Objectively scrutinising the impact of the obesogenic environment on obesity in Yorkshire, England: a multi-level cross-sectional study

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Summary
Policy makers are beginning to engage with the idea that the built environment may be a contributing factor to obesity. Despite an increasing policy focus, identifying associations between exposure to an obesogenic environment and increased adiposity has proved challenging. The evidence base remains equivocal. By influencing the 'default' option in the obesogenic environment such as the proximity of fast food outlets or green space, there may be some potential to affect dietary intake, physical activity and obesity. This study aims to examine the spatial distribution of obesogenic environment across Yorkshire and the impact on adult adiposity.

1. Introduction

Obesity rates in UK adults continue to be the some of the highest in Europe with 24% and 25% of males and females reported to be obese respectively. Of concern is that governments and local authorities have repeatedly attempted to address the issue of obesity. Despite some attenuation, their approaches on the whole have been ineffective. Policy makers are subsequently, beginning to engage with the idea that the built environment may be a contributing factor to the obesity epidemic. Indeed, public health professionals in the UK are now encouraged to address the prevalence of fast food outlets in their area to support healthier lifestyles (Cavill and Rutter 2013).

Neighborhood built environments; both food and physical activity, have been labelled obesogenic. They are said to facilitate an over-consumption of energy-dense, nutrient poor foods at the expense of minimal energy expenditure; thus increasing obesity. Despite an increasing policy focus, identifying associations between exposure to an obesogenic environment and increased body weight has proved challenging and the evidence base remains equivocal. For instance, a recent systematic review (Fleischhacker et al. 2011) found that of those studies examining these exposures in relation to increasing body weight, fewer than half reported positive associations. Further, even fewer of the reviewed studies that were included were conducted in England. The evidence base is therefore not strongly placed at present to support interventions into politically difficult modifications of alleged obesogenic environments.

Despite a lack of scientific support, modification of the obesogenic environment currently represents a key focus of local authority health policy. It is an attractive population level intervention to limit risk factors conducive to obesity. Briefly, genetic evolution has been wholly unable to match the rapidity of the environmental and societal transitions made within the 21st century. Therefore, individuals currently pay an overwhelming amount of attention to override their natural habits due to the environmental cues of contemporary life. For example, the high energy densities of many fast foods challenge human appetite control systems with conditions for which they were never designed (Prentice and Jebb 2003). By influencing the 'default' option in the obesogenic environment such as the proximity of fast food outlets or green space, there may be some potential to affect dietary intake, physical activity and ultimately obesity.

The 'default option' for an individual may be influenced somewhat by the obesogenic environment however; some population groups for example low socioeconomic status (SES) may be more vulnerable than others to the effects of the obesogenic environment. Individual- and area-level SES measures are independently related to obesity. It is increasingly important to consider both individual- and area-level measures of SES using multi-level modelling. Lower area level SES with a greater density of fast food outlets may amplify individual risk factors for obesity such as low income, education or absence of transport; a phenomena known as deprivation amplification. Despite the apparent consequences of individuals operating within obesogenic environments the research to date has insufficiently and inconsistently addressed the issue.

It is interesting that despite lobbying from policy, contemporary evidence on the obesogenic environment is essentially in its infancy. It may be unsurprising that those associations linking exposure to food and physical activity environments to weight status are at present equivocal. Besides, comparisons between studies are made difficult by a US-centric evidence base and should be interpreted with care. England in any case has a very different environmental temperament to the US yet, this important distinction has rarely explicitly been raised. Lastly, few studies have data on both the food and physical activity environment. Therefore, there is little understanding of which aspect of the neighborhood is comparatively stronger in predicting obesity and thus offering greatest policy impact. In addition to these considerations, the lack of associations identified in studies could be explained through other limitations.

Due to the infancy of the evidence, much is cross-sectional limiting the ability to draw causal inference. Furthermore, an individual's neighbourhood (which in turn defines exposure) is often arbitrary defined for instance, a 400m circular buffer around a participants home. This definition rarely has any theoretical underpinning as to the size or shape of the neighbourhood. Neighbourhoods used within obesogenic environment research are inconsistently defined and rarely represent the locations used to actually buy food. Encouraging a range of measures at present is the best estimate. Importantly, neighbourhoods and exposure to the obesogenic environment often extend beyond home neighbourhood to the work or commute neighbourhood. However, research predominantly focuses on just the residential environment. Further research is needed to inform evidence based policy to tackle the obesity epidemic.

