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Automobile dependence: A contributing factor to poorer health among lower-income households

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A B S T R A C T

Lower household income is one of the strongest predictors of poor health. In this viewpoint, we explore an understudied pathway between household income and health: automobile dependence. We argue that the provision of policies that reduce automobile dependence, and facilitate active and affordable modes of travel (i.e. walking, cycling and public transport), may mitigate poorer health among individuals from lower-income households. Policies and environments that support active travel are likely to have particularly strong health and economic benefits for lower-income residents.

1. Introduction

Living in a lower-income household is detrimentally associated with health behaviours and outcomes including: physical activity (Kari et al., 2015; Kim and So, 2014), sedentariness (Sugiyama et al., 2008), diet quality (Kamphuis et al., 2006), smoking (Casetta et al., 2016), mental health (Sareen et al., 2011), physical functioning (Loh et al., 2016), type 2 diabetes (Bird et al., 2015), cardiovascular disease (Lemstra et al., 2015), and premature mortality (Signorello et al., 2014). Despite previous individual-level approaches to improving health among those from lower-income households (Bambra et al., 2015; Turrell and Vandevijvere, 2015), large income-related health inequities remain (OECD, 2015). There is a need for interventions that can have widespread and sustainable effects (Sallis et al., 2012). Facilitating active transport through environmental and policy changes has been used as a means of improving population-level health through increases in physical activity (Community Preventive Services Task Force, 2017; Heath et al., 2012). However, research has not yet fully explored the potential role of automobile dependence in reducing health inequities. This viewpoint article argues that the provision of policies that reduce automobile dependence and facilitate active and affordable transport can address health inequities, through etiological pathways illustrated in Fig. 1. First we describe how financial strain (due to low disposable income) affects health, based on indicative research findings. Then, using Brisbane, Australia as a case study, we estimate the cost of transport under several scenarios (different income levels, with and without automobiles), and demonstrate the greater financial burden of automobile ownership among lower-income households. We then discuss strategies to reduce automobile dependence.

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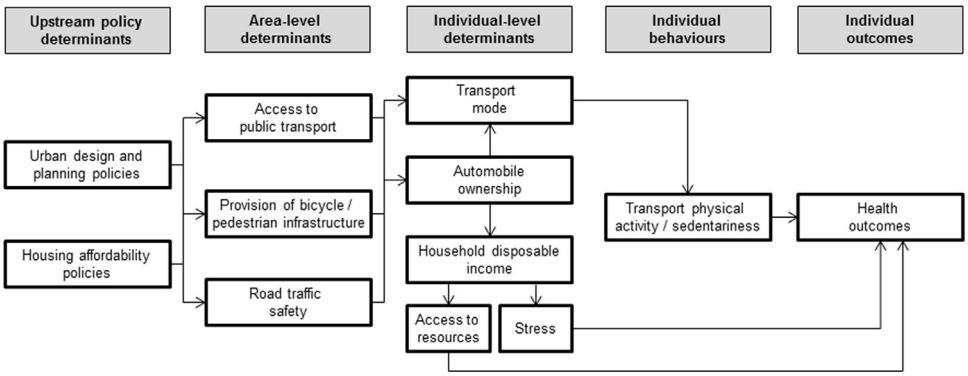

Fig. 1. Conceptual and analytic framework detailing how upstream policy influence health outcomes through the transport environment, automobile ownership, and household disposable income.

2. Household income and health

The arguments proposed are based on literature on the relations between household income and health that posits two mechanistic pathways: access to resources and stress.

