

Institution: University of Cambridge		
Unit of Assessment: 2 Public Health, Health Services and Primary Care		
Title of case study: Improving population health by promoting physical activity through transport decision-making, policy and planning		
Period when the underpinning research was undertaken: 2007-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
David Ogilvie James Woodcock	Programme Leader Reader in Transport and Health Modelling	May 2013 – present Jul 2011 – present
Marko Tainio Jenna Panter Oliver Mytton	Senior Research Associate Senior Research Associate Academic Clinical Lecturer	Nov 2013 – Jun 2019 May 2013 – present Oct 2013 – Sep 2020
Period when the claimed impact occurred: 2014-present		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
<p>Insufficient physical activity is a major contributor worldwide to poor health. University of Cambridge research has strengthened the evidence about how to increase activity by supporting the switch to more active forms of everyday travel, such as walking and cycling. By demonstrating the link between low levels of activity and poor health, and by demonstrating the effectiveness of changing the environment to increase activity, Cambridge research has profoundly impacted on policy in the UK and globally. Its development of highly practical, actionable tools has directly supported better planning and targeted expenditure by local-level decision-makers, delivering health and economic benefits and helping reduce CO₂ emissions.</p>		
2. Underpinning research (indicative maximum 500 words)		
Physical inactivity: a global public health problem		
<p>Physical inactivity directly contributes to 1 in 6 deaths in the UK and costs GBP7.4 billion a year (Public Health England statistics). Only two-thirds of men and 58% of women take 150 minutes' physical activity per week (Health and Social Care Information Centre statistics) – the minimum recommended. One way to facilitate large-scale increases in activity is by changing the way transport systems and policies are designed and implemented to support active travel (such as walking and cycling to commute). Active travel is more likely to ensure more people routinely exercise than focusing solely on sport, which only engages a minority of people.</p> <p>Redesigning transport to improve population health, reduce health inequalities, and protect the environment from CO₂ emissions requires that policymakers have robust evidence and useful tools to support strategies to shift people towards active transport, factor health gains from physical activity into transport decisions, and prioritise investment in infrastructure. By developing new modelling tools and evaluating the impact of real-world interventions, research by the University of Cambridge has addressed this need.</p>		
Strengthening the case for physical activity and health in transport		
<p>University of Cambridge research at the Centre for Diet and Activity Research (CEDAR) in the MRC Epidemiology Unit has been important in showing the link between walking and cycling for transport and improved mental and physical health outcomes [1]. Its work has shown that commuting to work on foot or bike reduces the risk of heart attack and stroke [2].</p> <p>This Cambridge team has also generated the evidence for solutions that can improve levels of physical activity [1,3,4], focusing particularly on how the design of the transport environment can stimulate people to engage in more active forms of travel. The team has evaluated major travel initiatives such as the Cambridgeshire Guided Busway (22km of segregated bus track plus traffic-free walking and cycling) [1], and Connect2 (a major project</p>		

promoting walking and cycling routes at 79 sites around the UK) [3,4]. These studies show that, by targeting walking and cycling, environmental interventions can increase walking and cycling without reducing other physical activity, boosting physical activity by around 45 minutes per week [3]. They also show that new walking and cycling routes and new public transport encourage people who are less active – as well as those already active – to walk or cycle more [1,4].

Quantifying health impacts and modelling solutions

Cambridge researchers have developed new methods, models and tools to estimate health impacts of transport interventions and scenarios. These innovations allow cycling potential to be estimated, model the population benefits of sustainable travel, and quantify trade-offs between injury risk, air pollution exposure and physical activity. These evidence-based approaches include the **Integrated Transport and Health Impact Modelling Tool (ITHIM)** [5], which allows policymakers to visualise the health and environmental impacts of different walking and cycling scenarios, in the UK and beyond [6,7].

The **Propensity to Cycle Tool (PCT)** study and interactive tool (www.pct.bike), which was led by Cambridge University with Leeds and Westminster universities, and co-produced with the Department for Transport [8], offers new methods to estimate cycling potential and new ways of handling 'big data' on transport systems, including new methods of visualising millions of routes. A key feature of the tool is that it is open source, facilitating the creation of scenarios and deployment in new contexts.

