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Article

Urban green space and obesity in older adults: Evidence from Ireland

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ABSTRACT

We examine the association between living in an urban area with more or less green space and the probability of being obese. This work involves the creation of a new dataset which combines geo-coded data at the individual level from the Irish Longitudinal Study on Ageing with green space data from the European Urban Atlas 2012. We find evidence suggestive of a u-shaped relationship between green space in urban areas and obesity; those living in areas with the lowest and highest shares of green space within a 1.6 km buffer zone have a higher probability of being classified as obese (BMI $\geqslant$ 30). The unexpected result that persons in areas with both the lowest and highest shares of green space have a higher probability of being obese than those in areas with intermediate shares, suggests that other characteristics of urban areas may be mediating this relationship.

1. Introduction

Over half of the world's population (54%) currently lives in urban areas (UN, 2015). Growing urbanisation is set to continue with a projected two-thirds of the global population expected to reside in urban areas by 2050 (UN, 2015). Given the worldwide trend of urbanisation, there has been renewed focus on the physical health impacts of living within these urban areas, and in particular the importance of ensuring adequate green space provision. Indeed the United Nations Sustainable Development Goal 11.7 states a target of providing "…universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities" by 2030. The benefits arising from green spaces can be examined from a multitude of angles e.g. mitigation of the urban heat island effect, promotion of local ecosystems, improved air quality and, health and wellbeing effects (see Carlin, Cormican, and Gormally (2016) for full review). This paper focuses on the physical health benefits of green space; in particular whether the presence of green space in urban areas has the potential to reduce an individual's probability of being obese.

The WHO estimates that the prevalence of obesity has more than doubled worldwide between 1980 and 2014 (WHO, 2016), with 1.9 billion adults classified as overweight in 2014, and of these, 600 million classified as obese. This is particularly concerning given that obesity substantially increases the risk of developing other noncommunicable diseases such as cardiovascular disease, diabetes, osteoarthritis and some cancers (WHO, 2016). The primary cause of obesity is an energy imbalance between calories consumed and calories expended (WHO, 2016). This imbalance is the result of increased consumption of high-energy foods and decreased physical activity. Obesity can therefore be considered a side effect of increased urbanisation, which has led to a rise in sedentary life-style patterns. Coined by Swinburn, Egger, and Raza (1999), the term obesogenic environment refers to "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations". This definition which recognises the importance of an individual's social, economic and physical environment, shifts the focus of solving the obesity epidemic from the individual to the systemic level.

As identified by Mackenbach et al. (2014), several features of the physical environment are proposed to impact obesity including urban sprawl, land-use mix, food environment, crime rate, walkability, and green space. The primary channel through which urban green space is proposed to impact obesity is through increased physical activity. However, as identified by Lachowycz and Jones (2011) who performed a systematic review of the pre-existing literature, there is a large amount of conflicting evidence regarding the association between obesity and urban green space. In particular self-selection effects can be difficult to control for due to data limitations (Boone-Heinonen, Gordon-Larsen, Guilkey, Jacobs, and Popkin, 2011). Additional concerns arise from the use of self-reported rather than objective obesity measures, the use of observations at the geographical or population level rather than the individual level, the quality of the green space data used, and lastly, the ability to control for potentially confounding variables.

This paper attempts to overcome some of these challenges by

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linking data on individuals in The Irish Longitudinal Study on Ageing with their location in the Urban Atlas 2012 dataset. As such, our paper contributes to the literature by creating a richly detailed micro dataset linking objective health outcomes to the environment. This allows a large number of confounding variables to be controlled for at the individual level when estimating the relationship between the greenness of an area and the probability of being obese. In addition, the use of objectively measured BMI as out indicator of obesity represents an improvement on previous approaches which rely on self-reported obesity measures. Last we contribute to the literature by examining the impact of green spaces in urban areas on the probability of being obese in *older* people rather than the general population which is more commonly examined. In terms of using data from Ireland, we see that this is country in which the trends of increased urbanisation and obesity rates have both prevailed. Recent figures from the 2016 Census indicate that 63% of the Irish population live in urban areas, with 44% of the urban population living in the capital city, Dublin (CSO, 2017). Data from 2015 also estimates that 37% of the Irish population aged 15 and over is over-weight, with a further 23% obese (Healthy Ireland, 2015).

2. Background

2.1. Defining obesity

According to the WHO, obesity can be defined as 'a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired' (WHO, 2000). There are many different measures used to identify obesity in individuals including Body Mass Index, waist circumference and waist-hip ratio (see Burkhauser and Cawley (2008) for a comprehensive review). Body Mass Index (BMI) is the most commonly used index to classify obesity in individuals and is the obesity indicator under consideration as an outcome variable in this paper. BMI is measured as a person's weight in kilograms divided by the square of their height in meters (kg/m^2) with obesity classified as having a BMI value ≥ 30.

