ARTICLE IN PRESS

Journal of Transport & Health xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

Walkability, transit, and body mass index: A panel approach

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ARTICLE INFO

Keywords:
Transit
Walkability
BMI
Walk Score
Panel data

ABSTRACT

Researchers and advocates have increasingly drawn connections between individuals' transportation choices and healthy body weight, and most have found a connection. This paper improves on prior research by using panel data spanning 1999 to 2013 from the nationally (U.S.) representative Panel Study of Income Dynamics (N = 23,605 observations of 4870 individuals) to assess the connection between Body Mass Index (BMI) and transit availability, the use of transit, residential density, and neighborhood walkability. I further assess whether those who move to transit-richer, denser, or more walkable neighborhoods see systematic changes in body weight over time. The model results suggest that changes in one's transportation environment and travel behavior may be associated with reductions in BMI; for example, for the average-height man (5'11", 1.75 m), moving from the worst to best transit environment is associated with a reduction in body mass of nearly five pounds (2.2 kg), and moving from the worst to best pedestrian environment with a reduction in body mass of about two pounds (< 1 kg). The largest effect is seen in the panel model, in which giving up one's car correlates with a nearly seven-pound (over 3 kg) reduction in body mass after six years.

1. Introduction

In recent years, the connection between transportation and public health outcomes has garnered increased attention from researchers and policy-makers. Scholars have long investigated transportation's role in crash injury and death, as well as exposure to environmental pollution. This new wave of research, however, has broadened the research to include other topics, including active transportation and healthy body weight, and transportation as an essential part of the healthcare system.

Concerns over increasingly sedentary lives and climbing rates of obesity have driven the increased attention to transportation and body weight. Rates of childhood and adult obesity have climbed steadily for decades, reaching 38% of U.S. adults and 17% of youth in 2014 (Ogden et al. 2015), and the associated problems of cardiovascular disease, diabetes, and others have risen in tandem. Many see increasing reliance on private automobile travel as a part of the obesity puzzle.

Transportation policy-makers at various levels of government have played a large role in engendering a discussion on transportation and health outcomes. At the federal level, the U.S. Department of Transportation has partnered with the Centers for Disease Control to provide guidance on the topic by publishing an online Transportation and Health Tool that links transportation investments and decisions to various health outcomes (U.S. Department of Transportation 2015), as well as by providing funding for transportation services linked to healthcare access (U.S. Department of Transportation 2016). The National Academies have supported research on the topic, including an ongoing effort to provide a research "roadmap" to address critical issues on the topic (National Academies of Sciences n.d.). At the local level, county and city agencies, including departments of public health, have begun to direct attention and funding to projects that encourage cycling and walking as a strategy to reduce obesity (e.g. Los Angeles

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https://doi.org/10.1016/j.jth.2017.12.012
Received 12 August 2017; Received in revised form 19 December 2017; Accepted 29 December 2017

County Department of Public Health n.d.).

In this paper, I focus on the connection between the availability (and use) of public transportation, neighborhood walkability, and residential density on the one hand, and body weight on the other. I use a long-running panel dataset, the Panel Study of Income Dynamics (PSID) (*Panel Study of Income Dynamics, Restricted Use Data* 2015), to investigate these connections. This research improves on previous studies in several ways, though there are also drawbacks to using the dataset. The PSID has information on transportation use and health outcomes, and the use of biennial panel waves from 1999–2013 allows an investigation of whether changing one's transportation choices, or one's neighborhood, has an impact on body weight. It further allows for an understanding of how these effects accrue or diminish over time, and the large sample size and national scope provide data on individuals living in a variety of settings, making a variety of transportation choices. A considerable drawback to the dataset is that the data on body weight and height (from which Body Mass Index, BMI, is calculated) are self-reported, and researchers have found that survey respondents—particularly, obese respondents—tend to underreport their weight (Gosse 2014), which may lead to biased results. Further, the PSID measures transit use indirectly (via spending on transit fares at the family level) and no measurement of walking or cycling activity; thus, the analysis only focuses on whether using transit—and *living in* an environment that supports transit and active transportation—is associated with changes in body weight. For planners and policy-makers, though, this may be enough; while they cannot force individuals to use transit, walk or bike, they do have significant input into shaping the built environment and transit service.

