



An ecological study on means of transportation to work and obesity: Evidence from U.S. states



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ABSTRACT

Obesity has become a public health problem in the United States. Policymakers are concerned with effective ways of encouraging better nutrition and more physical exercise to combat increasing levels of obesity and overweight residents. Commuting to work can be an important means for regular physical activity. Based on an ecological approach, this paper examines the effects of means of transportation to work on the prevalence of overweight and obesity at the U.S. state level. This analysis extends the previous literature by including a series of transportation variables in a regression model examining state prevalence of overweight and obesity using the most recent panel data from 2004 to 2013. We find that increased automobile usage contributes to the rising trend in the prevalence of obesity and overweight among states. In contrast, active transportation to work (public transportation and walking) has a negative impact on state prevalence of obesity and overweight. The paper concludes with policy suggestions for combating obesity and overweight by integrating public health objectives into the transportation planning and investment process.

1. Introduction

The prevalence of obesity has become a major public health concern in the United States in recent years. Data from the U.S. Centers for Disease Control and Prevention (CDC) reveals that obesity rates in the U.S. are consistently rising despite a wide range of campaign efforts to reduce the rate. In fact, the U.S. CDC, 2016 reports that 36.5% of U.S. adults in 2015 were obese. Moreover, that rate was an increase of 17% from 2000 and 13.4% from 2005. The growing numbers of obese citizens, along with obesity-related diseases and health problems have contributed to a tremendous increase in U.S. healthcare costs. The estimated annual medical cost of obesity in the U.S. was \$147 billion and the medical costs for obese persons was \$1,429 higher than those of normal weight persons (U.S. CDC, 2016).

Combating rising obesity levels is a critical undertaking for the nation. There is sufficient evidence to support the claim that the decline in physical activity is a key contributor to the obesity epidemic (e.g., Jacobson et al., 2011; U.S. Transportation Research Board, 2005, 2012). Commuting to work is an important means for regular physical activity as well as walking and bicycling for daily transportation (e.g., Morency et al., 2011; Mokdad et al., 2004). Commuting to work by public

transportation may also lead to a substantial level of physical activity through walking or riding to a transit station or transit stop (e.g., Besser and Dannenberg, 2005; Franks et al., 2004; Morency et al., 2011). Thus, bicycling, walking, and public transportation have been recommended as a healthy means of transportation to work (e.g., Bassett et al., 2008; Lee and Sener, 2016; U.S. Transportation Research Board, 2012).

Since the 1960s, due to increased automobile ownership and use, Americans have become more automobile dependent and more favorable towards automobile travel. This trend in travel behavior is associated with a dramatic decline in physical activity level (Jacobson et al., 2011; U.S. Transportation Research Board, 2005). Several academic studies found that automobile dependence and the dramatic decline in active transportation (walking and public transportation) have contributed to the rise in obesity at the local and national levels (e.g., Bell et al., 2002; Franks et al., 2004; Jacobson et al., 2011). Despite these findings, there is an absence of research examining the relationship between commuting to work and the prevalence of obesity at the state level (U.S.). This void in the research is important because the prevalence of obesity varies widely across the American states. In order to fill the gap in the literature, this research explores the impact of transportation mode to work on obesity and overweight rates using panel data from the 50 states from 2004 to

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2013. Given the widely expressed concern about the epidemic of obesity, research about the effects of transportation mode choices on obesity is timely and important. The research adds significant value to the transportation literature in three key ways. First, it expands our understanding of the determinants of obesity and overweight. Second, it empirically explores how different means of transportation to work matter for the prevalence of obesity and overweight among states. Third, this research offers practical policy suggestions for combating obesity and overweight by integrating public health objectives into the transportation planning and investment process.

2. Research background: trends in travel behavior of Americans

In 1910, less than 10 percent of the nation's population lived in suburbs, but as automobiles became more affordable and populations migrated to suburbs, more people came to rely on their cars for transportation. By 2010, more than 50 percent of the U.S. population lived in suburban communities, thus increasing the average distances of daily commutes to work (Population Reference Bureau, 2011). Table 1 shows that the number of licensed drivers increased by 141% from 87 million in 1960 to 210 million in 2010. The annual growth rate in the number of licensed drivers is nearly twice the population growth. In addition, the share of drivers in the total population increased from less than half (48.33%) of the total population to more than two thirds (68%) during this period. More importantly for this research, the number of registered vehicles more than tripled from 1960 to 2010, which subsequently led to a four-fold increase in the number of miles traveled by automobile.