3. References to the research (indicative maximum of six references)

1. **Ogilvie D, Panter J**, Guell C, et al. Health impacts of the Cambridgeshire Guided Busway: a natural experimental study. *Public Health Res* 2016; 4(1).*
2. **Panter J, Mytton C**, Sharp S, et al. Using alternatives to the car and risk of all-cause, cardiovascular and cancer mortality. *Heart* 2018; 104(21): 1749–1755.*
3. Goodman A, Sahlqvist S, **Ogilvie D**, on behalf of the iConnect Consortium. New walking and cycling routes and increased physical activity: one- and 2-year findings from the UK iConnect study. *Am J Public Health* 2014;104(9):e38-e46.*
4. **Panter J, Ogilvie D**. on behalf of the iConnect consortium. Can environmental improvement change the population distribution of walking? *J Epidemiol Community Health*.2017; 71(6), 528-535.*
5. **Woodcock J**, Givoni M, Morgan A. Health Impact Modelling of Active Travel Visions for England and Wales Using an Integrated Transport and Health Impact Modelling Tool (ITHIM) *PLoS One* 2013; 8(1): e51462.*
6. Maizlish N, **Woodcock J**, et al. Health Cobenefits and Transportation-Related Reductions in Greenhouse Gas Emissions in the San Francisco Bay Area. *AmJPH* 2014; 104(9), e38-e46.*
7. Hérick de Sá T, **Tainio M**, Goodman A, Edwards P, Haines A, Gouveia N, Monteiroa C, **Woodcock J**. Health impact modelling of different travel patterns on physical activity, air pollution and road injuries for São Paulo, Brazil. *Environ International* 2017;108:22-31.*
8. Lovelace R, Goodman A, Aldred R, Berkoff N, Abbas A, **Woodcock J**. The Propensity to Cycle Tool: an open source online system for sustainable transport planning. *Journal of Transport and Land Use* 2017; 10(1): 505-528.*

*These publications have been peer-reviewed, providing evidence of research quality.

Competitive funding received

Medical Research Council. Physical activity and public health [unit core programme]. GBP3.5M, 1/4/15 – 31/3/20. (PI: **D Ogilvie**)

NIHR Public Health Research Programme. Health impacts of the Cambridgeshire Guided Busway (Commuting and Health in Cambridge). GBP1.3M, 1/1/10 – 30/2/15. (PI: **D Ogilvie**)

UK Clinical Research Collaboration. Centre for Diet and Activity Research. GBP5M, 01/10/08 – 30/09/13; renewal: GBP4.2M, 01/10/13 – 30/09/18. (PI: N Wareham; Co PI: **D Ogilvie**)

Department for Transport. National Propensity to Cycle Tool Project (stages 1-3), 2015-2019:

GBP500k (PI: **J Woodcock**)

MRC Population Health Scientist Fellowship 2013-2016 GBP309K 01/0713 30/06/16 (PI: **J Woodcock**)

4. Details of the impact (indicative maximum 750 words)

Improving population health by embedding physical activity in transport policy

Globally, a quarter of adults do not meet the World Health Organization (WHO) recommendations on physical activity for health (WHO statistics). Yet regular physical activity is important in the prevention and treatment of the leading diseases, including heart disease, stroke, diabetes, and some cancers. Physical activity also has a key role in controlling risk factors such as high blood pressure, overweight and obesity, and is associated with improved mental health, delay in the onset of dementia, and improved quality of life and well-being. Beyond health, increasing participation in physical activity has multiple social and economic benefits and can contribute to achieving the United Nations' 2030 Sustainable Development Goals (Lancet Global Health 2018). University of Cambridge research has had a major impact on promoting active travel as a means of increasing physical activity, informing debate and shaping policy and practice at local, national and international levels through evidence and practical tools.

Improving international transport policymaking

The ITHIM (the Integrated Transport and Health Impact Modelling tool), first developed for use in England, has been widely used in policy and practice worldwide [A].

