Journal of Transport & Health 1 (2014) 251–259

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

The link between socioeconomic position, access to cycling infrastructure and cycling participation rates: An ecological study in Melbourne, Australia

Chance Pistoll [a,*], Anna Goodman [b]

[a] The Royal Melbourne Hospital, Melbourne, Victoria, Australia
[b] Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK

ARTICLE INFO

Available online 24 October 2014

Keywords:
Cycling prevalence
Cycling infrastructure
Socioeconomic position
Health policy

ABSTRACT

Objective: Promoting cycling has moved up the policy agenda in recent years, but debate still exists surrounding the role played by socioeconomic barriers to participation in low cycling countries. This ecological study aimed to examine whether there are systematic socioeconomic disparities in access to cycling infrastructure and investment in Melbourne, Australia.
Methods: We used Geographic Information System (GIS) techniques to measure the density of on-road, off-road and informal cycling routes in 58 neighbourhoods of inner Melbourne. We examined whether small-area socioeconomic indicators were associated with the density of these three types of cycling infrastructure or with local government spending on cycling. We additionally examined how small-area socioeconomic position and infrastructure density were associated with the prevalence of cycling to work in the 2011 census.
Results: The density of on- and off-road cycling infrastructure was positively associated with cycle modal share (both $p < 0.0001$), and there was no evidence that the strength of this association differed between the two infrastructure types. The density of informal routes was not associated with cycling to work. There was no evidence that small-area socioeconomic position was systematically associated with the presence of on-road or quiet roads cycling infrastructure or with levels of investment. Levels of off-road infrastructure were somewhat higher in richer areas ($r=0.32$, $p=0.02$), although much of this was located in parkland and may have a predominant recreational function.
Conclusion: In Melbourne, cycling infrastructure is positively correlated with cycle prevalence and is generally distributed equitably with respect to area-level socioeconomic position. In part this reflects the high levels of cycling infrastructure and spending in some relatively disadvantaged areas. Further studies that seek to understand the drivers behind successful policies in these areas may provide lessons for other areas, and aid our understanding of the complex relationships between cycling infrastructure, cycling behaviour and socioeconomic position.

1. Introduction

A large and growing body of evidence indicates that regular commuter cycling is beneficial to the health of individuals and populations (Woodcock et al., 2011; Bassett et al., 2008; de Hartog et al., 2010; Huy et al., 2008; Pucher et al., 2010a; Saunders et al., 2013, Shephard, 2008). Cycling for active transportation is associated with significantly reduced rates of obesity (Gordon-Larsen et al., 2009), type 2 diabetes, hypertension (Furie and Desai, 2012) and perhaps all-cause mortality (de Hartog et al., 2010; Sahlqvist et al., 2013). Furthermore, the physical activity benefits of regular cycling appear at a population level to outweigh potential risks such as road traffic injury and exposure to air pollution (Rojas-Rueda et al., 2011; de Hartog et al., 2010; Woodcock et al., 2014).

Recent years have seen a rise in cycling-related policies at many institutional levels (Ogilvie et al., 2011; Gotschi, 2011; Lindsay et al., 2011; Rojas-Rueda et al., 2011; Woodcock et al., 2009). This interest not only reflects the health benefits of cycling, but its potential to offer

* Correspondence author at: The Royal Melbourne Hospital, Melbourne Health, 300 Grattan Street, Parkville VIC 3050, Australia. Tel.: +61420388385.
E-mail address: Chance.Pistoll@mh.org.au (C. Pistoll).

http://dx.doi.org/10.1016/j.jth.2014.09.011
2214-1405/

solutions to problems such as climate change, congestion, noise and air pollution and economic development. In the Australian Federal context, policies include the Australian Department of Health's 'Healthy Spaces and Places' program (Australian Department of Health, 2010), and the updated Active Transportation Policy of the federal Department of Infrastructure and Transport (Australian Department of Infrastructure, 2013). Victoria state level examples include the Cycling into the Future Policy of the Victorian Department of Transport (Victoria Department of Transport, 2012a) and the Sustainable and Active Transport Policy of the Victorian Department of Health (Victoria Department of Health, 2013). Local Melbourne examples include the City of Melbourne's Bike Plan (City of Melbourne, 2012) and the City of Yarra's Bicycle Strategy (City of Yarra, 2010).