2.1. Access to resources

Competing priorities in households with limited disposable income often result in poorer health-related outcomes. For example, Australian research has shown that lower-income families are more likely to experience challenges in purchasing adequate quantities of food, as well as appropriately healthy food (Turrell and Kavanagh, 2006). Even middle-income Australian families who have recently had a reduction in income (e.g. through job loss) or who have high living expenses (such as the cost of owning or maintaining one or more motor vehicles) may also experience food insecurity due to a lack of available funds to allocate to food purchases (Burns, 2004). Poor diet quality is associated with greater risk of chronic health conditions (McCullough et al., 2002). Household income is strongly associated with health care service utilisation. A study of income-related inequalities in health care services utilisation in 18 OECD countries found that, after adjusting for individuals' needs for health care, people with higher incomes were more likely to consult a physician or specialist (Devaux, 2015). Regular health checks with physicians are important for the identification and treatment of chronic disease and associated risk factors (Krogsbøll et al., 2013).

2.2. Stress

Mounting evidence supports causal relationships between socioeconomic factors and health through complex pathways involving biopsychosocial processes (Seeman et al., 2010). Individuals from lower-income households tend to experience more stress, which can be caused by insecurity in income, lack of personal safety, and exposure to poorer environments such as crowding, crime, and noise pollution, while also having fewer resources to deal with these challenges (Baum et al., 1999). The mismatch between demands that individuals live with, coupled with the reduced capacity to cope effectively, can result in greater distress (Eaton et al., 1999) that contributes to poorer health (Miller et al., 2009). For example, analyses of nationally representative U.S. data for adults aged 20 years and over from the National Health & Nutrition Survey (NHANES) found socioeconomic gradients in allostatic load (biological "wear and tear") (Sabbah et al., 2008; Seeman et al., 2008), and age-specific accumulation was greater among those in poverty (Crimmins et al., 2009). Seeman et al. (2004) found that stress-related biological dysregulation explained 34% of the difference in mortality risk between levels of socioeconomic background.

3. Household income and the cost of automobile dependence

In automobile-dependent neighbourhoods, characterized by large distances from homes to destinations (e.g. work and shops), residents must purchase and maintain one or more motor vehicles for mobility. Otherwise, living in these neighbourhoods limits employment and social engagement opportunities (Dodson and Sipe, 2008). The cost of maintaining automobiles reduces household disposable income, which is used for daily living. We demonstrate differences in the burden of automobile ownership by level of household income, using Brisbane, Australia as a case study. We present four scenarios with varying degrees of automobile ownership and estimate the costs associated with automobile maintenance in dollars and as a proportion of household income.

3.1. Scenario 1

A household with two automobiles that will be driven 15,000 km and 10,000 km, respectively, per year. The automobile driven 15,000 km per year is assumed to be less than three years old, purchased new and financed with a loan. The automobile driven

Table 1
Weekly transportation costs in Brisbane, Australia.
Source: Australian Automobile Association (March 2017).

Item	Scenario 1 (AU$)	Scenario 2 (AU$)	Scenario 3 (AU$)	Scenario 4 (AU$)
Roadside assist	1.71	0.86	0.00	0.00
Tolls	49.30	29.58	0.00	0.00
Fuel	64.97	38.98	0.00	0.00
Servicing and tyres	31.65	18.99	0.00	0.00
Insurance	23.42	14.05	0.00	0.00
Registration/licensing	29.00	14.50	0.00	0.00
Car loan repayments	123.80	123.80	0.00	0.00
Public Transport[a]	0.00	53.64	107.28	32.18
Total	**323.85**	**294.40**	**107.28**	**32.18**

[a] The cost of a return trip to the CBD from the outer suburbs (7 zones) using an electronic fare card in Brisbane = $10.73.

10,000 km per year is assumed to be 10 years old and owned outright. This scenario represents the average Australian household, and is based on data from the Australian Bureau of Statistics and Australian Automobile Association (Australian Automobile Association, 2017); and broadly represents the travel characteristics of the average Australian household, where 71% commute to work or study in a private passenger vehicle, 16% take public transport, 4% walk, and 2% cycle (Australian Bureau of Statistics, 2014).

