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Can neighborhood green space mitigate health inequalities? A study of socio-economic status and mental health

Takemi Sugiyama [a,b,c,d,*], Karen Villanueva [c,e], Matthew Knuiman [f], Jacinta Francis [f], Sarah Foster [f], Lisa Wood [f], Billie Giles-Corti [c]

[a] Centre for Design Innovation, Faculty of Health Arts & Design, Swinburne University of Technology, Melbourne, VIC, Australia
[b] Spatial Epidemiology and Evaluation Research Group, School of Population Health, University of South Australia, Adelaide, SA, Australia
[c] McCaughey VicHealth Community Wellbeing Unit, Centre for Health Equity, Melbourne School of Population and Global Health, The University of Melbourne, Melbourne, VIC, Australia
[d] Institute for Health and Ageing, Australian Catholic University, Melbourne, VIC, Australia
[e] Murdoch Childrens Research Institute, Royal Children's Hospital, Melbourne, VIC, Australia
[f] Centre for the Built Environment and Health, School of Population Health, The University of Western Australia, Perth, WA, Australia

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ABSTRACT

This study examined whether the association of psychological distress with area-level socio-economic status (SES) was moderated by the area and attractiveness of local green space. As expected, the odds of higher psychological distress was higher in residents in lower SES areas than those in higher SES areas. However, our results were inconclusive with regard to the moderating role of green space in the relationship between psychological distress and SES. Further investigations incorporating safety and maintenance features of green space and street-level greenery are warranted.

1. Background

Socio-economic disparities in health persist in society, and reducing health inequalities is recognized as a critical strategy for population health (Centers for Disease Control and Prevention, 2013; Marmot and Bell, 2012; National Preventative Health Taskforce, 2009). Despite public health efforts to reduce inequalities, systematic and avoidable health disparities exist between people of lower and higher levels socio-economic status (SES), who in definition differ in terms of access to material and social resources (Australian Bureau of Statistics, 2008). For example, in Australia, those who are in the lowest quintile in household income are 2–4 times more likely to suffer from long-term ill health than those in the highest quintile (Brown and Nepal, 2010). Socio-economic disparities also exist in mental health (Lorant et al., 2003). A Welsh study found that residents of lower income areas tended to have poorer mental health status than those in higher income areas (Fone et al., 2007). A Danish study also reported that lower income (bottom third) participants had 3.5 times higher odds of minor depression, and 8.5 times higher odds of major depression, relative to those with higher income (Andersen et al., 2009).

Neighborhood green spaces are important community assets that could contribute to residents' mental health, through a number of potential pathways (Lachowycz and Jones, 2013). For instance, exposure to nature is known to have restorative effects (Hansmann et al., 2007; Hartig et al., 2003). Physical activity and social interaction, often facilitated within local parks, are also associated with better mental health (Kawachi and Berkman, 2001; Penedo and Dahn, 2005). Research has shown positive associations between neighborhood green space and residents' mental health. Adults who perceived their neighborhood to be greener were found to have better mental health than those who perceived it less green (Sugiyama et al., 2008). Residents of neighborhoods with a high-quality green space had lower levels of psychosocial distress than those of neighborhoods with a low-quality open space (Francis et al., 2012). Neighborhood greenness, measured using satellite imagery, was also found to be negatively associated with adult's stress levels (Fan et al., 2011). Similarly, a UK study found that participants living in areas with more green space tended to have lower perceived stress and a healthier cortisol measure (Roe et al., 2013).

* Corresponding author at: Centre for Design Innovation, Faculty of Health Arts & Design Swinburne University of Technology, Internal Mail H31, PO Box 218, Hawthorn, VIC 3122, Australia.

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The distribution and quality of green spaces across diverse SES areas may have implications in SES-related inequalities in mental health. Examining whether exposure to greener environments mitigates the health gap between disadvantaged and less disadvantaged neighborhoods, Mitchell and Popham (2008) found that inequalities in mortality and cardiovascular disease between areas of low and high deprivation (determined based on the proportion of low income households) were less pronounced among those who live in greener neighborhoods (Mitchell and Popham, 2008). A more recent study also found a narrower socio-economic inequality in mental well-being among those who reported better access to recreational/green areas (Mitchell et al., 2015). However, it is unknown how the size and attractiveness of local green spaces are related to mental health inequalities between lower and higher SES areas. We postulate that the relationship between psychological distress and SES will be less pronounced among participants who have greater amount and more attractive green space, because exposure to greenery may reduce psychological distress, which is more prevalent in lower SES areas. In addition, attractive green space may encourage residents to engage in recreational walking and physical activity, which are also known to be less prevalent in lower SES areas (Beenackers et al., 2012; Janssen et al., 2010).

