking of fruits or vegetables) (Poudyal et al., 2009).

In an empirical study, Maas et al. (2006) found a positive association between the percentage of aggregate green space (urban green, agricultural green, forests, and natural conservation areas) in people's living environment and perceived general health in the Netherlands. In

<sup>1</sup> A recent study has estimated that more than 170 million people (which is approximately 69% of the entire U.S. adult population) visit the U.S. national forests annually for outdoor recreation. Physical activities associated with these visits burn 290 billion food calories (Kline et al., 2011).

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Fig. 1. Land coverage in the conterminous U.S., 2011. Source: Homer et al. (2015).

another study, Maas et al. (2009) found that the annual prevalence rate of 15 out of 24 disease clusters was lower in living environments with more green space in a one kilometer radius in the Netherlands. Michimi and Wimberly (2012) found that natural amenities, such as topography, climate, water bodies, and forest cover were associated with county-level prevalence of obesity and physical activity in nonmetropolitan areas of the U.S. More recently, Boncinelli et al. (2015) found that the probability of being overweight was negatively associated with the percentage of land covered by forests in Italy.

Overweight and obesity are major public health concerns in the U.S., where their prevalence has increased at an alarming rate over the past three decades, and it is estimated that one in every three adults and one in every six children are obese (Flegal et al., 2010; Ogden et al., 2014). Overweight and obesity pose serious health risks: they greatly raise the risk of coronary heart disease, high blood pressure, stroke, diabetes, and metabolic syndrome (American Heart Association, 2014), with significant economic impacts on the U.S. health care system.<sup>2</sup> Obesity also has economic costs for those affected; obese adults earn

significantly less than their non-obese counterparts (Cawley, 2004; Lundborg et al., 2014).

Despite the “Healthy People 2020” federal initiative to reduce obesity prevalence, little progress has been made toward the goal of reducing overweight and obesity prevalence in the U.S. (CDC, 2012). To tackle the obesity problem, upstream policies that influence the physical activity environment to make physical activity choices easier have been proposed as one of the three public health approaches in the Obesity Policy Action Framework (Sacks et al., 2015). The Institute of Medicine (2012) has also recommended a holistic approach to obesity prevention, including increased opportunities for physical activity. In this regard, the findings of our study will help inform the design of such policies, specifically on the role of the environment in which such physical activity takes place.

Our study aims to improve the understanding of the relationship between green space and adult obesity in several important ways. First and foremost, we acknowledge that green space is heterogeneous and analyze the potentially different impact of various types of green space (forestland, range- and pastureland, and cropland) on adult obesity. In other words, we consider green space of different types. This is unlike most previous studies that either analyze a composite, aggregate measure of open space, or focus on only one specific type (usually

<sup>2</sup> Medical care costs associated with obesity have been estimated at \$147 billion per year (in 2008 constant price) in the U.S., half of which is paid by the government, through Medicare and Medicaid (Finkelstein et al., 2009).

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