



Evaluating the relative influence on population health of domestic gardens and green space along a rural-urban gradient



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HIGHLIGHTS

- Domestic gardens mitigate health deprivation more effectively than green space.
- Local population mediates the effect of urban green land-use cover.
- Level of urbanity affects the relationship between urban greenery and health.

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ABSTRACT

Studies have repeatedly affirmed the positive links between human and environmental health but few have sufficiently addressed the complexity brought about by the range of urbanity, population and both green space and domestic gardens cover associated human settlements. With the global population increasingly residing in cities, the relevance of urbanisation, local population and discrete types of green space provision on measures of health, remains a research imperative. To explore this complexity, a series of regression models were employed to quantify the mitigation of local health deprivation by green space and domestic gardens, across a four-stage rural-urban gradient, controlling for household income and local population. The population-standardised quantification of green space provision offered greater interpretive power than did a simple measure of land cover density. Domestic gardens, of the two green land-cover types, provided the most convincing mitigating effect on health deprivation. The findings call for increased acknowledgement of urban gardens in local health promotion, and a closer consideration of local population in planning green space provision and management.

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1. Introduction

The links between the natural environment and human health have taken a central role in approaches to natural resource management since the launch of the Ecosystem Approach (CBD, 2004). In particular, Principle 5 of the Ecosystem Approach, which promotes the conservation of ecosystem function towards the maintenance of services vital to human well-being, was taken up in earnest by the Millennium Ecosystem Assessment (MEA, 2005). The ecosystem services framework has since become a ubiquitous ingredient in social-ecological research (Costanza et al., 2006; Costanza, Fisher, Mulder, Liu, Christopher, 2007; De Groot, Wilson, & Boumans, 2002; Mace, Norris, & Fitter, 2012; Niemelä et al., 2010; Tyrvaäinen, 2001;

Wall & Nielsen, 2012) and has taken a central role in efforts to influence the nurturing of positive human-environmental relationships through policy (Defra, 2010, 2011; Haines-Young & Potschin, 2013; MEA, 2005; TEEB, 2008; UK NEA, 2011).

A variety of services have been identified as relevant to human health. These cover the regulating, provisioning, supporting, and cultural ecosystem services (Millennium Ecosystem Assessment classification: MEA, 2005). Many of these services are concerned with the production of indirect-use goods and services such as food production, air purification, water attenuation and filtration, soil formation and pollination (De Groot, Alkemade, Braat, Hein, & Willemen, 2010) and the primary focus of the Millennium Ecosystem Assessment involved an investigation into the importance of such services for human well-being and poverty alleviation, particularly in developing countries and the Global South. In addition to services directly related to human subsistence, a number of so-called non-use value services relate to human experience and interaction with nature itself (De Groot et al., 2010;

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Niemelä et al., 2010). The majority of such benefits of natural environments are described as *cultural ecosystem services* primarily appreciated for their aesthetic and recreational value (Haines-Young & Potschin, 2013; MEA, 2005; Niemelä et al., 2010; UK NEA, 2011). Increasingly, however, the importance of activity in and proximity to nature, mediated by such factors as aesthetics (Galindo & Corraliza, 2000), biodiversity (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007) and recreation (Bird, 2007) have been proven to be beneficial to human health (Carrus et al., 2015; Tzoulas et al., 2007). Research into the importance of exposure to nature for human well-being (Carrus et al., 2015; Fuller et al., 2007; Krasny & Tidball, 2015; Maas et al., 2009; Mitchell, Astell-Burt, & Richardson, 2011; Pretty, Peacock, Sellens, & Griffin, 2005), has gained increasing momentum towards the understanding and promotion of health in urban populations, particularly in urban centres of the Global North, the context of the current study.

With the majority of the global population now residing in towns and cities (United Nations, 2007), attention has turned to the ecological conditions which influence human health in the urban environment (Bolund & Hunhammar, 1999; Coutts, 2011; MEA, 2005; WHO, 2005). Although urban areas appropriate vast ecological resources, relying on ecosystem services generated at much wider scales (Folke, Jansson, Larsson, & Costanza, 1997), quality of life for urban residents is also highly dependent on natural elements within cities (Krasny & Tidball, 2015; MEA, 2005; Stott, Soga, Inger, & Gaston, 2015; UK NEA, 2011). Studies have repeatedly shown the positive effects on the well-being of urban inhabitants stemming from naturalistic environments in cities (Burls & Khan, 2005; Mitchell & Popham, 2007; Niemelä et al., 2010; Tzoulas et al., 2007; Von Shiring, 2002). In attempts to understand the dynamic between urban green space and human physical and mental health, much of the research carried out has explored correlations between measures of self-reported health and environmental factors such as living in proximity to green space (Jackson, 2003; Gidlöf-Gunnarsson & Öhrström, 2007; Kaplan, 1995; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Maas et al., 2009; Maller, Townsend, Pryor, & Brown, 2006), local access to naturalistic areas (Ward Thompson, Aspinall, & Roe, 2014) and physical activity in nature (Bird, 2007; Carrus et al., 2015; Marselle, Irvine, & Warber, 2014; Pretty et al., 2005; Tzoulas et al., 2007). The measured health-related outcomes include reduced levels of morbidity (Mitchell & Popham, 2007), stress reduction (Thompson et al., 2012), attention restoration (Li & Sullivan, 2016; Sullivan & Chang, 2011; Taylor, Kuo, & Sullivan, 2002) and increased social (Sullivan, Kuo, & DePooter, 2004) and physical (Epstein et al., 2006) activity.

