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Greenspace, physical activity and well-being in Australian capital cities: how does population size moderate the relationship?

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ABSTRACT

Objectives: The purpose of this study is to investigate the synergy between greenspace and physical activity and its implications for well-being. In particular, how this synergy may depend on population size in the neighborhood.

Study design: Cross-sectional analysis of resident-level responses from the Household, Income and Labour Dynamics in Australia (HILDA) survey for 2013 subset to Australia's major capital cities and linked to Geographic Information Systems (GIS) data.

Methods: GIS data on greenspace and Australian Bureau of Statistics data on population size for the neighborhood are matched to the residents in the HILDA survey on the basis of the Census Collection District in which they reside. A cluster-specific fixed effects model is estimated for the outcomes of mental health and psychological distress. A battery of socio-demographic and location characteristics were also adjusted for. Interaction terms are used to discern the extent to which population size may moderate any synergistic well-being benefits associated with physical activity and greenspace. This question is ultimately operationalized as a three-way interaction effect (greenspace × physical activity × population size).

Results: The results indicate that physical activity is most strongly and positively associated with mental health (statistically significant at the 1% level), with an estimated coefficient of 0.6307. The results also reveal that physical activity is negatively associated with psychological distress (statistically significant at the 10% level), with an estimated coefficient of −0.2447. Unexpectedly, for both mental health and psychological distress the greenspace and population variables are not found to have separate statistically significant effects.

Furthermore, while the results fail to find, on average, the hypothesized synergy between greenspace and physical activity, a closer inspection reveals that this link may depend on the population size of a neighborhood. The interaction term for greenspace, physical activity and population bears a coefficient estimate of 0.0033, statistically significant at the 5% level in the mental health regression and a coefficient of −0.0032, statistically significant at the 1% level in the psychological distress regression.

Conclusion: The results indicate that physical activity is linked differently to mental health and psychological distress. The results initially provide no evidence of the hypothesized

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greenspace–physical activity synergy. The results provide evidence that this synergy is greater in more populated neighborhoods.

Introduction

Globally the rate of urbanization is unprecedented.[1–3] Australia, already one of the most urbanized countries in the world,[4] is sharing in this global trend. This concentration of people in cities presents both benefits and challenges. Urbanization provides clear economic benefits, being strongly linked to economic growth.[3] However, urbanization and land use change are irrevocably altering the environment in which many residents live,[5] impinging on recreational spaces like parks and bushland,[6] driving terrestrial biodiversity loss[7] and generally undermining the amenity of value provided by the environment, such as the beauty and tranquillity of the countryside.[8] It is important to understand what these transformative changes in the urban environment mean for the well-being of local residents.[9,10]

A consequence of urban planning and design policies focused on densification and urban consolidation is that residents are more likely to reside in neighborhoods with less greenspace.[11] Furthermore, associated with the relative scarcity of greenspace in urban areas (exacerbated by zoning and development regulations which allow a reduction of greenspace for higher density development[12]) appears to be a higher marginal well-being attributable the greenspace that remains in more populated neighborhoods.[13] In more populated neighborhoods, residents may seek to avoid crowds, reducing the recreational amenity green spaces offer. Conversely, overcrowding may raise the marginal benefit associated with the size of green spaces.[14] That is, greenspace may be more strongly associated with well-being in more populous places as it offers a an escape or reprieve from crowding[15] and excessive stimulus characteristic of more populated urban environments.[16,17] In this regard, urban design offers a potential mechanism through which to promote the health and well-being of residents.[18]

The Healthy Cities Movement argues that the design of urban environments can promote health and well-being through encouraging physical activity.[18] This argument relies on the benefits of a moderate level of physical activity on most if not all days of the week which are widely known[19] and have been integrated into public policy.[20] At the intersection of the well-established benefits of physical activity[19] and the restorative effects of contact with a natural environment,[21] a number of studies[22–26] hypothesize that physical activity in a natural environment might produce greater mental well-being benefits than physical activity elsewhere.[25] This hypothesis has been most succinctly described in the literature as an exploration of the greenspace–physical activity synergy.

However, despite the admirable efforts of earlier researchers, a recent systematic review of the literature in this area identifies persistent weaknesses in the methodology of earlier studies and points to a genuine need for high quality evidence on the issue.[24] In addition, the emergence of some unexpected findings have raised new and related questions, for instance, 'do different types of environment promote different kinds of positive psychological response?'[25] This question poses a challenge for researchers, policy makers and planners. It suggests that the relationship between greenspace, physical activity and well-being may in fact be more complicated than has tended to be hypothesized. A point made plainly clear by the declaration that, 'There is no inevitable, or straightforward, relationship between environment and health benefit. It has become impossible to consider the 'natural environment' and the human body as separate entities in any simplistic way … people-in-environments are complex systems, with multiple pathways interlinking space and health.'.[27]

Given the existing state of knowledge, global rates of urbanization and the attendant transformation of urban environments, it is pertinent to ask, what may this imply for the well-being of residents residing in such urban centres? Specifically, does the size of the population in a neighborhood moderate hypothesized greenspace–physical activity synergistic well-being benefits? It is not difficult to imagine how this question may be operationalized as a three-way interaction effect (greenspace × physical activity × population size).

In this respect, this study goes beyond earlier research efforts by exploring, for the case of Australian cities; how population size may moderate the greenspace–physical activity synergy. In doing so, this study contributes to the stock of knowledge regarding the confluence of greenspace, physical activity and well-being. The results borne out of this investigation may also prove useful to policy makers wrestling with the challenges of maintaining or improving residents' well-being in the face of continuing population growth and declining per capita greenspace in cities.

In what follows, the Methods section reports the method and data employed in the investigation, while the Results section provides an account of the results obtained. Finally, the Discussion section discusses the findings and concludes.

Methods

In order to investigate if population size may moderate the greenspace–physical activity synergy, well-being is modelled using the following cluster-specific fixed model for resident r in location k as shown in Equation (1).

$$WB_{r,k} = \omega + \sum_{j=1}^{m} \beta_j x_{r,k} + \kappa_k + \varepsilon_{r,k} \quad (1)$$

where $WB_{r,k}$ is a resident's mental health or psychological distress, $x_{r,k}$ is a vector of socio-economic variables such as,