In the USA, the Cambridge team has worked closely with the California Department of Public Health on ITHIM since 2013 [6]. The collaboration enabled California (the most populous state in the USA) to complete its own version of ITHIM, which was implemented in the San Francisco Bay Area, southern and central California between 2013 and 2015. The California Department of Transport includes ITHIM as part of the suite of tools used by regulatory transport authorities to update their transport plans. Following its success in California, ITHIM has been implemented by health and transport authorities in at least six other US states, with a combined population of 59 million [B].

Working with the WHO's Urban Health Initiative, the Cambridge team adapted ITHIM for use in several low-and-middle income countries, including Malaysia, Ghana, India and Brazil [7,C]. ITHIM thus became the first tool of its kind to be used in low-and-middle income countries, where it is shaping debate around transport and health, enabling collaboration between transport and health practitioners, and aiding local decision-making by quantifying the health benefits of transport interventions [C].

The team had a major impact on the WHO's Health Economic Assessment of Transport Walking and Cycling (HEAT) tool, recent versions of which (since 2014) are informed by ITHIM. The Cambridge team members served on the core working group as invited experts. They were involved in developing HEAT 4.0 (2017), which incorporates impacts on injuries and air pollution and is used around the world (for example, across 15 countries in Europe) to assess the health and health economic impact of walking and cycling interventions [D].

UK national policy impact: influencing and improving transport decision-making

Through long-standing relationships with transport policymakers at every level, the Cambridge team has ensured that its research is embedded in UK government guidance spanning transport and public health.

The team's work on active travel has directly impacted the Department for Transport's (DfT) thinking, its appraisal methods, and its cycling and walking policies. Its close working relationship has led to the DfT revising how it calculates financial benefits of living longer and healthier lives, enabling the DfT to make a stronger economic case for walking and cycling. In turn this has underpinned local investment decisions (see below). According to the DfT's former Deputy Director of Sustainable Travel, "[the Cambridge team's] work on physical activity [...] is having clear impact on DfT's cycling policy development, [...] and] helping to

make the investment case for cycling and walking significantly more attractive” [E].

Cambridge University research and outputs are central to the delivery of the UK government’s 2017 Cycling and Walking Investment Strategy, which is investing GBP2 billion in walking and cycling. This nationwide government strategy encourages local authorities to use the Propensity to Cycle Tool (www.pct.bike), the free tool commissioned by the DfT and developed by Cambridge with others [8,F]. The tool helps planners decide where best to invest to boost cycling and provides results on cycling potential and car trip reduction, as well as data on health and economic benefits.

The Cambridge team regularly provides evidence to parliamentary committees, executive agencies and non-departmental public bodies, helping shape policy on active travel. Evidence they provided to the House of Commons Health Select Committee in 2014/15 on how the physical environment influences levels of walking and cycling is cited in the Committee’s report on the *Impact of physical activity and diet on health*. It underpinned the Committee’s recommendation that government “*make a clear commitment, together with appropriate long term funding, to significantly increase the levels of cycling and walking*” [G].

In 2014, Public Health England (PHE) used the findings of the Cambridge team’s evaluation of the Connect2 programme to support *Everybody active, every day*, its evidence-based framework for embedding physical activity into the fabric of daily life [H]. The Cambridge team’s work is especially important to one of the framework’s four areas for action (creating environments to support active lives), and its research formed one of five key pieces of underlying evidence for the framework [H].

The team’s direct engagement (committee service, evidence provision, expert witness contributions) with the National Institute for Health and Care Excellence (NICE) has also shaped 2018 NICE guidance on walking and cycling and on physical activity and the environment. The Cambridge team’s research is among the few studies of environmental interventions conducted in the UK featured in the guidance [H].

Local authority impact: providing evidence, influencing planning, and delivering health, economic and environmental benefits

While national policy sets the scene and provides funding for transport policies, key decisions are also made at local level. The Cambridge team’s research and practical tools have been vital in ensuring that local investment decisions are made in a way that maximises health impact.

One important contribution has been in providing high-quality evidence of the links between health and the built environment. Cambridge-led evaluations of environmental strategies (such as the Cambridgeshire Busway and Connect2) were central to Public Health England’s *Spatial planning for health* (2017) [I].

