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Potential health implications and health cost reductions of transit-induced physical activity

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ABSTRACT

Transit has the potential to increase an individual's level of physical activity due to the need to walk or bike at the beginning and end of each trip. Consideration of these health benefits would allow transit proponents to better demonstrate its true costs and benefits. In light of transit's potential health-related impacts, this study contributes to the growing discussion in the emerging field of health and transportation by providing a review of the current level of understanding and evidence related to the physical activity implications of transit use and its associated health cost benefits. Findings from the review revealed that transit use is associated with increased levels of physical activity and improved health outcomes, but the magnitude of these effects is uncertain. There were few studies that estimated the health care cost savings of transit systems, and those that did tended to be imprecise and simplistic. Objective physical activity measures and frequency-based transit measures would allow for greater consistency across studies and help more directly attribute physical activity gains to transit ridership. Additionally, research in this area would benefit from disaggregate estimation techniques and more robust health datasets that can be better linked with existing transit data.

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1. Introduction

Public transportation (transit) provides numerous mobility benefits to communities and individuals, and has the potential to become a viable replacement for motorized vehicles. Because of the low entry barriers for transit use, such as the lack of personal vehicle down payments and maintenance costs, the mode is accessible to a wide variety of travelers. Transit is also capable of reducing congestion and delays, improving air quality, and increasing overall productivity levels (due to less time wasted in traffic congestion) (Center for International Economics, 2001; ECONorthwest & Parsons Brinckerhoff Quade & Douglass, Inc., 2002; Litman, 2010, 2014; Public Transport Victoria, 2014). Furthermore, transit offers riders the opportunity to multi-task (Lyons and Urry, 2005; Lyons et al., 2007) so that they can travel while accomplishing other tasks such as working, reading, or sleeping. It is theorized that social capital can be increased through transit use and more pervasive transit provision (Currie and Stanley, 2008).

Finally, and of particular importance to this research, transit can help the user population become healthier since it encourages human-powered travel (Besser and Dannenberg, 2005; Edwards, 2008; Centers for Disease Control and Prevention, 2010; Mackett and Brown, 2011; Rissel et al., 2012; Freeland et al., 2013). In particular, transit has the potential to increase an individual's level of physical activity due to the need to walk or bike at the beginning and end of each trip. Given that the majority of the population can use transit with low initial capital outlay and little or no training, the inherent physicality associated with transit travel may not only impart higher levels of well-being but may also be the answer to health problems associated with sedentary lifestyles.

Despite its demonstrated benefits compared to auto-oriented modes, transit generally receives a disproportionately lower share of transportation funding. In the United States, for example, declining transportation revenues have resulted in transit budget shortfalls (Kirk and Mallett, 2013; General Accountability Office, 2014). One possible reason for the lack of reliable transit funding is the limited empirical evidence of transit's positive health cost effects for individuals and the population at large. Improvements to personal health not only improve individuals' lives but also reduce public expenditures (e.g., public funds spent on subsidized health care coverage), private

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industry costs (e.g., lost productivity), and inflation (DeVol, 2007). These impacts likely result in a benefits multiplier effect that is more pervasive than the current funding process acknowledges. Still, voters and decision makers have limited resources to allocate, making it critical to quantifiably demonstrate financial benefits. Transit costs are typically evaluated in terms of direct expenditures, revenues, and traveler accessibility gains. The additional consideration of transit-related health benefits would allow transit proponents to better demonstrate transit's true costs and benefits in order to enable sustainable revenue streams.

In light of transit's potential health-related impacts, this study explores the current level of understanding related to the physical activity implications of transit use and its associated health cost benefits. Not intending to be exhaustive, this paper presents the current state of the evidence and aims to contribute to the growing discussion in the emerging field of health and transportation. This is accomplished by first providing an extensive synthesis investigating the physical activity implications of transit. Building on these insights, the review then continues with a discussion of the health care costs associated with physical inactivity and the expenditures that may be reduced or avoided via increased transit use. Finally, the paper concludes with a discussion of review findings and conclusions about methodological considerations to advance research in these fields.

2. Health, physical activity, and transit

2.1. Health Implications of physical inactivity

There is a well-established body of literature examining the health effects of physical inactivity. Physical inactivity has been directly tied to negative health outcomes and an increased likelihood of early mortality. Most studies have linked physical inactivity with higher rates of obesity and being overweight, which increases the risk of cancer, heart disease, hypertension, and type 2 diabetes (Bijnen et al., 1994; Blair and Brodney, 1999; Hu et al., 2005; Lopez-Zetina et al., 2006; Warburton, 2006; Hamburg et al., 2007; Naci and Ioannidis, 2013; Zarr, 2014; Myrie and Daniel, 2014; Schiller, 2014; World Health Organization, 2014). According to the World Health Organization (WHO), physical inactivity is the main cause for as much as 25 percent of breast and colon cancer diagnoses (World Health Organization, 2014). These findings have now been strengthened by various extensive studies over the last several decades. For example, Hu et al. (2005) highlighted a strong independent effect of physical activity on mortality. Their results suggest an increased risk of mortality from cancer (among other disease processes) due to increased prevalence of physical inactivity. Another study by Naci and Ioannidis (2013) supported this notion, suggesting that physical activity health interventions had the same, if not greater, positive effect on mortality as prescription medication when used to treat chronic disease (e.g., heart disease, diabetes, and stroke recovery).

