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Dietary quality in children and the role of the local food environment

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ABSTRACT

Diet is a modifiable contributor to many chronic diseases including childhood obesity. The local food environment may influence children's diet but this area of research is understudied. This study explores if distance to and the number of supermarkets and convenience stores in the local area around households are associated with dietary quality in nine year olds whilst controlling for household level socio-economic factors. This is a secondary analysis of Wave 1 (2007/2008) of the Growing Up in Ireland (GUI) Child Cohort Study, a sample of 8568 nine year olds from the Republic of Ireland. Dietary intake was assessed using a short, 20-item parent reported food frequency questionnaire and was used to create a dietary quality score (DQS) whereby a higher score indicated a higher diet quality. Socio-economic status was measured using household class, household income, and maternal education. Food availability was measured as road network distance to and the number of supermarkets and convenience stores around households. Separate fixed effects regression models assessed the association between local area food availability and dietary quality, stratified by sex. The DQS ranged from −5 to 25 (mean 9.4, SD 4.2). Mean DQS was higher in those who lived furthest (distance in quintiles) from their nearest supermarket ($p < 0.001$), and in those who lived furthest from their nearest convenience store ($p < 0.001$). After controlling for socio-economic characteristics of the household, there was insufficient evidence to suggest that distance to the nearest supermarket or convenience store was associated with dietary quality in girls or boys. The number of supermarkets or convenience stores within 1000 m of the household was not associated with dietary quality. Food availability had a limited effect on dietary quality in this study. Issues associated with conceptualising and measuring the food environment may explain the findings of the current study.

Introduction

Poor diet is an important modifiable contributor to many chronic diseases including childhood obesity (Han, Lawlor, & Kimm; World Health Organization, 2004). Understanding the determinants of dietary behaviour during childhood is important as poor dietary behaviours track from childhood to adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011). Children's diet is influenced by individual preferences as well as the wider shared family, social and physical environment, as highlighted by ecological models of health behaviour (Bronfenbrenner, 1997). The contribution of the local food environment to a poor diet is a relatively new area of research. To date, findings are inconsistent and this may be due to conceptual and methodological issues associated with measuring the food environment (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Feng, Glass, Curriero, Stewart, & Schwartz, 2010; Holsten, 2009; Mackenbach et al., 2014).

The food environment is multidimensional (Glanz, Sallis, Saelens, & Frank, 2005) and the availability of food outlets is one important aspect of the local food environment. Research has found that smaller food outlets including convenience stores tend to stock a higher proportion of processed foods, a smaller range of fruit and vegetables, and charge higher prices for food than supermarkets, especially in poorer areas (Kaufman, MacDonald, Lutz, & Smallwood, 1997; MacDonald & Nelson, 1991; Rose & Richards, 2004). Shorter distances to a supermarket and a higher number of local supermarkets are consistently associated with a higher dietary quality in North America, particularly among low income households (Rose & Richards, 2004). Evidence from Europe and Australia is less consistent

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(Black, Moon, & Baird, 2013) with recent studies finding no difference in food availability between better and worse off communities (Cummins & Macintyre, 1999, 2002), particularly for supermarkets (Maguire, Burgoine, & Monsivais, 2015).

Research on the association between the food environment around children's homes and diet is sparse and inconclusive. Engler-Stringer, Le, Gerrard, and Muhajarine (2014) conducted a systematic review which examined the influence of location and accessibility of food outlets on children's diet (Engler-Stringer et al., 2014). Though there was much heterogeneity between studies, the review found some moderate evidence to suggest that the local food environment around households may influence children's diet. However, the effect sizes in many of the included studies were small (Engler-Stringer et al., 2014). For example, a study from the UK reported that increasing distance to a convenience store was associated with a slightly lower intake of foods such as chocolate and crisps (Skidmore et al., 2010). Furthermore, in the UK, availability of 'unhealthy' food outlets was associated with a higher body mass index (BMI) which is a more distal outcome than diet (Jennings et al., 2011). Leung, Gregorich, Laraia, Kushi, & Yen, 2010 reported an inverse association between the prevalence of food/retail destinations in the neighbourhood environment and total energy intake in girls aged 6–8 years from the USA (Leung et al., 2010). However, there have also been null findings for the association between the local food environment and diet in children (An & Sturm, 2012).

Increasingly, policymakers recognise the potential role of the food environment to curb chronic diseases including obesity and also to encourage healthy eating. Thus, a better understanding of the relationship between local area food availability and dietary quality in children is needed. In 2007, 89% of all eating occasions for Irish children aged 5–12 years occurred at home (Burke et al., 2007) suggesting that food availability around households is important. For the current paper, we hypothesised that greater access to food outlets (closer proximity and the number of supermarkets) would be associated with a higher dietary quality in children. As children may have limited autonomy over food purchase and eating behaviours, we control for family level socio-economic factors to capture aspects of the shared home environment. This paper explores if distance to and the number of food outlets (supermarkets and convenience stores) in the local environment around households are associated with dietary quality in a nationally representative sample of nine year old children controlling for family level socio-economic factors.