Despite this policy interest, much debate exists about how best to increase cycling levels in low cycling countries. One recent research focus concerns the role of cycling infrastructure in supporting increased cycling rates. Although some causal effect of infrastructure upon cycling participation rates is probable, reliance on cross-sectional studies, small before-and-after studies and stated preference surveys means that the underlying evidence base is relatively weak (Fraser and Lock, 2011, Pucher et al., 2010b; Yang et al., 2010). The historical origins of cycling policy in Melbourne may offer an unusual opportunity to contribute to this debate. Construction of much of Melbourne's cycling infrastructure began in the 1990s in response to largely top-down policy decisions at the state level, reflecting state-wide economic, transport and environmental concerns (Goodman, 2008; Pucher et al., 2011). At the time when this new infrastructure was being created, cycling rates were at their lowest recorded levels (0.8% commute prevalence in greater metropolitan Melbourne in 1996), but have since steadily increased (to 1.6% in 2011, (Australian Bureau of Statistics, 2013b)). This policy backdrop may help to mitigate one traditional limitation of cross-sectional studies in this field, by providing some macro-level evidence that the extension of cycling infrastructure in the city occurred prior to any increases in cycling prevalence and was largely prompted by external considerations rather than local demand. The diversity of types of cycling infrastructure created in Melbourne also offers the potential to contribute to debates regarding the relative importance of on-road versus off-road cycling infrastructure (Dill, 2009; Pucher et al., 2010b).

Another recent focus of investigation has been the role that socioeconomic barriers may play in preventing an equitable uptake of cycling. In countries with low modal shares such as the UK and Australia, evidence suggests that recent modest growth in cycling has tended to occur disproportionately amongst socioeconomically advantaged groups (Goodman, 2013; Kamphuis et al., 2008; Sahlqvist and Heesch, 2012; Steinbach et al., 2011). Evidence from Melbourne seems to confirm this finding. An analysis of census data from 1996–2006 found that the fastest growth in commuter cycling rates occurred among commuters with higher educational qualifications, higher income and working in white-collar occupations (Victoria Department of Transport, 2008). One possible mechanism for such an effect could involve greater investment in cycling facilities in socioeconomically advantaged areas. To our knowledge, only two studies (both from the USA) have explicitly sought to investigate relationships between socioeconomic position and proximity to cycling infrastructure. The first of these was an ecological study that examined the socioeconomic distribution of cycling infrastructure in New Jersey. This study concluded that infrastructure location was not inequitably situated in that state (Deka and Connelly, 2011). The second involved an equity analysis of cycling infrastructure in Portland, Oregon. This study found that cycle routes were more likely to be located in low socioeconomic areas, but less likely to be located near areas with high proportions of ethnic minorities, the elderly and youths (Dill and Haggerty, 2009). These mixed findings suggest a complex and context-specific interaction between policy-making, the physical environment and socioeconomic indicators.

This paper seeks to contribute to this research literature in two ways. Firstly, it aims to examine the relationship between cycling infrastructure density and cycling prevalence in Melbourne, Australia. Secondly, it aims to establish whether there are systematic area-level socioeconomic differences with respect to access to cycling infrastructure and investment. Through addressing these aims, this paper intends to examine whether in Melbourne any inequalities in access to cycling infrastructure and investment exist that are likely to lead to inequalities in cycling participation.

2. Materials and methods

2.1. Setting

The study area was inner Melbourne, the urban centre of the capital of Victoria, Australia, with a population of around 700,000 (Australian Bureau of Statistics, 2013b). Inner Melbourne comprises a high-density, mixed-use core, surrounded by significant urban sprawl, and bounded by rivers on three sides (Supplementary Fig. S1). The city is flat with a mild oceanic climate creating ideal conditions for year-round cycling (Pucher et al., 2011). Inner Melbourne is one of the highest-cycling regions in Australia (Australian Bureau of Statistics, 2013b).

Cycling policy and governance in Melbourne is fragmented. State government is concerned with strategy, acting primarily through the Department of Transportation. Promoting cycling through local investment, construction, by-laws and other programs is largely the responsibility of Local Government Authorities (LGAs), of which there are 17 in inner and middle Melbourne. Parks Victoria has significant oversight of development in green zones. This policy fragmentation has contributed to a variable quantity and quality of cycling infrastructure across inner Melbourne, with marked differences between LGAs in the extent of infrastructure provided, and in the relative balance between on- and off-road routes.

2.2. Geographical units of analysis and study area

Most analyses were conducted at the 'Statistical area 2' (Sa2) level; these are census units with a population of around 10,000 individuals, reflecting communities that interact together socially and economically (Australian Bureau of Statistics, 2012b). Assuming the majority of cycle commuting converges on the Central Business District (CBD), we defined the study area as Sa2s with a centroid within 10 km of the geographical centre of the CBD (Supplementary Figs. S1 and S2). This distance approximates what is traditionally referred to as 'inner Melbourne', and ensured a relatively homogenous set of urban areas for comparison. In addition to excluding areas further than 10 km from the CBD, we also excluded two additional Sa2s, Port Melbourne Industrial Area and Flemington Racecourse – both special economic areas with very low permanent populations. This resulted in 58 Sa2s in our analysis (mean size 4.2 km^2, mean commuter population 10,059 individuals, average commuter age 37.1 years).

Sa2 analyses were in a few instances complemented by analyses at the LGA level. LGAs reflect local government divisions within Australia, with an average population of 135,000 (Australian Bureau of Statistics, 2012a).

Ethical approval was not required as all data were fully in the public domain.