Notwithstanding the insight gained from such work, few studies have given sufficient attention to the effect of increasing urbanity itself on human well-being. Some investigations have attempted to quantify the impact of increasing urbanisation on ecosystem services through the use of spatial analyses across a rural-urban gradient (Radford & James, 2013). However, such work does not directly explore the accumulative influence of urbanisation on resident well-being through specifically health-related datasets. The latter have been effectively employed in previous studies into the effects of green space and human health (e.g. Maas et al., 2009; Mitchell & Popham, 2007; Mitchell et al., 2011) but these have in turn largely neglected the relevance of rural to urban transitions.

Mitchell and Popham (2007) investigated the effect of green space at discrete levels of both physical (urbanity) and socio-economic (household income) characteristics but employed a simplistic typology of urbanity which failed to reflect the range of urbanisation occurring along a rural-urban gradient. Moreover, such studies have not accounted for levels of human population in their assessments of green space provision, primarily taking percentage land cover as a standardised measure. Given that increasing urbanity is, by definition, accompanied by increasing human popu-

lation, detailed investigations into the relationship between human health and green space would benefit from integrating local population data into their methodologies.

Although the therapeutic effects of biodiverse spaces have been well documented (Carrus et al., 2015; Marcus & Sachs, 2013; Tzoulas et al., 2007), much of the work investigating the reciprocity of human-environmental health has focussed specifically on green space and neglected the role of urban gardens, despite the latter being presented as highly biodiverse elements in urban ecosystems (Cameron et al., 2012; Clarke & Jenerette, 2015; Goddard, Dougill, & Benton, 2010; Orsini et al., 2014; Taylor, Lovell, Wortman, & Chan, 2016; Thompson et al., 2003). Furthermore, studies have compared the ecological quality of domestic and community gardens with that of other green space types such as city parks (Barthel, Folke, & Colding, 2010; Speak, Mizgajski, & Borysiak, 2015), emphasising the greater value of the former in terms of species richness. Despite these claims, research into the relative benefits of domestic and green space towards measures of human health is currently lacking. Mitchell et al. (2011) concluded that larger areas of green space were of most importance in terms of health promotion in urban landscapes but did not discriminate between green space and more compact domestic gardens types. The same view, and shortcoming, is evident in Stott et al. (2015) where larger parks and reserves were promoted as being crucial for ecosystem service provision and, therefore, well-being among urban inhabitants. Again, no distinction was made here between the differential benefits stemming from public and domestic gardens types. Francis (1987) observed that there are significant differences in the physical activities which take place in communal gardens and larger areas of green space such as city parks. Moreover, horticultural practices in communal gardens involved greater levels of physical activity and interaction with ecological processes suggesting that such spaces may be particularly beneficial to health (Francis, 1987). Horticulture-based activities have been championed in other research due to their potential for improving the physical and mental health of practitioners (Perrins-Margalis, Rugletic, Schepis, Stepanski, & Walsh, 2000; Hynes & Howe, 2004; Pudup, 2008; Krasny & Tidball, 2015) the particular effect of domestic gardens on human health in cityscapes warrants closer attention in epidemiological studies into health in the urban environment. The benefits of gardens and gardening to well-being are considered so effective that the design of “healing” gardens has become a topic of research in itself and a credible ingredient to patient convalescence in health care situations (Marcus & Sachs, 2013). The restorative influence of gardens has been well demonstrated in hospital settings (Söderback, Söderström, & Schäländer, 2004; Marcus, 2007) but also in other environments such as educational institutions (Lau & Yang, 2009) and places of work (Lottrup, Grahn, & Stigsdotter, 2013). They have also been presented as significant in more cultural forms of healing such as conflict resolution (Krasny & Tidball, 2015), promoting individual and wider social education and transformation (Pudup, 2008), and social cohesion (Kuo, Bacaicoa, & Sullivan, 1998; Kuo & Sullivan, 2001; Okvat & Zautra, 2011).

To address the absence of knowledge on the relative effects of green space and domestic gardens on human health, a comparison of the relationships between both domestic gardens and green space on local health across a rural-urban gradient was conducted in the north-west of England, UK. This region of the United Kingdom includes a wide range of habitats across the full range of possible levels of urbanity, from mountainous areas of national parkland to coastal regions to highly urbanised centres in the form of some of the oldest industrialised metropolises in the world (Kidd, 2006). The region thereby provided a considerable and appropriate dataset with which to explore the relationship between green space and domestic gardens types with public health at discrete levels of urbanisation.

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