Methods

Study design and subjects

This is a secondary analysis of the Child Cohort of the Growing Up in Ireland (GUI) study. Details of the study have been described elsewhere (Williams et al., 2009). Briefly, this is a nationally representative study of 8568 nine year old children living in the Republic of Ireland. Wave 1 of the study was conducted in 2007/2008. A two-stage cluster based sampling process was used, with a random sample of primary schools selected as the primary sampling unit. Age eligible children from participating schools were then invited to partake. Data collection took place within the home and included parent questionnaires. Trained researchers conducted the computer assisted personal interviews. A primary caregiver (the parent who spent most time with the study child) was nominated as the primary respondent (98% mothers) for the parental questionnaires.

Written informed consent was obtained from a parent/guardian prior to the study commencing. Ethical approval was granted by the Research Ethics Committee (REC) of the Health Research Board, Dublin, Ireland.

Outcome variable

Dietary quality

As there is some evidence to suggest that children under ten are unable to accurately estimate their dietary intake (Magarey et al., 2011), we used a brief parent reported 20-item food frequency questionnaire (FFQ) to estimate each child's diet. The FFQ was an adapted version of a Sallis Amherst questionnaire (Layte & McCrory, 2011; Sallis, Taylor, Dowda, Freedson, & Pate, 2002). Twenty food/drinks items were listed. The parents reported whether each food or drink item was consumed (1) not at all, (2) once, (3) more than once, or (4) don't know over the previous 24 h. As a low number of parents reported 'don't know' (N=77), these responses were coded as missing.

In Ireland, it is recommended that children consume plenty of bread, cereal (preferable wholemeal) and potatoes, fruit and vegetables; have a moderate consumption of dairy (preferable low fat), lean meats, poultry and fish; and limit consumption of foods high in sugar, fat and salt (Flynn et al., 2012). An un-weighted dietary quality score (DQS) was constructed to generally reflect current Irish dietary guidelines. Each food or drink item was defined as 'healthy' or 'unhealthy'. Fourteen food or drink items were defined as healthy and six as unhealthy. Healthy foods and drinks included fresh fruit, vegetables, meat, eggs, bread, cereals, potatoes, dairy products, and water. Unhealthy items included meat pie, hot chips, crisps, biscuits, and soft drinks (see Additional file 1 for full FFQ). For consumption of each healthy item, a value of 0 for not eaten at all, 1 for eaten once and 2 for eaten more than once were assigned. Unhealthy items were given a value of −2 for eaten more than once, −1 for eaten once and 0 for not eaten at all (Perry et al., 2015). A continuous DQS was produced by summing the individual items whereby a higher score indicated a higher diet quality. The score ranges from −5 to 25 in the participating children.

Exposure variables

Food environment

The structure of the food environment and types of food outlets in Ireland have been explained elsewhere (Competition Authority, 2008; Layte et al., 2011). Briefly, supermarkets have the largest share of the market. Similar to the UK, the Irish grocery sector can be divided into three groups as (1) supermarkets, (2) a retail brand or franchise, or (3) an independent retailer including newsagents. Similar to previous Irish research (Layte et al., 2011), food outlet type was coded as either a supermarket or convenience store (a retail brand or franchise or an independent retailer). This categorisation was used as supermarkets are commonly deemed as 'healthier' than convenience stores (Kaufman et al., 1997; MacDonald & Nelson, 1991; Rose & Richards, 2004).

The trained researchers used handheld GPS devices during fieldwork to record the co-ordinates of each participating child's household. A complete database of residential and commercial addresses (https://www.geodirectory.ie/) was used to document the co-ordinates of all supermarkets and convenience stores located in the Republic of Ireland at the time of data collection. The GeoDirectory is the primary source of business address data in the Republic of Ireland and is continually updated and validated by a dedicated unit. Using the precise spatial co-ordinates of households and food outlets (supermarkets and convenience stores), network-based travel distances were calculated using the Network Analyst extension in Geographic Information Systems (GIS), ArcGIS, v.9.3.1. Network analysis is a GIS technique used to calculate the distances covered and/or times taken in making a journey on a 'network', such as the road network. It facilitates a 'route analysis' to derive the optimal route from a specified start point (e.g. an individual's residence) to a specified end point (e.g. a supermarket). Given that road network density tends to differ significantly across Ireland, road network travel distances are generally preferable to standard Euclidean measures of distance when measuring proximity