Risks related to physical inactivity affect all ages, races, genders, cultures, and socioeconomic strata (World Health Organization, 2014). Additionally, physical inactivity is so pervasive in developed nations that some experts suggest population-wide interventions (Sallis et al., 1998). Ongoing physical activity is necessary for long-term health sustainability for individuals, communities, and nations. Simple reductions in body weight or brief bouts of a physically active lifestyle may not be enough to maintain a healthful condition (Blair and Brodney, 1999, Hamburg et al., 2007). Instead, repetitive physical activity (e.g., activity associated with regular transit use) integrated into daily routines is necessary to achieve longstanding benefits (U.S. Department of Health and Human Services, 2008).

2.2. Transit and self-reported physical activity

The Centers for Disease Control (CDC) and WHO recommend a minimum of 150 min of physical activity per week (The World Health Organization, 2010; Centers for Disease Control and Prevention, 2011). If a person is active for 30 min per day, the amount of weekly physical activity recommended by CDC and WHO is achievable in five days—a typical work week. Because riders often walk or bicycle at either end of a transit trip, a higher transit mode share might serve as an effective way to integrate physical activity into daily routines on a broad scale.

The amount of walking or bicycling conducted for transit varies depending on a number of factors including location, level of transit service, transportation alternatives, and land use characteristics. In less vehicle-dominated areas of the world, walking associated with transit use can be quite prevalent. Travel surveys conducted by Olvera et al. (2013) in Guinea and Cameroon indicated that walking and public transit had combined mode shares of 94 percent and 98 percent, respectively, and approximately 20 percent reported walking trips paired with transit. Additional survey data from Lomé, Togo, where public transit is primarily comprised of motorcycle taxis or shared taxis, found that over 10 percent of transit trips comprised a walking segment of at least 10 min. Across a number of African cities, bus riders report walking approximately 10 min to reach a transit stop, though many walk much longer distances out of necessity (Kumar and Barrett, 2008). In Cape Town, South Africa, walking distances to transit are longer than in most cities, with an average of 1.4 km for bus trips and 2.1 km for rail (Hitge and Vanderschuren, 2015). In contrast, BRT riders in Bangkok walk an average of just 0.4 km to access the bus, often relying on motorcycle taxis for longer access journeys (Chalermpong and Ratanawaraha, 2015).

Bicycling as an access or egress mode for transit can also be used to support daily physical activity goals while increasing the catchment area around a station (Ensor et al., 2010), making transit more accessible to a greater number of users. In areas where bicycle mode share is low, the proportion of riders using a bicycle for the access or egress trip typically follows suit. Research in the United Kingdom, Rio de Janeiro, and Singapore has revealed that transit access trips by bicycle are uncommon, at approximately 2 percent mode share (Martens, 2004; Souza et al., 2010; Tay, 2012; Sherwin and Parkhurst, 2013). In contrast, more bicycle-supportive regions demonstrate the potential for complementary interactions between bicycling and transit. In Nanjing, bicycle access and egress rates at metro stations range between 5–12 percent (Chen et al., 2012), while Munich and Copenhagen have bicycle access rates of 13 percent and 26 percent, respectively. The Netherlands, in particular, has been a leader in bicycle-supportive policy and infrastructure, leading to a 38 percent bicycle mode share for rail access trips and 10 percent for egress trips (Givoni and Rietveld, 2007). Because it is typically easiest to ride a bicycle to a station and park it, bicycling for the access trip can be as much as six to eight times higher than the egress trip (Martens, 2004).

When converted to travel times, the distances covered on bicycle for paired bicycle/transit trips are roughly equivalent to the previously reported transit walking times. Martens (2004) found that bicycle access trips are typically as long as 4–5 km, which is in line with the findings of Sherwin and Parkhurst (2013), who reported an average distance of 3.7 km for rail access trips by bicycle in the United Kingdom. Similarly, transit riders in Philadelphia and San Francisco who bicycled to or from transit reported a median bicycle trip distance of 3.2 and 5.3 km, respectively (Flamm and Rivasplata, 2014). Nearly all of these riders also reported that if unable to bike to transit they