This study examined whether the associations of residents' mental health (psychological distress) with area-level SES were moderated by the size and quality of green space. We hypothesized that the relationship between psychological distress and SES is less pronounced (1) among participants with larger green space; (2) among those with attractive green space in their neighborhood.

2. Methods

2.1. Data source and participants

This study forms part of the Life Course Built Environment and Health project, a cross-sectional data linkage study exploring associations between built environment features and health across different life stages (children through to older adults) in Perth, Western Australia. The overall project methods are described in detail elsewhere (Villanueva et al., 2013). Briefly, participants were those who completed the Western Australian Health and Wellbeing Surveillance System (HWSS) survey, administered by the Department of Health of Western Australia (DoHWA). The HWSS was conducted in 2003–09, collecting data from 21,347 participants, who were sampled randomly from the Perth metropolitan and Peel area. The data of built environment were linked to 75% of survey participants who consented to data linkage and had a geocoded home address ($n=15{,}954$). For this study, adults aged 18–64 years who completed one of the HWSS surveys conducted in 2005–09 were included ($n=7034$). Those who participated in 2003 and 2004 were not included because some covariates used in this study were not asked in these years. Ethics approval was obtained from the Department of Health of Western Australia and The University of Western Australia.

2.2. Outcome: psychological distress

The HWSS included the Kessler Psychological Distress Scale (K10), a 10-item scale intended to assess non-specific distress based on questions about anxiety and depressive episodes that a person experienced in the past four weeks. This scale has been validated in the Australian population against clinical diagnoses of depressive symptom and anxiety disorder (Andrews and Slade, 2001), and has shown to have better discriminatory power than the GHQ-12 for screening DSM-IV mood and anxiety disorders (Furukawa et al. 2003). It has been also shown to have a high internal consistency, with Cronbach's alpha over 0.9 (Cornelius et al., 2013). Possible K10 scores ranged from 10 to 50, where a higher score indicates that a person may be experiencing higher levels of distress consistent with a diagnosis of a severe depression and/or anxiety disorder (Andrews and Slade, 2001). As there are no agreed standards for scoring the K10, this study adopted the K10 categories used in previous Australian health surveys (Australian Bureau of Statistics, 2012): "low" (10–15); "moderate" (16–21); "high" (22–29); and "very high" (30–50). Due to a small number of participants belonging to the very high category (2.5%), the high and very high categories were combined to create three levels: low, moderate, and high.

2.3. Exposure: area-level socio-economic status

As an area-level indicator of SES, the Index of Relative Socio-economic Disadvantage (IRSD) was extracted for each census collection district (CCD) defined by the Australian Bureau of Statistics in 2006. The IRSD is a composite area-level socio-economic indicator consisting of factors such as income, education, employment, and car ownership, with lower scores pertaining to higher levels of disadvantage (Australian Bureau of Statistics, 2008). At the time of data collection, CCDs were the smallest geographic sub-units for census data collection, averaging approximately 225 dwellings in urban areas (Australian Bureau of Statistics, 2006). For the purpose of descriptive analysis, the CCDs in which participants resided were categorized into quartiles based on their IRSD score, and participants were grouped according to the quartile. The IRSD was treated as continuous (standardized) for regression analysis, given that research has shown roughly a linear association between socio-economic status and psychological distress (Andersen et al., 2009).

2.4. Potential moderators: park area and attractiveness

Parks in this study refer to green spaces for recreational use, which are accessible to the general public, free of charge. They do not include private or inaccessible spaces such as residential gardens and school grounds. Parks in metropolitan Perth were manually digitized in Geographic Information Systems (GIS) software, ESRI ArcGIS v10.1, by drawing a polygon around the park perimeter using the 2010 orthophotography (aerial imagery) and Perth street directory as guides. Parks >0.3 ha within a road network distance of 400 m, 800 m, 1200 m, and 1600 m from participants' home (neighborhood buffer) were used for the study. Parks ≤ 0.3 ha (i.e., pocket parks) were not included due to the unavailability of audit data. The pedestrian network was not available for this study.

For each neighborhood buffer, three park variables, total area, mean attractiveness score, and attractiveness score of the most attractive park, were examined as potential moderators of the relationships between area-level SES and psychological distress. Total park area (ha) was computed for each neighborhood buffer size for each participant. When a park was intersected by a buffer, its whole area was included in the total area. Attractiveness was measured by assigning a score to the park's features and amenities. In 2010, all parks >0.3 ha in Perth metropolitan area ($n=2525$) were audited using the Public Open Space Desktop Audit Tool (POSDAT), a desktop auditing tool developed for capturing park attributes (Edwards et al., 2013). Briefly, nine park attributes (lawn irrigation; walking paths; shade along paths; sporting facilities; being adjacent to beach/river; water features; bird life; surrounding roads; lighting) were audited using remote sensing techniques (e.g., Google Earth). Each park was given an