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Area-level socio-economic disparities in active and sedentary transport: Investigating the role of population density in Australia

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ABSTRACT

Physical inactivity is considered as a key factor that contributes to socio-economic inequalities in health, a persistent problem in our society. Living in areas of lower socio-economic status (SES) is known to be associated with lower levels of leisure-time physical activity. However, research examining the relationship between area-level SES and transport-related physical activity has reported mixed findings. This may be due to the presence of sub-groups in which differential associations between transport behaviours and SES exist. This cross-sectional study examined associations of area-level SES with active and sedentary transport behaviours, and whether population density moderates the associations. Data from two household surveys conducted in Australia (South East Queensland, Melbourne) were used. Participants (35,283 adults, aged 18–64 years) reported their travel behaviours using a 24-hr travel diary. They were categorised according to the level of walking (active transport), public transport use (active transport), and car use (sedentary transport). Overall, we found that living in lower SES areas was associated with lower likelihood of walking, public transport use, and prolonged car use. However, stratified analyses found that the associations of area-level SES with active and sedentary transport behaviours varied between areas with different levels of population density. Our findings suggest that residents of low-SES, high-density areas in Australia are particularly at risk of being physically inactive for daily travel (less walking, less public transport use, and longer car use). Given that travel behaviours tend to be habitual, preventive actions may be needed to promote active transport and to reduce the risk of chronic diseases for this sub-group. Interdisciplinary research involving the public health, transport, and planning sectors can inform the development of policy initiatives to facilitate active transport.

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1. Background

Health inequalities are a chronic societal problem without simple solutions. Physical inactivity is considered as a key modifiable risk factor that contributes to socio-economic inequalities in health (Eikemo et al., 2014; Hammig et al., 2014; Hosseinpoor et al., 2012; Kamphuis et al., 2008). What matters in this context is not only who you are (individual socio-economic status) but also where you live (area-level socio-economic status) (Macintyre et al., 2002). It is well-documented that lower area-level socio-economic status (SES) is associated with lower levels of leisure-time physical activity (Beenackers et al., 2012; Cleland et al., 2012; Janssen et al., 2010; Turrell et al., 2010). Thus, increasing leisure-time physical activity in disadvantaged areas is likely to help mitigate socio-economic inequalities in health. However, research examining the relationship between area-level SES and transport-related physical activity has reported mixed findings (Beenackers et al., 2012). On one hand, studies have shown that adults living in lower SES areas tend to be more active for transport (Goodman, 2013; Steinmetz-Wood and Kestens, 2015; Turrell et al., 2010). It is possible that those living in disadvantaged areas are less likely to have access to cars, and some of them may need to walk to get to local destinations or to public transport stops (Mackett, 2014). On the other hand, there are studies reporting associations of higher area-level SES with higher levels of walking for transport or for commuting (Cerin et al., 2009; Zahran et al., 2008). Disadvantaged areas may be less supportive of walking in terms of safety and aesthetics (Sallis et al., 2012). There are also studies showing no association of neighbourhood-level SES with walking to work (Zander et al., 2014) or with active transport (Freeman et al., 2013; Lachapelle et al., 2011).

Such mixed findings for transport-related physical activity may be due to the presence of sub-groups in which differential associations between active transport and SES exist. For instance, it has been found that the association between active transport and neighbourhood SES is more pronounced in areas characterised by greater walkability (Steinmetz-Wood and Kestens, 2015). The relationships of environmental attributes relevant to active transport (e.g., access to local destinations, conditions of routes to destinations) with area-level SES may be different between high and low walkable areas. Indeed, a study in the US has shown that access to local destinations is positively associated with neighbourhood income in high-walkable areas, but negatively associated in low-walkable areas (Sallis et al., 2011). Such moderation by environmental factors might be a reason for previously-reported mixed associations between active transport and area-level SES.

This study examined the role of population density, a fundamental attribute of neighbourhood environments, in the socio-economic gradient in active transport behaviours (walking for transport, public transport use). Population density is considered as a potential moderator in this study because it is a key element of walkability and is related to other environmental attributes such as housing type, street pattern, access to public transport, availability of local destinations such as shops and services, hence residents' travel behaviours (Cervero and Kockelman 1997; Forsyth et al., 2007). This study also examined to what extent the socio-economic gradient in sedentary transport (car use) may be moderated by population density, since no research seems to have examined how low and high SES areas differ in this behaviour despite its known associations with poor health (McCormack and Virk, 2014; Sugiyama et al., 2016).

2. Methods

2.1. Study design and settings

We utilised household travel survey data from two discrete areas of Australia. Household travel surveys, which primarily aim to inform the development of transport modelling and transport-related decision-making, provide detailed information about residents' travel behaviours. We used the 2009 South East Queensland Travel Survey (SEQTS) and the 2009 Victorian Integrated Survey of Travel and Activity (VISTA). The SEQTS and VISTA were administered by the same consultancy agency using similar methods and instruments, thus allowing the databases to be combined. The surveys were conducted in accordance with ethical guidelines under government statutes and regulations. Informed consent was obtained from participants.

The SEQTS was conducted in South East Queensland, which includes Brisbane, Sunshine Coast, and Gold Coast. Its data comprised of 27,213 participants from 10,335 households. In 2009, South East Queensland had a population of 2.9 million people with 1.0 million households (Australian Bureau of Statistics, 2011b). The sampling rate of the SEQTS varied between 4.4% and 6.6% of households within the regions, and the response rates ranged from 46% to 60%. The VISTA was conducted in 2009/2010 in the Melbourne Statistical Division, Victoria. Data were collected from 41,626 participants in 16,269 households. In 2009, Melbourne had a population of 4.0 million with over 1.2 million households (Australian Bureau of Statistics, 2011b). In VISTA, 1.9% of the households in Melbourne were selected, and the response rate was 45%. Both South East Queensland and the Melbourne Statistical Division included a variety of built environments ranging from high-density mixed-use urban areas to low-density regional areas.

Both surveys used cross-sectional, multistage random sampling design: Census Collection Districts (CCD; the smallest geographic sub-units for the collection of Census data at the time of data collection) were selected first, then households were selected from each CCD. Surveys were either hand- or mail-delivered to, and collected from surveyed households. The specified survey day for each household was allocated by spreading the sample households over the survey period, and then randomly allocating each household to a day of the week. All residents and visitors over five years old in households were asked to report their travel behaviours for the assigned survey day. In this study, we focused on working-age adults aged between 18 and 64 years old.

The SEQTS and VISTA used a self-administered questionnaire with a one-day travel diary. Participating households were asked to report the following: the number of people usually residing in the household; dwelling type; number of vehicles; and each household member's age, gender, country of birth, driving license-holding status, employment status, and occupation. The travel diary asked