ARTICLE IN PRESS

Preventive Medicine xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Preventive Medicine

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

Neighbourhood typologies and associations with body mass index and obesity: A cross-sectional study

M. Hobbs[a,b,*], C. Griffiths[a], M.A. Green[c], H. Jordan[d], J. Saunders[e,1], J. McKenna[a]

[a] School of Sport, Carnegie, Leeds Beckett University, Leeds LS6 3QT, UK.
[b] School of Social and Health Sciences, Leeds Trinity University, Leeds, UK.
[c] School of Environmental Sciences, University of Liverpool, Liverpool, UK.
[d] School of Health and Related Research (ScHARR), University of Sheffield, Sheffield, UK.
[e] Carnegie, Leeds Beckett University, Leeds LS6 3QT, UK

ARTICLE INFO

Keywords:
Latent class analysis
Food outlets
Physical activity facilities
Parks
Body mass index
Obesity

ABSTRACT

Little research has investigated associations between a combined measure of the food and physical activity (PA) environment, BMI (body-mass-index) and obesity. Cross-sectional data (n = 22,889, age 18–86 years) from the Yorkshire Health Study were used [2010 – 2013]. BMI was calculated using self-reported height and weight; obesity = BMI ≥ 30. Neighbourhood was defined as a 2 km radial buffer. Food outlets and PA facilities were sourced from Ordnance Survey Points of Interest (PoI) and categorised into 'fast-food', 'large supermarkets', 'convenience and other food retail outlets' and 'physical activity facilities'. Parks were sourced from Open Street Map. Latent class analysis was conducted on these five environmental variables and availability was defined by quartiles of exposure. Linear and logistic regressions were then conducted for BMI and obesity respectively for different neighbourhood types. Models adjusted for age, gender, ethnicity, area-level deprivation, and rural/urban classification. A five-class solution demonstrated best fit and was interpretable. Neighbourhood typologies were defined as; 'low availability', 'moderate availability', 'moderate PA, limited food', 'saturated' and 'moderate PA, ample food'. Compared to low availability, one typology demonstrated lower BMI (saturated, b = − 0.50, [95% CI = − 0.76, − 0.23]), while three showed higher BMI (moderate availability, b = 0.49 [0.27, 0.72]; moderate PA, limited food, b = 0.30 [0.01, 0.59]; moderate PA, ample food, b = 0.32 [0.08, 0.57]). Furthermore, compared to the low availability, saturated neighbourhoods showed lower odds of obesity (OR = 0.86 [0.75, 0.99]) while moderate availability showed greater odds of obesity (OR = 1.18 [1.05, 1.32]). This study supports population-level approaches to tackling obesity however neighbourhoods contained features that were health-promoting and -constraining.

1. Introduction

One in four adults are currently obese; while recent evidence suggests that long-term trends of increasing body weight are starting to slow, the prevalence remains high (Ng et al., 2014; Green et al., 2016). Increasingly, research and policy are focusing on the environmental contributions for understanding these population-level patterns (Town and Country Planning Association, 2014; Hobbs et al., 2016). However, an extensive body of literature has shown inconsistent associations between aspects of the food environment such as supermarkets (Michimi and Wimberly, 2010; Larsen and Gilliland, 2008; Athens et al., 2016; Fiechtner et al., 2016; Cummins et al., 2014; Lytle and Sokol, 2017) or fast-food outlets (Athens et al., 2016; Burgoine et al., 2016; Cobb et al., 2015; Sturm and Hattori, 2015; Kruger et al., 2014) and obesity. Furthermore, evidence demonstrating a relationship between the physical activity (PA) environment and obesity also remains equivocal (Hunter et al., 2015; Mackenbach et al., 2014; Evenson et al., 2016; Bancroft et al., 2015; Parsons et al., 2015).

Recent research has demonstrated that individual features of obesogenic neighbourhoods may cluster in the same locations (Myers et al., 2016). It is therefore worthy of consideration to not to treat each feature in isolation i.e. just fast-food. Developing multi-dimensional measures of both the food and physical activity (PA) environments may offer an alternative approach for representing the wider environmental influences on obesity. Previous studies have used a combined measure to delineate different urban contexts suggesting that individual

* Corresponding author at: Leeds Trinity University, Leeds LS18 5HD, UK.
E-mail address: m.hobbs@leedstrinity.ac.uk (M. Hobbs).
[1] Formerly, Public Health Team, Rotherham Borough Council.

https://doi.org/10.1016/j.ypmed.2017.11.024
Received 6 July 2017; Received in revised form 15 November 2017; Accepted 26 November 2017
0091-7435/

Please cite this article as: Hobbs, M., Preventive Medicine (2017), https://doi.org/10.1016/j.ypmed.2017.11.024

experiences of neighbourhood context are multi-dimensional. However, combined measures of the environment may lack the appeal of identifying a specific availability point that can be addressed more easily through policy i.e. regulating the growth of just fast-food outlets (Clary et al., 2017). Capturing this clustering of neighbourhood features may be an opportunity to begin to more accurately reflect the wider range of environments that influence human behaviour and obesity (Riley et al., 2017).

Despite some evidence to suggest aspects of the food environment may cluster to form neighbourhood typologies, there is no clear pattern of co-occurrence when considering both PA and food environments (Myers et al., 2016). For instance, a comprehensive study that virtually audited the built environment using Google Streetview in London, Paris, Ghent and Budapest demonstrated a complex picture (Feuillet et al., 2016) with four clusters of neighbourhoods existing. The typologies revealed that neighbourhoods were not always a simple linear distinction in their extent of 'obesogenic' features with some clusters containing features that were both potentially obesogenic and non-obesogenic. For example, aesthetically pleasing greener neighbourhoods which may promote PA were also those with a low presence of active transport facilities i.e. no bike lanes or foot paths. Current evidence often focuses on describing neighbourhood typologies, this study builds on existing work to investigate how different neighbourhood contexts around the home environment are associated with both body mass index (BMI) and obesity.