The practical tools produced by Cambridge University, including the Propensity to Cycle Tool, have been hugely useful to local authorities in planning local cycling networks, identifying interventions to promote cycling and preparing local Cycling and Walking Infrastructure Plans. As the DfT’s summary report on the tool puts it, the tool works to “*transform cycle planning by creating an evidence base for prioritising routes; telling us where routes should be built*” [J]. Local stakeholders involved in testing the tool found it invaluable in making and evidencing decisions, justifying investment and communicating their benefits [J].

The Propensity to Cycle Tool has been used by over 80 public authorities across England, including for funding bids, strategy documents and scenario planning [K]. For example, over 75 per cent of local authorities outside London used the Tool in preparing their bids for the government’s GBP175 million Active Travel Fund, helping to secure a return on this investment by ensuring evidence-based proposals, as well as reducing the burden on local planners in developing schemes [K]. In Greater Manchester, the tool has been used to inform cycling investments and create the Bee Network plan, covering the whole city-region. The Bee Network will ultimately comprise 1,800 miles of walking and cycling routes at a cost of GBP1.5 billion, but will return an estimated GBP6 billion in health, social and air quality

benefits [L].

Already, the impact of transport infrastructure investment is paying off in greater physical activity, reduced traffic and improved population health. Using the HEAT tool, Sustrans – the UK's leading walking and cycling charity and custodian of the National Cycling Network – estimated that for Greater Manchester alone, cycling uptake reduces car journeys by up to 45,000 per day, creates over GBP100 million in social and economic benefit for the city annually, and prevents 500 chronic conditions (and 42 early deaths) each year [L].

Based on the scenario planning undertaken by local authorities using the Propensity to Cycle Tool [K,M], it is estimated that the investments made by these 81 local authorities have potential to produce over 335,000 new cycling commuters. The health benefits of this increase equate to a gain of 2,632 life-years and 340,234 fewer days' sickness absence each year, with a total economic value of approximately GBP200 million per annum [M]. In environmental terms, this increase in commuting by bicycle decreases CO₂ emissions by over 55,000 tonnes per year [M]. These figures may underestimate the benefits, as they apply only to commuting trips (around 20% of total travel).

5. Sources to corroborate the impact (indicative maximum of 10 references)

- A. Integrated Transport and Health Impact Modelling Tool. <https://www.mrc-epid.cam.ac.uk/research/research-areas/public-health-modelling/ithim/> pp. 3-4
- B. Testimonial from former research scientist at the California Department of Public Health, October 2020.
- C. **(i)** Garcia L, Johnson R, Abbas A, [...] Tainio M, Woodcock J. Health impacts of changes in population travel patterns in Accra, Ghana [WHO report]; **(ii)** Testimonial from Technical Officer, Urban Health Initiative, World Health Organization, 2020.
- D. **(i)** WHO. HEAT tool. <https://www.heatwalkingcycling.org/#homepage>; **(ii)** WHO. Examples of applications of the health economic assessment tool (HEAT) for cycling. <https://tinyurl.com/yyjktqru>
- E. Centre for Science and Policy, Networks of Expertise and Evidence for Public Policy. Annual Report, 2014 p. 7
- F. Cycling and Walking Investment Strategy, Department for Transport, 2017 p. 37
- G. House of Commons Health Committee Impact of physical activity and diet on health. Sixth Report of Session 2014–15, p. 56. Report, together with formal minutes relating to the report
- H. PHE and NICE guidance **(i)** Everybody active, every day: An evidence-based approach to physical activity, Public Health England, 2014 pp 15, 26; **(ii)** Everybody active, every day: What works – the evidence, Public Health England, 2014 pp. 25, 26, 27; **(iii)** Physical activity and the environment, NICE guideline NG90, 2018 p. 47
- I. Spatial Planning for Health: An evidence resource for planning and designing healthier places, Public Health England, 2017 pp. 58-59
- J. National Propensity to Cycle Tool Project: Summary Report 2016, Department for Transport, pp. 7, 8
- K. **(i)** Use of the Propensity to Cycle Tool 2020 p. 5; **(ii)** Testimonial from economic advisor, Department for Transport
- L. **(i)** Change a region to change a nation: Greater Manchester's walking and cycling investment plan, 2020 pp. 22-24; **(ii)** Bike Life Greater Manchester 2019 pp. 4, 7
- M. Propensity to Cycle Tool. www.pct.bike