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Do differences in built environments explain age differences in transport walking across neighbourhoods?

Fatima Ghani[a,*,1], Jerome N. Rachele[b], Venurs HY Loh[a], Simon Washington[c], Gavin Turrell[a]

[a] Institute for Health & Ageing, Australian Catholic University, Level 6, 215 Spring Street, Melbourne, Victoria 3000, Australia
[b] Centre for Health Equity, Melbourne School of Population and Global Health, University of Melbourne, 207 Bouverie St, Carlton, Victoria 3053, Australia
[c] Head of School of Civil Engineering, Faculty of Engineering, Architecture, and Information Technology, The University of Queensland, Level 4 (Academic Office), General Purpose South Building (78) Queensland 4072 Australia

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ABSTRACT

Background: The neighbourhood built environment (BE) provides opportunities for regular walking for transport (WfT). Within the same city, age differences in WfT can vary significantly across neighbourhoods, although little is known about the reasons for this variation. This cross-sectional study investigated the contribution of the BE to explaining age differences in WfT across neighbourhoods.

Methods: This investigation used baseline (2007) data from the How Areas in Brisbane Influence HealTh and AcTivity (HABITAT) Study. The sample included 11,035 residents aged 40–65 years living in 200 neighbourhoods in Brisbane, Australia (68.4% response rate). Self-reported weekly minutes of WfT were categorized into none (0 mins) and any (1–840 mins); age was categorized into 40–48, 49–57 and 58–65 years. Objectively assessed neighbourhood-level measures of the BE included residential density, street connectivity and land-use mix. Analyses involved multi-level binomial logistic regression with age as main predictor, adjusting for gender, socioeconomic position, residential self-selection, and neighbourhood disadvantage.

Results: On average, older adults were significantly less likely to walk for transport. Age differences in WfT seemed to vary significantly across neighbourhoods, and the magnitude of the variation for older groups was twice that of their younger counterparts. The environmental measures analysed played a relatively limited role in explaining neighbourhood differences in the age-WfT relationship. Residential density and street connectivity explained up to 13% and 9% respectively of the observed between-neighbourhood variation in WfT across age groups.

Conclusion: Neighbourhood-level factors semeed to influenced the WfT of younger and older adults differently, with older adults being more sensitive to their neighbourhood environment. In Brisbane, age differences in WfT were smaller in areas with higher residential density and street connectivity. These results favor the ongoing investigation of demographic heterogeneity around neighbourhood averages in other urban contexts to inform tailored ecological interventions that facilitate WfT for all age groups everywhere, supporting active aging communities.

* Corresponding author.
E-mail addresses: fatima.ghanigonzalo@myacu.edu.au, virtud@rocketmail.com (F. Ghani), j.rachele@unimelb.edu.au (J.N. Rachele), venurshuiyee.loh@myacu.edu.au (V.H. Loh), hos@civil.uq.edu.au (S. Washington), Gavin.Turrell@acu.edu.au (G. Turrell).
[1] ORCID # 0000-0002-5528-371X.

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1. Introduction

Age is a consistent predictor of physical activity (PA), with older adults being less active than their younger counterparts (Bauman et al., 2012). Walking is the most common and preferred form of PA among older adults (Satariano et al., 2012; Touvier et al., 2010), whereas young adults are more likely to participate in vigorous-intensity PA (Hallal et al., 2012). Regular walking contributes to daily energy expenditure (Morris and Hardman, 1997), reducing or postponing morbidity and mortality from non-communicable diseases (Fortes et al., 2013; Murtagh et al., 2015).

Walking for transport (WfT) is undertaken with the purpose of reaching a destination such as work, the shops or public transit (National Heart Foundation of Australia, 2014). As an alternative to vehicular transportation, walking has synergistic co-benefits across several portfolios (health, transport, community and environment) (Ewing and Cervero, 2010), and contributes to overall PA levels in populations, particularly in older adults (Cerin et al., 2017). Seniors are likely to experience greater benefits from shifting to WfT than their younger counterparts, since it facilitates their independent living by enabling access to commercial and health services, as well as community life and opportunities for social interaction (Levasseur et al., 2017), which might translate into better health (Mueller et al., 2015). The design of neighbourhoods can potentially reduce age disparities in overall PA participation through the incorporation of incidental WfT into daily routines, which has implications for health equity and social justice (Panter and Jones, 2010).