3.2. Scenario 2

Scenario 1, minus the second (used) automobile. Five return trips per week to the Brisbane central business district (CBD) by automobile in Scenario 1 are replaced by public transport from the outer suburbs.

3.3. Scenario 3

No automobiles, and instead using public transport for 10 return trips per week to the Brisbane CBD from the outer suburbs.

3.4. Scenario 4

No automobiles, only using public transport for three return trips per week to the Brisbane CBD (i.e. occasional use of public transport), where local walking and cycling are the predominant forms of transport.

Table 1 demonstrates how reductions in household automobile ownership, even after substituting in the cost of public transport, can improve household finances. Moving from a two-automobile household to a one-automobile household is shown to reduce weekly cost by as much as $29/week, even after substituting in $65/week from increased use of public transport. Moving from a two-automobile household to having no automobiles can improve weekly finances by as much as $217/week, substituting in another five return trips to the Brisbane CBD. The fourth scenario, emphasising walking and bicycling, shows the greatest improvement in household finances, where families are $292/week better off.

Table 2 demonstrates how each of these automobile ownership and transport scenarios differentially impact households depending on their level of income. Although the proportion of household income taken up by transport expenditure decreases for all

Table 2
Proportion of income spent on owning and maintaining a car by level of household income and scenario.

Total weekly household income (AU$ per year)	Net weekly household income (AU$ per year)[a]	% of Australian Population[b]	Scenario 1 (%)	Scenario 2 (%)	Scenario 3 (%)	Scenario 4 (%)
1–299 (1–15,599)	1–299 (1–15,599)	4.8	> 100	> 100-98	> 100-54	> 100-16
300–599 (15,600-31,199)	300–598 (15,600-31,100)	17.8	> 100-54	98-49	54-27	16-8
600–999 (31,200-51,599)	598–943 (31,100-49,035)	18.4	54-34	49-31	27-14	8-4
1,000–1,499 (52,000–77,999)	943–1323 (49,035–68,773)	17.1	34-24	31-22	14-9	4-3
1,500-2,499 (78,000–129,999)	1323–2013 (68,773-104,656)	21.8	24-16	22-15	9-6	3-2
2,500-3,499 (130,000–181,999)	2013-2,662 (104,656-138,442)	13.9	16-12	15-11	6-5	1
3,500-4,999 (182,000–259,999)	2,662-3,614 (138,442-187,906)	4.4	12-9	11-8	5-4	1
5,000 or more (260,000 or more)	3,614 or more (187,916 or more)	1.8	≤9	≤8	≤3	≤1

[a] Assuming that there are two working adults in the household with a 60/40 split of income, calculated with the Australian Tax Office's Simple Tax Calculator.
[b] From the 2011 Australian Bureau of Statistics Census.

levels of household income, the largest proportional differences are for the lowest income households. In other words, the largest benefits of reducing automobile ownership and undertaking more active and affordable forms of transport accrue to the lowest income households.

4. Reducing automobile dependence

Multiple policy and environmental initiatives are needed to help lower-income households to rely less on automobiles. A long-term solution would be to enable a wider cross-section of the population to travel to employment, education, food, health and social services, and to recreate and socialise via adequate access to diverse transport modes (Badland et al., 2014). To achieve this, the evidence suggests that cities would likely need to increase in density, rather than expanding their geographical boundaries (Sallis et al., 2016). A recent Lancet paper on urban design, transport, and health outlined several design features likely to improve uptake of active and affordable transport, thereby reducing automobile dependence (Giles-Corti et al., 2016). Local urban design features included: connected and safe street networks (including pedestrian and bicycle infrastructure) that reduce exposure to traffic; higher residential density that supports the viability of local business and high-frequency public transport services; residential areas with different types of housing mixed with commercial, public service, and recreational opportunities; neighbourhoods that are designed to be safe, attractive and accessible to all; and public transport that is convenient, affordable, frequent, safe and comfortable (Giles-Corti et al., 2016). Further environmental interventions that reduce automobile dependence and improve active transport include automobile-free pedestrian zones, traffic calming, signage, and accessibility for all (e.g. wheelchair and pram access) (Buehler et al., 2017). Present findings demonstrate that, to reduce household income-related health inequities, uniform interventions across cities to reduce automobile dependence would be sufficient. However, changes to transport environments within cities often take years or even decades (Buehler et al., 2017). In these cases, phasing of interventions that target lower-income neighbourhoods first is likely to have greatest impact on improving health equity.

