Social Science & Medicine 71 (2010) 568–575

Contents lists available at ScienceDirect

Social Science & Medicine

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

Gender differences in relationships between urban green space and health in the United Kingdom☆

Elizabeth A. Richardson [a,*], Richard Mitchell [b]

[a] School of GeoSciences, University of Edinburgh, Drummond Street, Edinburgh EH8 9XP, United Kingdom
[b] Section of Public Health and Health Policy, Faculty of Medicine, University of Glasgow, Glasgow G12 8RZ, UK

ARTICLE INFO

Article history:
Available online 12 May 2010

Keywords:
UK
Green space
Gender
Mortality
Self-reported health
Environmental quality

ABSTRACT

Natural environments, or 'green spaces', have been associated with a wide range of health benefits. Gender differences in neighbourhood effects on health have been found in a number of studies, although these have not been explored in relation to green space. We conducted the first UK-wide study of the relationship between urban green space and health, and the first such study to investigate gender differences in this relationship. An ecological approach was used. Two land use datasets were used to create a proportional green space measure (% by area) at the UK Census Area Statistic ward scale. Our sample consisted of 6432 urban wards, with a total population of 28.6 million adults aged 16–64 years in 2001. We selected health outcomes that were plausibly related to green space (cardiovascular disease mortality, respiratory disease mortality and self-reported limiting long-term illness) and another that was expected to be unrelated (lung cancer mortality). Negative binomial regression models examined associations between urban green space and these health outcomes, after controlling for relevant confounders. Gender differences in these associations were observed and tested. Male cardiovascular disease and respiratory disease mortality rates decreased with increasing green space, but no significant associations were found for women. No protective associations were observed between green space and lung cancer mortality or self-reported limiting long-term illness for either men or women. Possible explanations for the observed gender differences in the green space and health relationship are gender differences in perceptions and usage of urban green spaces. We conclude that it is important not to assume uniform health benefits of urban green space for all population subgroups. Additionally, urban green space measures that capture quality as well as quantity could be more suited to studying green space and health relationships for women.

Introduction

Natural or green environments positively influence people's self-perceived health (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Mitchell & Popham, 2007; Sugiyama, Leslie, Giles-Corti, & Owen, 2008), blood pressure (Hartig, Evans, Jamner, Davis, & Gärling, 2003), levels of overweight and obesity (Ellaway, Macintyre, & Bonnefoy, 2005), longevity (Takano, Nakamura, & Watanabe, 2002) and risks of all-cause and circulatory disease mortality (Mitchell & Popham, 2008). Possible causative mechanisms behind the green space and health relationship include the psychologically and physiologically restorative effects of nature (Hartig et al., 2003; Pretty, Peacock, Sellens, & Griffin, 2005), the facilitation of social contacts (Maas, van Dillen, Verheij, & Groenewegen, 2009) and the provision of opportunities for physical activity (Humpel, Owen, & Leslie, 2002; Kaczynski & Henderson, 2007), though not all studies find associations between green space and physical activity (Hillsdon, Jones, Panter, & Foster, 2006; Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008). Visual access to green space may, in itself, provide a salutogenic effect (Ulrich, 1984).

There has been little exploration of whether the associations between green space and health vary between different types of people. One study from the Netherlands suggested that the health of young people, the elderly, housewives and those with low

☆ We are grateful to four anonymous reviewers for their constructive feedback on the draft manuscript. We thank the European Environment Agency for access to the CORINE dataset and the Office of the Deputy Prime Minister for access to the GLUD dataset. We also thank SASI at Sheffield for managing the individual level death records. This study was funded by the Forestry Commission.

* Corresponding author. Tel.: +44 (0)131 650 2800.
E-mail address: e.richardson@ed.ac.uk (E.A. Richardson).

0277-9536/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.socscimed.2010.04.015

socioeconomic status benefited more from residential green space than other groups (de Vries et al., 2003; Maas et al., 2006). This was attributed to the greater amount of time these groups spent in their residential area and thus their greater exposure to green spaces.

There is a larger body of work exploring the influences of other aspects of residential environment on health and this has found that effects may vary by residents' gender, age or socioeconomic status (Stafford, Cummins, Macintyre, Ellaway, & Marmot, 2005). In particular, gender differences in neighbourhood effects on health have been found in a number of studies. Stafford et al. (2005) found that various social and physical characteristics of the neighbourhood were more strongly associated with women's health than with men's. They suggest that the residential environment may be more important for women's health, perhaps because women have greater exposure to their neighbourhood environment, or are more vulnerable to its effects. Other studies suggest that neighbourhood social environment in particular is more important for women's health than men's (Kavanagh, Bentley, Turrell, Broom, & Subramanian, 2006; Molinari, Ahern, & Hendryx, 1998; Poortinga, Dunstan, & Fone, 2007), whilst its physical environment may be more important for men's health (Molinari et al., 1998). As men and women benefit from their residential area in different ways, further investigation of gender differences in neighbourhood effects is warranted (Poortinga et al., 2007).

