Urban Forestry & Urban Greening 19 (2016) 7–12

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Short communication

An investigation into the synergistic wellbeing benefits of greenspace and physical activity: Moving beyond the mean

Christopher L. Ambrey

Cities Research Centre, Gold Coast Campus, Griffith University, Queensland 4222, Australia

ARTICLE INFO

Article history:
Received 3 June 2015
Received in revised form 17 March 2016
Accepted 21 June 2016
Available online 4 July 2016

Keywords:
Geographic information systems (GIS)
Greenspace
Household
Income and labour dynamics in Australia (HILDA)
Life satisfaction
Mental health
Physical activity
Psychological distress
Wellbeing

ABSTRACT

The purpose of this study is to shed light on: (1) how greenspace and physical activity, independent of any synergy, are heterogeneously linked across the distribution of wellbeing; and also (2) how the potential synergies between greenspace and physical activity might have heterogeneous impacts across the distribution of wellbeing. Using data from the Household, Income and Labour Dynamics in Australia survey and data from Geographic Information Systems this study finds, for the case of major Australian cities, that greenspace and physical activity are independently positively associated with life satisfaction, mental health and negatively associated with psychological distress. A finding which is stronger for physical activity than it is for greenspace. Across measures of life satisfaction, mental health and psychological distress, the results lend support to the hypothesis that physical activity may be relatively more effective at mitigating the likelihood of experiencing a serious dearth of wellbeing, compared to promoting higher levels of wellbeing. Unexpectedly, the results do not provide support for the hypothesised greenspace-physical activity synergy. A result found to be common across the wellbeing distribution. While further research is required to draw a definitive conclusion, this result may indicate that physical activity is simply not conducive to the realisation of the restorative benefits of exposure to nature, and the other co-benefits of 'green exercise'. In all, the findings presented in this study add to the existing stock of knowledge from a socialecological perspective and also raise new questions for future research. The results presented in this study may also prove useful to policy makers wrestling with the challenges of maintaining or improving residents' wellbeing and reducing residents' ill-being in the face of continuing population growth and declining per capita greenspace.

1. Introduction

Throughout the world urbanisation is occurring at an unprecedented rate (United Nations Economic and Social Affairs, 2014a,b; United Nations Population Fund, 2015). Australia, already one of the most urbanised countries in the world (The World Bank, 2015) is sharing in this global trend. However, urbanisation and land use change are irrevocably altering the environment in which many residents live (Sachs, 2008), impinging on recreational spaces like parks and bushland (Lavelle, 2006) and leading to the congestion of those green spaces that remain (Arnberger, 2012) with implications for the health and wellbeing of a city's local residents (Barton, 2009). Acknowledging this relationship between greenspace and wellbeing a number of studies (cf. Bodin and Hartig, 2003; Hug et al., 2009; Mitchell, 2013; Pretty et al., 2007; Thompson Coon et al., 2011) have hypothesised that physical activity in natural environments might produce greater mental health benefits than physical activity elsewhere (Mitchell, 2013). This hypothesised synergistic link builds on the well-established physiological and psychological benefits of physical activity (cf. US Department of Health, 1996). It also combines: (1) the restorative effects of contact with a natural environment (cf. Kaplan, 1995); and (2) the co-benefits of 'green exercise' for example, feelings of connectedness to nature and an increased appreciation of nature, which may bolster the longevity of one's engagement in physical activity (Thompson Coon et al., 2011). Despite the best efforts of earlier investigators many caveats continue to surround the triadic relationship between the greenspace, physical activity and wellbeing (Mitchell, 2013).

A recent systematic review of the literature by Thompson Coon et al. (2011) demonstrates a real paucity of high quality evidence on which to base recommendations. Of the studies reviewed, the samples tend to contain of between 8 and 269 respondents. Further, most of these respondents are young university students, in the US, who are already physically active. The use of single short-term walking or running experiments also provides little indication

E-mail address: c.ambrey@griffith.edu.au

http://dx.doi.org/10.1016/j.ufug.2016.06.020
1618-8667/

of the efficacy of interventions over the long-term. Moreover, the lack of easily transferrable outcome measures and the presence of concurrent interventions obscures precisely what conclusions may be drawn from some earlier evidence.

Distinct from this body of literature, there is evidence emerging from the empirical economic and psychological literature which suggests that positive and negative wellbeing are more than merely opposite ends of the same phenomenon (Boes and Winkelmann, 2010). It may be the case for example, that individuals experiencing mild depression gain larger benefits from physical activity (Thompson Coon et al., 2011). In this regard, the purpose of this study is to go beyond earlier research efforts by revealing both: (1) how greenspace and physical activity, independent of any synergy, are heterogeneously linked across the distribution of wellbeing; and also (2) how the potential synergies between greenspace and physical activity might have heterogeneous impacts across the distribution of wellbeing. In particular, this study investigates the following hypotheses:

H1: Whether or not the greenspace and physical activity, independent of any synergy, are heterogeneously linked across the distribution of life satisfaction.

H2: Whether or not any greenspace and physical activity synergy differs across the distribution of life satisfaction.