Improving the built environments of lower-income neighbourhoods does have some risks. Inner-city urban renewal projects bring with them risk of gentrification: a process whereby lower-income households are displaced by their higher and middle income counterparts (Kennedy and Leonard, 2001). Place-based government investment such as improvements to public transport has been shown to increase the price of local housing, forcing lower-income households to relocate (Zheng and Kahn, 2013), often to lower-cost automobile-dependent neighbourhoods located on the urban fringes (Randolph and Tice, 2016). It appears that built environment improvements need to be coordinated with housing policies that allow lower-income residents to share the health and economic benefits. There are examples of government policies that safeguard against the displacement of low-income residents (Shaw, 2008) and help reduce health inequities. For example, the Danish 2015 federal budget included an agreement to give local municipalities the right to earmark up to 25% of future residential building projects for affordable housing ("Budget boosts affordable housing in Copenhagen," 2014). Another example from the United States is the Low-Income Housing Tax Credit program. The program provides tax incentives to encourage individual and corporate investors to invest in the development, acquisition, and rehabilitation of affordable housing (Cummings and DiPasquale, 1999). However, a recent policy evaluation revealed that transit equity among affordable housing was not meeting the policy's goals (Welch, 2013). A comparison of approaches to the planning and delivery of affordable housing across England, Australia and New Zealand revealed that effective delivery of affordable housing through the planning system was dependent on consistent and enforceable policy articulation, government commitment, a mature affordable housing sector, and particular market conditions (Austin et al., 2014). The risk of gentrification remains a significant challenge, with residents of lower-income neighbourhoods resisting environmental improvements that could yield health benefits if displacement could be avoided (Freeman, 2011).

5. Limitations

There are some limitations to the arguments made in this paper. First, the four scenarios presented in this paper assume that individuals have the ability (and confidence) to use public transport, walk and cycle, rather than drive an automobile. It is possible that physical health limitations is one of the reasons why some individuals live in households with lower levels of income, and this may impact on their ability to use modes of transport other than automobiles. Second, the scenarios do not include the cost of purchasing a bicycle, and its ongoing maintenance. Although the initial cost may be a barrier for lower-income households, the weekly cost over the long term is much lower than the cost needed to maintain automobile(s).

6. Conclusion

This viewpoint article has argued that reduced disposable income due to automobile ownership may exacerbate household income-related health inequities. Lower-income residents often need to live in urban fringe areas where housing prices are lower, but where automobiles are essential for daily mobility. The cost needed to maintain automobiles can have a substantial impact on disposable income, which is known to have a detrimental effect on health through poorer access to health-related resources and greater stress. Translating land use and transportation strategies to reduce automobile dependence into policies that reduce income-related health inequities will require broad social, political and environmental change, as well as multi-sector involvement (Giles-Corti et al., 2016; Marmot et al., 2008). Neighbourhood improvement efforts must be coordinated with affordable housing policies to avoid displacing the original residents of lower-income communities the improvements are intended to benefit. Undertaking research (based on the conceptual framework in Fig. 1) provides researchers and advocates with evidence to drive change. Interdisciplinary

research on the effects of urban planning, transport, and housing policies on health equity are needed. Building research capacity, undertaking studies, and revisiting existing studies where opportunities to demonstrate these relationships have been overlooked are priorities for future research in this field.

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Conflicts of interest

None declared.

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