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Demand response to improved walking infrastructure: A study into the economics of walking and health behaviour change

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ABSTRACT

Walking is the most common form of moderate-intensity physical activity among adults, is widely accessible and especially appealing to obese people. Most often policy makers are interested in valuing the effect on walking of changes in some characteristics of a neighbourhood, the demand response for walking, of infrastructure changes. A positive demand response to improvements in the walking environment could help meet the public health target of 150 min of at least moderate-intensity physical activity per week. We model walking in an individual's local neighbourhood as a 'weak complement' to the characteristics of the neighbourhood itself. Walking is affected by neighbourhood characteristics, substitutes, and individual's characteristics, including their opportunity cost of time. Using compensating variation, we assess the economic benefits of walking and how walking behaviour is affected by improvements to the neighbourhood. Using a sample of 1209 respondents surveyed over a 12 month period (Feb 2010–Jan 2011) in East Belfast, United Kingdom, we find that a policy that increased walkability and people's perception of access to shops and facilities would lead to an increase in walking of about 36 min/person/week, valued at £13.65/person/week. When focussing on inactive residents, a policy that improved the walkability of the area would lead to guidelines for physical activity being reached by only 12.8% of the population who are currently inactive. Additional interventions would therefore be needed to encourage inactive residents to achieve the recommended levels of physical activity, as it appears that interventions that improve the walkability of an area are particularly effective in increasing walking among already active citizens, and, among the inactive ones, the best response is found among healthier, younger and wealthier citizens.

1. Introduction

An increasing proportion of the population being overweight or obese in most Western societies is leading to a significant burden on society and contributing to the rise of conditions such as diabetes, cardiovascular disease and cancer (James et al., 2004; WHO, 2011). Physical activity levels are on the decline in Northern Ireland, as in other countries, including England, (Farrell et al., 2013; Sport N.I., 2010), with 60% of the local adult population not meeting the recommended levels of activity (DHSSPS, 2011). Physical inactivity, in addition to unhealthy diet, has fuelled the rising level of obesity within the population, with 59% of adults in Northern Ireland either overweight or obese (DHSSPS, 2011). Obesity has become an economic burden as well as a major health problem (Müller-Riemenschneider et al., 2008) and, as a result, governments and public health agencies are diverting considerable resources to prevent obesity and promote healthy lifestyles (DHSSPS, 2006; Butland et al., 2007; DHSSPS, 2010). The UK Department of Health recommends that adults should aim to be physically active on a daily basis and over the period of a week should aim to achieve at least 150 min of moderate intensity physical activity in bouts of 10 min or more (DoH, 2011). Significant health consequences arise from not meeting the recommended levels of activity, including

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higher relative risk (adjusted for known confounders) of coronary heart disease, type 2 diabetes, breast cancer, colon cancer and all-cause mortality (Lee et al., 2012). However if the recommended guidelines for physical activity are met, then the population can expect a lower average body mass index (BMI), a reduced incidence of lifestyle diseases related to obesity, such as type 2 diabetes mellitus and high blood pressure, and lower associated healthcare costs (Frank et al., 2009; Auchincloss et al., 2009; Ogilvie et al., 2007).

Walking is the most common form of moderate-intensity physical activity among adults (Siegel et al., 1995; Eyler et al., 2003; Ogilvie et al., 2007; Sport N.I., 2010), is widely accessible and especially appealing to obese people, who are less likely to perform vigorous-intensity physical activity (Erlichman et al., 2002). It is an aerobic exercise that confers the diverse health benefits of physical activity with few adverse effects (Morris and Hardman, 1997). Several studies have confirmed that walking reduces the development of cardiovascular diseases (Jones and Eaton, 1994; Albright and Thompson, 2006; Boone-Heinonen et al., 2009), even though the health improvements are smaller for obese people (Boone-Heinonen et al., 2009).

Many factors influence or facilitate the choice to walk for either travel or recreational purposes, including the availability of footpaths, the attractiveness of the route (e.g. interesting facades, a variety of architecture, the absence of long, blank walls), route choices for variety and safety, the number of destinations within a walkable distance (e.g. work places or nearby shops), and the opportunity cost of walking. Walking interventions include education and encouragement, as well as infrastructure investments, such as better street lighting, improved footpaths, and the creation of attractive green open spaces. Behavioural changes can arise from the increases in access, attractiveness, safety, comfort and security that these improvements offer (Krizek et al., 2009).

