Impact of New Transport Infrastructure on Walking, Cycling, and Physical Activity

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Introduction: Walking and cycling bring health and environmental benefits, but there is little robust evidence that changing the built environment promotes these activities in populations. This study evaluated the effects of new transport infrastructure on active commuting and physical activity.

Study design: Quasi-experimental analysis nested within a cohort study.

Setting/participants: Four hundred and sixty-nine adult commuters, recruited through a predominantly workplace-based strategy, who lived within 30 kilometers of Cambridge, United Kingdom and worked in areas of the city to be served by the new transport infrastructure.

Intervention: The Cambridgeshire Guided Busway opened in 2011 and comprised a new bus network and a traffic-free walking and cycling route. Exposure to the intervention was defined using the shortest distance from each participant's home to the busway.

Main outcome measures: Change in weekly time spent in active commuting between 2009 and 2012, measured by validated 7-day recall instrument. Secondary outcomes were changes in total weekly time spent walking and cycling and in recreational and overall physical activity, measured using the validated Recent Physical Activity Questionnaire. Data were analyzed in 2014.

Results: In multivariable multinomial regression models—adjusted for potential sociodemographic, geographic, health, and workplace confounders; baseline active commuting; and home or work relocation—exposure to the busway was associated with a significantly greater likelihood of an increase in weekly cycle commuting time (relative risk ratio=1.34, 95% CI=1.03, 1.76) and with an increase in overall time spent in active commuting among the least active commuters at baseline (relative risk ratio=1.76, 95% CI=1.16, 2.67). The study found no evidence of changes in recreational or overall physical activity.

Conclusions: Providing new sustainable transport infrastructure was effective in promoting an increase in active commuting. These findings provide new evidence to support reconfiguring transport systems as part of public health improvement strategies.

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Introduction

Physical inactivity is a major contributor to morbidity and mortality, and increasing regular physical activity—particularly among the least active—is likely to improve the health of individuals and populations.[1,2] However, there is a lack of clear evidence of effective strategies to achieve this.[3] Public health advocacy increasingly focuses on active travel as a target for intervention, and active commuting offers a comparatively easy way to integrate exercise into daily life.[3] People who walk or cycle to work or commute by public transport tend to be more physically active, and to have

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more favorable body composition and cardiovascular risk, than those who do not.[4–6] However, few studies have evaluated the effects of reconfiguring transport systems in favor of active travel, leaving major scientific uncertainty around how the projected health and environmental benefits can be realized in practice.[3,7]

It is often difficult or impossible to evaluate the effects of large-scale changes to the built environment using RCT methods. This calls for the use of quasi-experimental study designs, which present particular challenges in relation to defining exposure, constructing controlled comparisons, and minimizing the impact of residual confounding.[8] In addition, previous intervention studies in this area have often been limited by insufficient follow-up periods or imprecise measures of the duration or volume of activities, which are important for estimating their health impacts.[7,9–11] Recent guidance illustrates how "natural experiments" can be used to generate more-robust evidence of the effects of environmental changes despite these challenges, and provides a framework for the design and analysis of studies in this area.[8]

This study used quasi-experimental methods to test the hypothesis that exposure to new infrastructure to promote walking, cycling, and public transport—the Cambridgeshire Guided Busway—would result in an increase in time spent walking and cycling on the commute and higher levels of overall physical activity. The secondary aim was to investigate the extent to which these effects differed between population subgroups. A complementary paper describes the broader impacts of the intervention on travel mode share.[12]

Methods

The Intervention: the Cambridgeshire Guided Busway

The Cambridgeshire Guided Busway is a major transport infrastructure project comprising a new bus network and an adjacent 22-kilometer traffic-free walking and cycling route in and around Cambridge, described in detail elsewhere (www.thebusway.info).[13] For much of the route, buses run on a guideway completely segregated from other traffic, but in places—notably for approximately 5 kilometers through the city center—they use the existing road network (Appendix File 1, available online). The path can be accessed at bus stops and other points along the route. Construction began in March 2007, and although completion was scheduled for summer 2009, in fact the busway was opened more than 2 years late on August 7, 2011.

Study Design, Setting, and Participant Recruitment

The authors evaluated the busway using a quasi-experimental analysis nested within a cohort study of commuters, the Commuting and Health in Cambridge study. The methods for participant recruitment and data collection[13,14] and baseline findings[15] have been reported elsewhere. Briefly, participants aged ≥16 years who worked in areas of Cambridge to be served by the busway and lived within approximately 30 kilometers of the city were recruited before the busway was completed, through a predominantly workplace-based strategy (Appendix File 2, available online). The Hertfordshire Research Ethics Committee approved the study and the baseline data collection (reference number 08/H0311/208) and the Cambridge Psychology Research Ethics Committee approved the follow-up data collection (reference number 2014.14). All participants provided written informed consent.

Data Collection

Participants received a baseline postal questionnaire[15] between May and October 2009 and annual follow-up questionnaires, matched to the same week of the year, when possible. Because the busway was not opened until August 2011, the 2012 survey was used for the follow-up measure in these analyses (Appendix File 3, available online).

Measures

At both time points, participants reported all travel modes used on the commute in the last 7 days; if they had walked or cycled any part of their journeys, they also reported the average time spent doing so per trip. Total weekly time spent walking and cycling on the commute was computed and shown to have acceptable validity, with only a small mean overestimation compared with objective measures for walking (2.37 minutes/trip) and cycling (1.12 minutes/trip).[16] The criteria used to assess commuting data quality, and therefore inclusion in analysis, are given in Appendix File 2 (available online).

Participants completed the Recent Physical Activity Questionnaire (RPAQ), which uses comparatively simple validated measures to assess activities across the intensity spectrum at home, at work, for recreation, and for transport in the last 4 weeks.[17] The three derived outcomes variables were total weekly time spent: walking and cycling for commuting and recreation, in recreational moderate-to-vigorous physical activity, and in overall physical activity (Appendix File 2, available online).

Descriptive spatial analysis of the sociodemographic and behavioral characteristics of the cohort suggested that comparable intervention and control groups could not be created based crudely on area of residence,[18] so the authors used an individual measure of proximity to represent exposure to the intervention. It was hypothesized that the intervention could promote walking and cycling either as modes of travel along the path or as feeder modes to the bus service. Using ArcGIS, version 9.1, the distance from each participant's home to the nearest busway stop or path access point (whichever was closer) was computed using any combination of the road network and traffic-free or informal paths represented in the Ordnance Survey's Integrated Transport Network and OpenStreetMap. As use of the busway decreased nonlinearly with distance,[18] exposure was modeled as the square root of the negative of the distance.

Participants reported the characteristics shown in Table 1 at baseline. At follow-up, participants were also asked about any life events, such as pregnancy or changes in caring responsibilities, in the last year.