The following section outlines previous research on the topic, and highlights gaps in the literature. I then present an overview of the data, the modeling approach, and the analysis. The models suggest a role for transportation and the built environment in promoting healthy body weight. I conclude with a discussion of the findings and recommendations for the road ahead in research in policy.

2. Literature review

The literature on transportation's connection to overweight and obesity has grown considerably in recent years, and most researchers have found a connection, though often the connection is weak. Transit use has been examined by several researchers, who posit that transit riding may increase physical activity meaningfully, since most transit trips include a meaningful amount of walking. In a recent review, Rissel et al. (2012) find that transit use increases walking by eight to thirty-three minutes per day. Wener and Evans (2007) find that rail commuters in Northern New Jersey take thirty percent more steps per day than do car commuters, and others have come to similar conclusions in different settings (Edwards 2008; Freeland et al. 2013; Saelens et al. 2014). Lachapelle et al. (2016) find that all transit users, but especially so-called “dependent” transit users with no automobile, engage in significantly more active travel, and that more active travel is associated with additional leisure-time physical activities, particularly for dependent transit riders. Hong et al. (2016), using accelerometer data in a before-and-after study examining the effect of a new light rail line in Los Angeles, find that the line's opening increased physical activity among those living near the line compared to those living further away.

Few studies, however, directly connect transit use with body mass index or other health outcomes. Rundle et al. (2007) employ a cross-sectional approach to examine the link between transportation, the built environment, and BMI in New York City and find that denser census tracts with a greater mix of land uses, as well as more bus stops and subway stations are associated with lower BMI. Wen and Rissel (2008), similarly using a cross-sectional approach, find that commuting to work by bicycle or public transport significantly reduces the odds of being overweight or obese among men in Australia, though they found no effect for women.

A small number of studies have employed a panel approach, measuring health outcomes for the same individuals across time. In a study of a new policy granting free public transportation passes to older people in England, Webb et al. (2012) find that people who switch to traveling by public transportation have slower rates of BMI growth than do those who do not switch. Similarly, MacDonald et al. (2010), find that those who opt to ride a new light rail system in North Carolina have significantly lower BMI and considerably lower risk of obesity over time, compared to those who do not switch to the new system. While the findings in this study are statistically significant, the sample size—particularly of those who made the switch to riding rail (n = 26)—suggests more work can be done in this research area.

Scholars have paid greater attention to the role of active travel (walking and cycling) in reducing obesity. In a review of forty-six articles covering active travel's impact on overall physical activity and body weight, Wanner et al. (2012) find limited evidence that active travel is associated with lower body weights in adults. They caution that simplistic measurement and cross-sectional, rather than longitudinal, study design may cloud the issue. In a small-sample intervention that overcomes the problems of cross-sectional design, another group found that cycling is associated with better cardiovascular health (Geus et al. 2007).

A growing number have examined the relationship between the built environment, walkability, physical activity, and health. A 2007 review summarized 20 publications on the topic, finding that most find a connection, though the effects are often modest in size (Papas et al. 2007). The review authors note that of the papers they reviewed, 18 were cross-sectional studies, limiting their ability to make causal claims. Of the two papers that used longitudinal study design, one did not directly test the issue of the built environment, and the other found no effect of county-level urban sprawl on obesity in children (Ewing et al., 2006).

A considerable portion of the literature focuses on transportation and physical health among school-age children. One review finds stronger evidence that children cycling to school increases cardiovascular fitness, though the authors conclude that research on the connection between active travel and body composition has been mixed and the study designs of moderate quality only (Larouche et al. 2014). Moodie et al. (2011) find that an Australian program to increase active travel among 10- and 11-year-olds was effective in reducing BMI, though they conclude the program may not be cost-effective. Few of studies have closely examined the role of public