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On the relationships between commuting mode choice and public health

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ABSTRACT

This paper studies the associations that may exist between commuting mode choice and public health. For this purpose, we used Community Health Survey data collected in New York City in 2010. Obesity, blood pressure, and diabetes are used as indicators of respondents' physical health, and Non-Specific Psychological Distress as an indicator of respondents' mental health. After rigorous statistical analyses, a binary probit model was fitted for each physical and mental health indicator to quantify the associations between different commuting modes and physical/mental health.

Results show that walking, as expected, is associated with a lower probability of obesity, hypertension, diabetes, and mental disorders (all statistically significant) when compared to using private transportation. Using subway is related to a lower probability of obesity and diabetes while using the city bus was linked with a higher probability of obesity (all statistically significant) compared to using personal vehicles. Finally, in comparison with using personal vehicles, working at home is associated with a higher probability of having mental disorders (statistically significant).

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1. Introduction

Traffic congestion yielded 6.9 billion hours of delay, 3.1 billion gallons of extra fuel consumption, and a total cost of \$160 billion in 2014 across the United States (Schrang et al., 2015). Passenger cars are among major contributors to traffic congestion, fuel consumption, and air pollution in the US metropolitan areas. In fact, about 88% of all US workers commute to their work place using passenger cars with 77% driving alone (Wener and Evans, 2011). These values are high and need to be reduced to alleviate traffic congestion and its side effects.

Encouraging drivers to choose other modes of transportation or to telework will reduce the number of passenger car commuters and is perceived to have positive influence on reducing traffic congestion and its side effects (Anderson, 2014; Litman, 2013; Sælensminde, 2004; Buekers et al., 2015). In this paper, we refer to walking and using transit systems as other “forms of commuting” and homeworking as an alternative to commuting.

Transportation decision makers keep developing policies that encourage commuters to use transportation modes other than passenger cars. However, these non-passenger-car transportation forms may influence travelers' physical and mental health, which are unknown and need to be quantified.

Transportation systems, as a major component of the physical environment, play an integral role in public health (Lindström, 2008; Sælensminde, 2004; Yan et al. 2015; Tainio, 2015). In fact, five determinants of public health include

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physical environment, social environment, lifestyle and health behaviors, medical care, and genetics (McGovern et al., 2014).

This paper studies potential associations between using different commuting forms and public health. In particular, we focus on private transportation, public transit, and active transportation as different forms of commuting and homeworking as an alternative, using a large sample of workers in New York City (NYC). To analyze the effects of various commuting forms on public health, a discrete choice model approach is used. Physical and mental health impacts of different commuting modes and homeworking are compared to those of private commuting mode.

In the remainder of this paper, a review of relevant literature is presented, the dataset is described, and the methods to quantify the impacts of different commuting modes on employees' health are detailed. Then, the discussion is followed by modeling results and concluding remarks.

2. Background

2.1. Passenger car effects on health

Reducing car use and increasing walking, cycling, and using public transportation in metropolitan areas can increase physical activity of travelers and reduce air pollution (Rojas-Rueda et al., 2012; Sælensminde, 2004). The majority of the literature we reviewed indicated that car commuting reduced travelers' physical activity level (Lachapelle and Frank, 2009; Samimi and Mohammadian, 2010).

In fact, MacDonald et al. (2010) showed that spending more time in passenger cars is associated with a statistically significant increase in obesity. Frank et al. (2004) reported that obesity increases about 6% for each hour spent in a car per day, and Stokols et al. (1978) showed that traffic congestion increases drivers' blood pressure. However, there is no consensus on the effects of car commuting on physical health, as some studies show car commuting has some positive health effects in comparison to other commuting modes. Williams et al. (2008) and Ellaway et al. (2003) showed that driving reduces physical stress and mortality rates significantly.

There is no agreement among different studies on the effects of car commuting on travelers' mental health either. Some studies have concluded that car commuting is more stressful and leads to a negative mood among drivers (Wener and Evans, 2011; Bellet et al., 1969; Ferenchak and Katirai, 2015; Gatersleben and Uzzell, 2007; Künn-Nelen, 2015; Rissel et al., 2014). They explain the results by reasoning that car drivers perceive their trip as more effortful and unpredictable than public transport commuters (Wener and Evans, 2011). On the other hand, Macintyre (2001) showed a significant association between car ownership and better mental health. In addition, it is shown that driving to work gives a positive feeling that individuals have control over their trip and they are more flexible than others (Anable and Gatersleben, 2005) and it provides a feeling of being more secure (Eriksson et al., 2013).

2.2. Public transportation effects on health

There seems to be an agreement on the effects of using transit systems on physical health. Public transport users tend to be physically healthier than car commuters as they meet the recommended level of physical activity more often (Rojas-Rueda et al., 2012; Lachapelle and Frank, 2009; Humphrey, 2005; Rundle et al., 2007; Liao et al., 2016; Sener et al., 2016). They walk significantly more than car commuters to reach transit stations (MacDonald et al., 2010; Humphrey, 2005; Wener and Evans, 2007). However, using public transport may harm older people physically due to non-collision injuries inside the vehicle (Kendrick et al., 2015).

There are different opinions about the impacts of public transportation on mental health. Some studies suggest that using public transportation causes travelers to experience a lower level of stress because they do not experience traffic congestion especially when they use train or light rail transit (Wener and Evans, 2011; Evans et al., 2002). In addition, living near reliable public transport facilities helps people to be less isolated as they have a chance to communicate with their friends or relatives through these facilities (Boniface et al., 2015). In contrast, it is deduced that crowded public transportation services increase physiological stress of travelers (Gatersleben and Uzzell, 2007; Singer et al., 1974; Cox et al., 2006).

2.3. Active transportation effects on health

Active commuters are defined as those who either walk or ride a bicycle to work. There is substantial evidence that active transportation leads to improvements in physical health. Active transportation is associated with a lower rate of being overweight or obese and meeting the recommended physical activity level (Edwards, 2008; Vuori and Oja, 1999; Merom et al., 2010; Oja et al., 1998; Kaczynski et al., 2012; de Geus et al., 2007; Dill, 2009; Scheepers et al., 2014; Liao et al., 2016). Rabl and de Nazelle (2012) indicated that active transportation helps reduce air pollution, which in turn contributes to reducing the risk of cancer (Litman, 2010). In addition, active transportation reduces the risk of cardiovascular diseases (Litman, 2010; Hamer and Chida, 2008; Genter et al., 2008; Scheepers et al., 2014). Schauder and Foley (2015) reported that active transportation has negative association with weight and cholesterol, but no significant impact on blood pressure and glycohemoglobin.

On the mental health effects, walking and cycling are perceived to be more exciting than other modes of transportation and help commuters feel more relaxed (Scheepers et al., 2014). Furthermore, active transportation leads to higher life

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