Active transportation is a component of active aging, acknowledged within the socio-ecological perspective underpinning the World Health Organization's *Global age-friendly cities (*World Health Organization, 2007*)*. This framework highlights the dynamic interactions between individuals and the environment in which they live, and calls for research-based evidence to inform the necessary environmental modifications that ensures elder-friendly communities which are likely to extend the health and quality of life in older age (World Health Organization, 2007; Sun et al., 2013; Plouffe and Kalache, 2010). This includes the identification of the key design elements of neighbourhoods that might delay age-related declines in WfT (Turrell et al., 2014).

The built environment comprises the neighbourhood's physical features, such as pedestrian infrastructure and street lighting, and has stronger associations with WfT compared with other types of PA, including recreational walking (McCormack and Shiell, 2011). In particular, greater residential density, street connectivity and land-use mix (common features of pedestrian-friendly neighbourhoods) are consistently associated with WfT in adults (McCormack and Shiell, 2011) and seniors (Cerin et al., 2017; Kamruzzaman et al., 2016). Higher residential density also facilitates the mixed use of land (which provides a range of destinations to walk to) as well as access to public transport, while greater street connectivity facilitates transport walking by providing direct routes to destinations (Wilson et al., 2012).

Previous multilevel research observed that WfT varies with age, with older adults less likely to walk for transport than their younger counterparts (Turrell et al., 2014; Turrell et al., 2013), possibly reflecting changes in occupational status such as retirement (Bjornsdottir et al., 2012). This evidence suggests that this is a critical life-stage for promoting transport walking (Touvier et al., 2010), particularly since shopping seems to be the most common reason for older adults leaving their homes (Davis et al., 2011). Further evidence is required to improve current understanding of the relationship between built environments and WfT among older adults (Van Cauwenberg et al., 2011).

To date, most neighbourhood-based studies have presented the overall (average) association between age and WfT (Cerin et al., 2017), overlooking the possibility that this relationship differs depending on the characteristics of neighbourhood environments. However, a previous investigation revealed that the effect of age on WfT varied significantly across neighbourhoods (Ghani et al., 2016), suggesting that the overall relationship was not necessarily reflective of the association within any particular neighbourhood. Moreover, the overall effect was potentially obfuscating important information about how neighbourhoods differentially influence the WfT of younger and older adults.

A few studies have explored age as a moderator of the relationship between the built environment and WfT (Shigematsu et al., 2009; Cerin et al., 2014; Van Cauwenberg et al., 2012), with two investigations revealing that neighbourhoods with greater land-use mix may delay the decline in WfT across time (Shigematsu et al., 2009; Cerin et al., 2014). These results suggest that a supportive built environment might be required to encourage older adults to walk more for transport. While physical function declines with age (Yen et al., 2009) and living spaces appear to shrink in older age (Laatikainen et al., 2016), pedestrian-friendly neighbourhoods may generate smaller age differences in WfT, since such features are conducive to walking for all age groups. In contrast, unfavorable environments for WfT (with less residential density, fewer street intersections and low land-use mix) may produce larger age disparities in WfT, accelerating the decline of the physical and cognitive functions in older adults as a result of walking less for transport. Therefore, the impact of the neighbourhood built environment on a person's probability of WfT might depend on their age.

Furthermore, between-neighbourhood variation of age differences in WfT might be attributed to age-specific sensitivity to environmental characteristics, reflecting the fact that younger and older adults might experience –and engage with– their local environments in distinct ways (Kavanagh et al., 2006). Thus, it is plausible that the built environment of a neighbourhood might have a stronger influence on the transport walking of older adults compared to their younger counterparts, due to the increasing multiple physical and social limitations associated with aging (Cerin et al., 2014; Inoue et al., 2011).

Consistent with the principles of social-ecological models, which posit dynamic interrelations across multiple levels of influence (Sallis et al., 2008), this study investigates the contribution of three commonly reported built environment measures (i.e. residential density, street connectivity and land-use mix) to explaining: (1) neighbourhood differences in the age-WfT relationship; and (2) between-neighbourhood variation in WfT for different age groups. The first question examines whether the effect of age on WfT varied significantly across neighbourhoods, suggesting that the overall relationship is not necessarily reflective of the association within any particular neighbourhood. The second question examines whether age differences in WfT might be moderated by the built