Gender differences in exposure to or use of green space have been suggested by several studies, although this work leads to contradictory hypotheses about how these differences might manifest themselves in health associations. Women are underrepresented in their use of green space, proportionate to their numbers in society (Cohen et al., 2007; Hutchison, 1994; Ward Thompson et al., 2003) and are less likely to engage in vigorous physical activity than men whilst in green space (Cohen et al., 2007). Thus we might hypothesise that green space will be more important for men's health than women's. Alternatively, women spend more time in their neighbourhood than men because they are more likely to be supervising children, working part time, conducting domestic work or being primary caregivers (Kavanagh et al., 2006). We could therefore hypothesise that the neighbourhood environment (including green space availability) will be more important for women's health. This study was prompted by these competing hypotheses and by the lack of existing evidence for gender differences in the relationship between urban green space and health.

The setting for this study was the United Kingdom. Evidence of a positive association between green space and health has been found in England (Mitchell & Popham, 2007, 2008) and Scotland (Ellaway et al., 2005), but lack of a UK-wide green space measure has precluded investigation of green space and health relationships for the entire UK. The study aims were: to develop a UK-wide small area measure of green space coverage; to use it to examine the associations between health and green space coverage; and to determine if there are gender differences in these associations.

Methods

Geographical unit of analysis

Our areal units were Census Area Statistics (CAS) wards (2001), the smallest geographical unit for which our health, environment and population measures were available throughout the UK. There are 10654 CAS wards in the UK, but we selected the 6432 wards classified as urban according by the urban-rural classifications of the UK's constituent countries (DEFRA, 2005; NISRA, 2005b; Scottish Executive, 2006; i.e., settlements with populations >10,000). We restricted our analysis to urban settings for two reasons. First, the dominant types of green space and their accessibility tend to differ between urban and rural areas (Liu, Wilson, Qi, & Ying, 2007; Mitchell & Popham, 2008). Often agricultural land dominates in rural areas for example, and it is known that environmental correlates of health-related behaviour differ between urban and rural areas (Parks, Housemann, & Brownson, 2003). Second, the majority of the population in the UK live in urban areas. Our sample of 6432 wards had a mean population of 6930 in 2001 (standard deviation 4014), and a mean size of 4.6 km^2 (standard deviation 11.3).

Green space measure

Two land use datasets were used to create our green space measure. The Generalised Land Use Database (GLUD, Office of the Deputy Prime Minister, 2001) provided percentage green space per small area. GLUD is derived from the high resolution Master Map product available from the Ordnance Survey (OS). OS Master Map vector data is captured at a scale of 1:1250, hence the GLUD estimates include all vegetated areas larger than 5 m^2 in area (with the exception of domestic gardens), regardless of their accessibility (public or private). However, the GLUD only covers England. The Coordination of Information on the Environment (CORINE) land cover dataset was also obtained (EEA, 2000), as this has UK-wide coverage. Raster pixels (100 m^2) from remotely-sensed satellite imagery are classified into one of 44 land cover categories (e.g., green urban areas, continuous urban fabric, pasture, water bodies). The smallest area of green space mapped in the CORINE dataset was 25 ha (Büttner, Feranec, & Jaffrain, 2002), hence only large green spaces were represented.

CORINE (UK-wide coverage but only sensitive to larger spaces) and GLUD (more sensitive to total green space regardless of space size, but only English coverage) were used together to produce a data set estimating green space within *all* wards in the UK. We created a regression model in which GLUD percentage green space for each English ward was predicted by a combination of its CORINE composition (% green space, % urban fabric, % blue space) and population density (2001 census). The model predicted the GLUD values extremely well ($R^2 = 0.95$, $p < 0.001$). Predicted green space values for all wards in the UK were then derived from the model. For English wards we compared model results (see below) obtained when using GLUD as a measure of green space, with those using our derived estimates of green space. Unsurprisingly (given the strength of the predicting regression model), no differences were observed. Due to its origins in the GLUD dataset our derived measure was an estimate of the percentage combined coverage of all green spaces larger than 5 m^2 (excluding domestic gardens) for each ward in the UK. The measure had greater sensitivity to small green spaces than the CORINE dataset, with the benefit that green spaces smaller than 25 ha were included. Green spaces included therefore ranged from transport verges and neighbourhood greens, to parks, playing fields and woodlands.

Health data

We selected three prevalent health outcomes whose aetiology could be plausibly associated with green space availability, based on the assumption that green space effects on health derive from a combination of physical activity promotion and stress reduction. There is clear evidence for the protective effects of physical activity against cardiovascular disease mortality (Nocon et al., 2008), respiratory disease mortality (Garcia-Aymerich, Lange, Benet, Schnohr, & Anto, 2006) and self-reported ill health (Netz, Wu, Becker, & Tenenbaum, 2005). We also selected lung cancer mortality, as a health outcome for which a plausible association with green space is absent or less clear (Tardon et al., 2005).