2.2. Defining greenness of locality

In order to proxy the "greenness" of a respondent's urban location we first define their local area or locality by drawing a circular buffer with a 1.6 km radius around their home. The greenness of an individual's locality is then calculated as the amount of green space within this buffer zone as a proportion of the total buffer zone area. We choose a 1.6 km radius as it has been used extensively in the literature (see Browning and Lee (2017); Hobbs et al. (2017) for full review) and assumes a maximum 20 minute walk to green space (see Teljeur, O'Dowd, Thomas, & Kelly, 2010). In addition, Browning and Lee (2017) find evidence that larger buffer sizes (up to 2000 m) are better at predicting physical health than smaller ones. It is important to note that while the radius size for these buffers was chosen with reference to previous research on accessibility in terms of straight line walking speed, we are not modelling green space accessibility. Instead we are using these buffers as a way to uniformly characterise the relative greenness of a respondent's locality. Further detail regarding the types of spaces we consider 'green', creation of the buffer zones and the data used are found in Section 3.2.

2.3. Green spaces and obesity

Lachowycz and Jones (2011) and James, Banay, Hart, and Laden (2015) both outline that although most studies primarily find in favour of the protective effects of green space, there is still mixed evidence regarding the association between green space and obesity. For example Cummins and Fagg (2012) find using a cross-sectional study in England that residency in the greenest areas is significantly associated with increases in overweight and obesity, and in addition that these outcomes are not attenuated by physical activity. However, using data from Canada, Prince et al. (2011) find a gender difference in the relationship, with higher green space associated with reduced physical activity levels and increased overweight/obesity in men, and decreased overweight/obesity in women.

More specifically Broekhuizen, de Vries, and Pierik (2013) perform a systemic review of the existing literature of the health effects of green space exposure in *older* people. They find evidence of a positive association between green space and physical activity, and between green space and (perceived) health, including morbidity, mortality and survival among older adults, yet conclude that there is no relationship between green space and BMI outcomes in older adults. However, this conclusion can be criticised for its over-reliance on a single paper by Li et al. (2008). Similarly, Astell-Burt, Feng, and Kolt (2014) find, using a study on Australian adults aged 45 years and older, that although green space was associated with increased moderate-to-vigorous physical activity levels and reduced sedentary behaviour, only women were found to have a reduced risk of being overweight or obese, with no protective effect found for men. Finally, Sander, Ghosh, and Hodson (2017) find that greenspace is not related to BMI for men over 50 and men and women over 65 years.

A significant difficulty with the literature is the inability to account for individuals with lower obesity outcomes self-selecting into areas which have a greater share of green space. Although the structure of our data does not allow us to completely remove this self-selection effect, we attempt to minimise it by drawing upon the literature and including a wide array of demographic and socio-economic characteristics which could simultaneously determine both the location of an individual's residence and their obesity outcome measurement. The following variables are included as confounding factors in our models: income and education (Madden, 2010), employment status (Mosca, 2013), gender (Sreetheran and Van Den Bosch, 2014), age (Chiu, Chang, Mau, Lee, and Liu, 2000; Villareal, Apovian, Kushner, and Klein, 2005), marital status (Wilson, 2012), urban location (Penney, Rainham, Dummer, and Kirk, 2014), and type of medical cover (Whelton et al., 2007). Last we control for smoking (Aubin, Farley, Lycett, Lahmek, and Aveyard, 2012; Courtemanche, Tchernis, and Ukert, 2016) and an indicator for the presence of a physical disability (Liou, Pi-Sunyer, and Laferrere, 2005).

3. Data

This paper combines two datasets from Ireland in order to examine the relationship between green space and obesity: The Irish Longitudinal Study on Ageing, and the European Urban Atlas 2012. Both are discussed in greater detail below.

3.1. TILDA

The Irish Longitudinal Study on Ageing (TILDA) is a nationally representative longitudinal study of people aged 50 and over in Ireland. Data from Wave 1 (W1) was collected between October 2009 - July 2011 from 8175 individuals aged 50 and over, from the 6279 households that participated in the study. Interviews were also conducted with the younger spouses and partners of TILDA participants (even if aged less than 50), leading to a total sample size of 8504. Interviews were conducted by trained interviewers in each respondent's home, and were carried out using Computer Assisted Personal Interviewing (CAPI). Participants were also given a self completed questionnaire (SCQ) with more potentially sensitive questions to fill out and return by mail. Last, W1 TILDA respondents were also invited to attend a nurse-led health assessment at either a specialised centre in Dublin or Cork, or a modified partial assessment in their home where travel was not practicable.