Interventions aimed at increasing walking have been shown to be effective (Ogilvie et al., 2007), but policy makers making investment decisions aimed at improving the infrastructure for walking may wish to consider the costs and the benefits of such interventions (Dallat et al., 2014). Whilst their costs can be relatively easily quantified using market data, the monetary benefits of such interventions, in terms of increased walking, are more difficult to assess and estimate (Litman, 2003). One notable exception is the World Health Organization's Health Economic Assessment Tool (HEAT) for estimating the monetary health benefits from reduced mortality from interventions aimed at increasing walking and cycling (Kahlmeier et al., 2010; WHO, 2014). This paper aims to quantify such benefits in monetary terms and to answer the following questions. What is the monetary value and the demand for walking in an individual's neighbourhood? How are these monetary benefits and demand affected by the characteristics of the neighbourhood, and by its improvements? What is the value of the health benefits that might accrue from the additional walking associated with the demand response to neighbourhood improvements? How do these benefits vary for respondents with different health levels?

We address these questions by proposing an economic model of walking, based on the assumption that walking in a neighbourhood is affected by the characteristics of the neighbourhood itself, substitutes for walking in the neighbourhood and that walking is a function of the value of time.

In the next section, we review previous studies on the economics of walking. Section three describes our economic model for walking. Section four presents the case study of walking in East Belfast, Northern Ireland. The results of the econometric analysis are reported in section five, with section six presenting forecasts of demand response (resulting behaviour change) and welfare calculations. Section seven concludes with a discussion of the results and suggestions for further research.

2. The economics of walking

Several studies have successfully modelled the economics of walking, spanning the well developed disciplines of outdoor recreation (see Burt and Brewer, 1971; McConnell and Strand, 1981; Herriges and Kling, 1999), active transportation (see Button, 2010), and health related physical activity (Humphreys and Ruseski, 2007, 2011). Jones and Eaton (1994), investigating how walking affects the relative risk of developing coronary heart disease, found that if all inactive people began walking regularly, the US would save US$4.3bn annually. Other studies have focussed on both cycling and walking. Sælensminde (2004) conducted a cost–benefit analysis of walking and cycling track networks in three Norwegian cities taking into account insecurity, health effects and external costs of motorized traffic. The health-economic benefits from both walking and cycling varied considerably between the three cities and ranged between US$16 million and US$258 million. Wang et al. (2004) compared direct medical costs between active and inactive people to assess costs and benefits of building and maintaining new bike/pedestrian trails, finding a benefit cost ratio of 2.94. Sustrans (2006), in a cost–benefit analysis of three walking and cycling routes, found benefit cost ratios ranging between 14.9 and 32.5.

The HEAT for walking and cycling (Rojas-Rueda et al., 2011; De Hartog et al., 2010; Kahlmeier et al., 2010; WHO, 2014) addressed the question "If x people cycle or walk for y minutes on most days, what is the economic value of the health benefits that occur as a result of the reduction in mortality due to their physical activity?" (WHO, 2014, page 14). It is based on the value of a statistical life and provides a tool to estimate the health benefits in terms of mortality reduction from walking or cycling interventions. Using the HEAT method, Rabl and De Nazelle (2012) found that for a driver who switches to cycling or walking for a commute of 5 km (one way) 5 days/week 46 weeks/year the health benefit from the physical activity is worth about 1200 €/year, even though it may be questionable whether a person would actually walk 10 km/day for commuting purposes.

Other studies have used the hedonic price method, focussing on "walkability" – the quality of walking conditions, including safety, comfort and convenience – and how this is affected by development density, land use mix, provision of public open space and pedestrian infrastructure (Cortright, 2009; Sohn et al., 2012). Such studies have found that house prices in more walkable neighbourhoods are about US$4000 – US$34,000 higher than houses located in areas with average levels of walkability.

Although the economics of walking may have been relatively overlooked by health economists, it has been extensively investigated in transportation economics and the economics of outdoor recreation. The transportation literature has most commonly used a value of time trade-off method to compare different transportation modes including walking (see Beesley, 1965; Wardman, 1998; Small and Verhoef, 2007). Walking is not a popular transportation mode, unless for very short journeys, and is often only considered in conjunction with a second transportation mode – walking and driving, walking and travelling by bus, or walking and travelling by train – as walking alone is impracticable for longer journeys (Litman, 2003).

The economic value of outdoor recreation sites, including walking facilities has been extensively studied, first using a revealed preference method, the travel cost method, (McConnell and Strand, 1981; Bockstael et al., 1987; Herriges and Kling, 1999; Abidoye et al., 2012) and then using stated preference methods,