Due to increased automobile ownership and use, Americans have become more automobile dependent and clearly have a tendency to favor the automobile over other forms of travel. When automobile use is compared to other forms of transportation, the difference is remarkable over time. Fig. 1 shows that the percentage of personal transportation usage is increasing as other forms of transportation have decreased since 1960. More specifically, in 1960, only 64% of the population drove an automobile to work. Meanwhile, 12.1% people took public transportation to work, and nearly 10% walked to workplaces. In contrast, by 2010, 86.3% of the working population drove an automobile to work while less than 5% of population used public transportation. Additionally, the share of people walking to work decreased to 2.80%. In sum, despite the significant health benefit of commuting to work by walking, bicycling and public transportation, driving by private car to work has been the dominant mode of commuting to work in the U.S. since the 1960s. The trend in travel behavior indirectly points to a decline in physical activity levels associated with the over-reliance on automobile travel (U.S. Transportation Research Board, 2005).

Note: Automobile use includes: cars, trucks, or vans-drove alone and carpools. Other means include: taxicabs, motorcycles, bicycles, or other means of motorized transportation.

3. Review of past research and analysis

The number of studies examining the public health effects of transportation mode choice has increased in recent years. A few studies found

that automobile dependence and the dramatic decline in active transportation (walking, bicycling, and public transportation) has contributed to the rise of obesity. One of the earliest studies assessed the impact of motorized transportation on obesity levels in China (Bell et al., 2002). Using a multistage randomized cluster sample, Bell et al. (2002) found that the odds of being obese were higher for men and women in households where a motorized vehicle was present compared to those where a vehicle was not present. When comparing men who eventually acquired a vehicle to those who did not, Bell et al. (2002) noted that they were more likely to gain weight and had a 2 to 1 odds of becoming obese.

Franks et al. (2004) examined the relationship between the built environment around each observation's place of resident, self-reported travel patterns, and obesity rates using data from a travel survey of 10,898 participants in the Atlanta area. They found that obesity in this area, as measured by body mass index (BMI), is positively associated with the amount of time spent in cars and negatively associated with mixed land-use and with walking. Overall, individuals who walked greater distances were less likely to be obese.

Based on a sample of riders who embarked from three New Jersey Transit (NJT) train stations in Bergen County, New Jersey, Green et al. (2005) contended that the new public transit stations were associated with a greater likelihood of using mass transit, which led to more physical activity. Edwards (2008) analyzed the 2001 National Household Travel Survey data and found that walking associated with utilizing public transit can lead to substantial lower levels of obesity. That is, individuals who walk from the public transit station and walk to work were less likely to be obese. In addition, he found that increases in the use of public transportation can also lead to decreases in medical costs.

Using a cross-country survey data set from 1994 to 2006, Bassett et al. (2008) found that countries with high rates of automobile use were more likely to have higher levels of obesity while countries with higher levels of active transportation were less likely to be obese. That is, people who used public transportation were more likely to couple this activity with walking or cycling. MacDonald et al. (2010) found similar evidence when examining the use of light rail in the city of Charlotte, North Carolina. Jacobson et al. (2011) also found that an increase in daily driving was positively correlated with an increase in obesity. However, they also determined that a decrease in driving had to be accompanied with an increase in active modes such as walking or cycling in order to lower obesity levels. Hess and Russell (2012) examined the influence of built environments and transportation access on the body mass index (BMI) of older adults (age 50 years or more). Based on a sample of 344 older adults in the Erie County, New York, they found that access to public transportation—measured by the density of nearby bus stops—had an inverse and statistically significant relationship with the BMI among older adults. They concluded that public transportation access could play a greater role in the overall activity levels and BMI of older adults.

Most recently, two studies have explored the health benefits of active transportation in an urban environment. Using a cross-sectional study based on the 2011 Barcelona Health Survey (ESB, 2011), Olabarria et al. (2014) tested the relationship between mobility and overweight and obesity in an urban context, taking into account physical activity levels in

Table 1
Vehicle registrations, drivers, and VMT: 1960–2010.

	Year					
	1960	1970	1980	1990	2000	2010
Population (Millions)	180	204	227	248	285	309
Drivers (Millions)	87	112	145	167	191	210
% of Drivers in Total Population	48.33%	54.90%	63.88%	67.34%	67.02%	67.96%
Vehicles Registered (Thousands)	73,858	111,242	161,490	193,057	225,821	242,061
Number of Vehicles per Driver	0.85	0.99	1.11	1.16	1.18	1.15
Vehicle-miles traveled (Millions)	718,762	1,109,724	1,527,295	2,144,362	2,746,925	2,966,506
Average miles traveled per vehicle (Thousands)	9.7	10.0	9.5	11.1	12.2	12.3

Source: U.S. Department of Transportation (DOT), 2010 National Highway Statistics.

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