This study therefore aims to examine:
i) The spatial distribution of the food and physical activity (obesogenic) environment across Yorkshire by gender, deprivation and ethnicity.
ii) The impact of exposure to the food and physical activity (obesogenic) environment on an individual's adiposity.

2. Methods

Study Design & Data Sources

The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) recommendations were used to add methodological rigour. This large (n=25,000) multi-level cross-sectional study represents collaboration with Sheffield University's Yorkshire Health Study (YHS). Following ethical approval participants were contacted through consenting general practitioner surgeries (response rate; 15.9%). Relevant exposure metrics of the physical activity and nutrition environment were then computed in ArcGIS (*ESRI, version 10.2*) using the UK Ordnance Survey Points of Interest (PoI) dataset.

Exposure Variables

Participant's home postcodes were geocoded and mapped using ArcGIS. Food outlet PoI's were categorised into supermarkets, takeaways and other retail. PA facility PoI's were included as a whole category. The density of PoI's (both food and PA) was then calculated by placing circular buffers (100m, 400m, 800m, 1000m, 1600m and 2000m) on home postcode locations. Proximity was

represented by calculating straight line distance from home postcode to the nearest PoI (food and PA). Further, the quantity of green space was represented at the Middle Super Output Area (MSOA) and Lower Super Output Area (LSOA) the individual lives in. Briefly, a LSOA and MSOA are UK Census geographies designed for small-area statistical analysis. Finally, rural or urban classification for each MSOA and LSOA will be obtained from the Commission for Rural Communities Framework 2004.

Outcome Variables

Originally, this study represents weight status (dependent) through multiple outcomes. Body mass index (BMI) was calculated by dividing weight (kg) by height (cm) squared. Participants were then split into categories of underweight (<18.50), healthy weight (18.50 – 24.99), overweight (25.00 – 29.99) and obese (>30.00) respectively. Waist Circumference (cm) was then categorised into no, high and very high increased risk of health complications based on gender specific cut-points. The National Institute of Clinical Excellence (NICE 2014) suggests the assessment of health risks associated with increased adiposity should now be based on BMI and WC (Table 3) to determine if the adult is at any increased risk of associated health issues.

Covariate Variables

Age, gender, ethnicity and SES were collected from the participants and the highest level of education was used as a measure of individual level SES.

Bias & Missing Data

Data validation was an extremely thorough process. Data was checked by all parties involved in the collaboration. The missing data was then explored (by the first author) dependent upon the type, amount and distribution of missing data. Based on the large sample size, data was included only if postcode, gender, age, ethnicity and either BMI or WC are present, age was greater than 18 years of age and the postcode lay within the Yorkshire boundary. This resulted in 25 706 and 25 294 cases for BMI and WC respectively.

Statistical Methods

The dataset has a multi-level hierarchical structure which consists of adults nested within neighbourhoods. Based on BMI two binary variables of i) overweight and obese or not and ii) obese or not were created for logistical analysis. A further logistical analysis for WC will be carried out for i) increased risk or not and ii) substantially increased risk or not. Subsequently, multi-level modelling using two level hierarchical logistical models will be used determine variance at different levels using the dependent variables of BMI and WC. Predictors will be sequentially added to models and possible interactions between explanatory variables will be explored.

Strategic Alignment

Relating back to the strategic aims of GISRUK, this project represents interdisciplinary collaboration between The School of Public Health and Related Research (ScHARR) at Sheffield University and The Centre for Active Lifestyles at Leeds Beckett University. Further, the project is led by a PhD student supported by Senior Lecturers and Research Associates from both institutions. The goal is to respond to the urgent need to identify evidence based policy to tackle the obesity epidemic. Further, with the help of GIS the project aims to guide long-term town planning, policy change and redesign of existing urban environments to maximise physical activity, nutrition and minimise sedentary behaviour and obesity; all determinants of human health.

3. References

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