This study uses a large cohort that is specifically designed for informing local-level decision making on weight and weight management. The study first explores how aspects of the food and physical activity environment cluster and second, investigates the association between neighbourhood typologies, BMI, and obesity.

2. Methods

2.1. Study sample

The sample used in this cross-sectional analysis was collected during wave one of the Yorkshire Health Study (YHS) (formerly the South Yorkshire Cohort Study) which has been reported in detail previously (Green et al., 2014). Briefly, the YHS is an observational cohort study collecting information on the residents (aged 18–86 years) from the Yorkshire and Humberside region in England. It aims to inform National Health Service (NHS) and local authority health-related decision making in Yorkshire. Data were collected on current and long-standing health, health care usage and health-related behaviours, with a focus on weight management. Wave one data collection contains records on 27,806 individuals (2010 − 12) from 11 boroughs within the Yorkshire and Humber region. Participants in the cohort are older than in the total South Yorkshire population with a higher proportion of females. The majority of participants were also reported being of White ethnicity (94.1%), which was over representative of the ethnic group (2011 Census; 90.5%). Adults living within the study area with a valid height, weight, postcode, ethnicity, and gender were included resulting in 22,889 participants. Ethical clearance was granted by the ethics committee of the Carnegie Faculty, Leeds Beckett University.

2.2. Individual-level measures and covariates

Height (cm) and weight (kg) of participants was self-reported. BMI was then calculated for each participant as weight (kg)/height^2 (m). Participants were also split dichotomously based on their BMI into obese (BMI ≥ 30) or not obese (BMI < 30). Age, gender, ethnicity (White-British and other), deprivation score (Index of Multiple Deprivation) and rural or urban classification were included in all models as covariates. IMD provides a multidimensional measure of deprivation (based on 37 separate indicators, organised across seven distinct domains of; income deprivation; employment deprivation; health deprivation and disability; education, skills and training deprivation; crime; barriers to housing and services; and living environment deprivation) and is commonly used by Local Governments in the UK. IMD scores were assigned to the lower super-output area (LSOA) of each individual, as determined by their geocoded postcode. A higher IMD deprivation score equates to a higher level of deprivation. Rural or urban (urban areas are built up areas with > 10,000 people) classification of the LSOA was made in line with local government classifications (Office for National Statistics, 2011).

2.3. Neighbourhood level measures

To define neighbourhood, the postcode of each participant was geocoded using home postcode. A neighbourhood boundary was then defined using a radial buffer of 2 km centred on these coordinates within ArcGIS 10.4. Neighbourhood was defined as a 2 km radial buffer as this is hypothesised as a distance easily accessible when driving (Thornton et al., 2013). A 2 km buffer in this case gives an approximate measure of availability within the home neighbourhood. It is acknowledged that neighbourhoods are difficult to define as individuals are known to operate outside a radial buffer or administratively defined area (Charreire et al., 2016). However, previous analyses (Hobbs et al., 2016) also showed little difference in associations when using 1600 m radial buffers in the same study sample which are hypothesised to better reflect walking behaviours (Smith et al., 2010).

We considered a wide range of food and physical activity neighbourhood characteristics. Data on food outlet locations and physical activity facilities was obtained from The Ordnance Survey (OS), a national mapping agency in the United Kingdom which covers the island of Great Britain. Data were sourced from the Point of Interest (PoI) dataset covering the study area at the time of the data collection (2010 − 2012) which has been suggested as a viable source of secondary data (Burgoine and Harrison, 2013) and was again mapped in ArcGIS 10.4. Classifications were defined based on a proprietary classification system within the PoI dataset. Food outlets were categorised into three groups of (i) large supermarkets, (ii) fast-food outlets and (iii) convenience or other food retail outlets. Fast-food outlets contained the PoI categories of "fast food and takeaway outlets", "fast food delivery services" and "fish and chip shops"; large supermarket contained "supermarket chains" and convenience and other food outlets contained other food outlets which included but was not limited to "restaurants", "convenience stores", and "bakeries". Physical activity (PA) facilities were included based on proprietary classification of "physical activity facilities". Park data was obtained from Open Street Map. A park was defined as an open, green area for recreation typically open to the public that is in a town or city, national parks were not included in this dataset (Open Street Map, 2015). PoIs and parks falling within and intersecting with the 2 km radial buffer were then identified through a point in polygon analysis in ArcGIS 10.4.

2.4. Statistical analysis

To describe the study population and their respective neighbourhoods, means and standard deviations and percentages were calculated. Results were presented for both individual-level and area-level variables included within the analysis.

A latent class analysis (LCA) was conducted in STATA MP 14.2 using the five environmental variables (large supermarkets, fast-food outlets, convenience or other food retail, PA facilities and parks). The environment varied considerably between each individual. For instance, some individuals had no food outlets within a 2 km buffer and others had 100 (Table 1). However, it is unlikely that an increase from 0 to 1 fast food outlets is the same as an increase from 101 to 102 fast food outlets. To account for this and model relative effect, we modelled food outlet data in quartiles using dummy variables (Q1 least exposed, Q4 most exposed). Quartiles were based on population so each quartile