H3: Whether or not the greenspace and physical activity, independent of any synergy, are heterogeneously linked across the distribution of mental health.

H4: Whether or not the greenspace and physical activity synergy differs across the distribution of mental health.

H5: Whether or not the greenspace and physical activity, independent of any synergy, are heterogeneously linked across the distribution of psychological distress.

H6: Whether or not the greenspace and physical activity synergy differs across the distribution of psychological distress.

In doing so, for the case of major Australian cities this study contributes to the stock of knowledge regarding the interplay between greenspace, physical activity and wellbeing. The findings presented in this study may prove useful to policy makers wrestling with the challenges of maintaining or improving residents' wellbeing and reducing residents' ill-being in the face of continuing population growth and declining per capita greenspace. In what follows, Section 2 reports the data and method employed. Section 3 provides an account of the results and Section 4 discusses the findings and Section 5 concludes.

2. Materials and method

In terms of the socioeconomic data on the 6082 residents this is obtained from wave 13 (2013) of the Household, Income and Labour Dynamics in Australia (HILDA) Survey, subset to the major capital cities of Australia.[1] The sampling design of the survey involves the selection of households into the sample by a multi-stage process. In wave 1 (2001) of the HILDA Survey, a random sample of 488 Census Collection Districts (CDs) based on the 1996 census boundaries was selected from across Australia, stratified by State, and within the five largest States in terms of population, by metropolitan and non-metropolitan regions, each CD consisting of approximately 200–250 households. The CDs were sampled with probability proportional to their size as measured by the number of dwellings (unoccupied and occupied) recorded in the 1996 Census with some adjustments for population growth since the Census. Within each of these CDs, all dwellings were fully enumerated and a sample of 22–34 dwellings randomly sampled based on the expected response and occupancy rates within each area (Watson and Wooden, 2002).

The life satisfaction dependent variable is obtained from residents' responses to the question*: 'All things considered, how satisfied are you with your life?'* The life satisfaction variable is an ordinal variable, the resident choosing a number between 0 (totally dissatisfied with life) and 10 (totally satisfied with life).

The mental health dependent variable is obtained using data from the Short-Form General Health Survey (SF-36) instrument (collected within the HILDA Survey), an internationally recognised diagnostic tool for assessing functional health status and well-being. The Mental Component Summary (MCS) used in this study is derived from 14 items on four scales; vitality, social functioning, role-emotional and mental health, transformed to a 0–100 index using 1995 Australian Bureau of Statistics population norms (Australian Bureau of Statistics, 1995; Ware et al., 2000). A higher mental health score indicates better mental health while a lower mental health score indicates the reverse.

The psychological distress dependent variable is measured by the Kessler Psychological Distress Scale (K10) also collected in the HILDA Survey. The ten questions and their selection are described at length in Kessler et al. (2002), as explained by Wooden (2009) the K10 score was derived by scoring responses on each of the items using a simple linear scale running from 5 (all of the time) to 1 (none of the time), and summing across all items. The overall score thus ranges from 10 to 50, where a higher score indicates greater psychological distress and a lower score indicates lower psychological distress.

Apart from the different dependent variables employed, the key measure of physical activity is derived from dichotomising the total physical activity Metabolic Equivalent of Task (MET) minutes per week (International Physical Activity Questionnaire). The variable is defined as *'Exercising as recommended (MET)'* (1) or not (0), where exercising as recommended is defined as MET minutes per week greater than 840 and less than 10,000. That is, the equivalent of 30 or more min × week × 4 MET. To avoid measurement error due to over-reporting, those reporting energy expenditure of 10,000 MET (min/week) or more were excluded (Giles-Corti and Donovan, 2002). Exercising as recommended was defined as the accumulation of the equivalent of 30 min or more of moderate physical activity on most days of the week (US Department of Health, 1996).

Data from the HILDA survey are linked to Geographic Information Systems (GIS) data on greenspace through the resident's Census Collection District (CD). Using GIS CDs are overlayed with greenspace measured from the PSMA Australia Limited Transport and Topography dataset (the 2010 release). Greenspace includes for instance, public parks, community gardens, cemeteries, sports fields, national parks and wilderness areas (cf. Bell et al., 2008). The variable is the number of hectares of greenspace per resident in the CD. A detailed description and summary statistics of the key variables are provided Table 1.[2]

Hypotheses 1–6 are investigated through the estimation of four conditional logistic regression models, one for each quartile of the dependent variable within a seemingly unrelated regression (SUR) system of equations.[3] The dependent variable $WB_{q_{1...4}r,k}$ represents a resident's life satisfaction, or mental health or psychological distress each of which have been disaggregated into $q_{1...4}$ quartiles. The different quartiles for each wellbeing measure allow heterogeneity across the distribution to be revealed.

[1] Major capital cities in Australia include: Adelaide, Brisbane, Canberra, Darwin, Melbourne, Perth and Sydney.

[2] Full summary statistics and results are available as supplementary material.

[3] The models estimated for each quartile are based on the same data, they are not independent from each other and hence their residuals are likely correlated. As such the regression results for the separate estimations, obtained using Stata/SE 13.1, are combined using Stata's 'suest' postestimation command.