Appetite 53 (2009) 157–165

Contents lists available at ScienceDirect

Appetite

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

Research report

Changing foodscapes 1980–2000, using the ASH30 Study

Thomas Burgoine [a,b,1,*], Amelia A. Lake [a,1,*], Elaine Stamp [a], Seraphim Alvanides [b], John C. Mathers [c,a], Ashley J. Adamson [a]

[a] Human Nutrition Research Centre, Institute of Health & Society, Newcastle University, Leech Building, Framlington Place, Newcastle, NE2 4HH, England, UK
[b] Geography, Institute of Health and Society, Newcastle University, Daysh Building, Claremont Road, Newcastle, NE1 7RU, England, UK
[c] Human Nutrition Research Centre, Institute for Ageing & Health, Newcastle University, Leech Building, Framlington Place, Newcastle, NE2 4HH, England, UK

ARTICLE INFO

Article history:
Received 20 January 2009
Received in revised form 1 May 2009
Accepted 16 May 2009

Keywords:
Food environment
Foodscape
Longitudinal
Dietary behaviours
Adiposity

ABSTRACT

There has been a dramatic change in the UK 'foodscape', accompanied by increasing rates of overweight and obesity. This study explores dietary change and change in BMI recorded longitudinally (1980–2000) against the change in food availability recorded retrospectively. Over 20 years the foodscape changed dramatically, with the total number of food outlets increasing by 79.4%. Analysis did not find a relationship between the foodscape and food intake patterns in 1980 or 2000. However statistically significant associations were found between 1980 foodscape and percent change in BMI. Adding geographical elements to a dietary study adds an interesting dimension in exploring the change in eating and BMI from adolescence to adulthood.

Introduction

Nutrition and health are inextricably linked and improving nutrition is a priority in global public health policy (World Health Organisation, 2003). Unhealthy diets are linked with numerous chronic diseases including obesity, which has been described as one of the largest societal challenges (Foresight, 2007). In the UK, predictions suggest that 60% of the population could be obese by 2050 (McPherson, Marsh, et al., 2007). This predicted rise in Body Mass Index (BMI) by 2050 will be associated with increases in diseases attributable to obesity including 30% increase for stroke, 20% for coronary heart disease and greater than 70% increase in type 2 diabetes (McPherson et al., 2007). Obesity is also a major risk factor for some of the most common cancers (World Cancer Research Fund/American Institute for Cancer Research, 2007).

While it is accepted that the food choices made by an individual are dependent on their 'personal food system' (Connors, Bisogni, et al., 2001) the context in which these choices are made is important in understanding the reasons for particular choices (Feather, Norman, et al., 1998). Most of the models of food choice indicate that both food choice and health behaviours are influenced by biological, demographic, social/cultural and environmental considerations as well as food-related government policies (Booth, Sallis, et al., 2001) and economic factors (Mela, 1999). An emerging body of literature has suggested environmental factors can influence individuals' dietary behaviour (Giskes, Kamphuis, et al., 2007). The underlying biological tendency for humans to acquire and store energy and the desensitisation of our appetite control system (Foresight, 2007) within the context of an obesogenic environment ('the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations' (Swinburn & Egger, 2002)) means individuals exert less control and choice over their lifestyle patterns which impacts on their weight (King & Thomas, 2007). It has been suggested that 'human biology has become out of step with the structure of society' (King & Thomas, 2007). King and Thomas (2007) refer to the abundance of 'high energy and cheap food' contributing to the overwhelming obesogenic environment of modern life. This structure of society in terms of the food environment or the 'foodscape' has changed rapidly in the UK over the last 20 years. Alongside this change has been an exponential increase in the prevalence of overweight and obesity. This has stimulated research across the world to explain the relationship between aspects of food retailing, diet and health (White, 2007).

Since the 1960s there has been a 'major retail revolution' (White, 2007); large food retailers have emerged and have captured the majority of the food market through supermarkets

* Corresponding authors.
E-mail addresses: t.h.s.burgoine@ncl.ac.uk (T. Burgoine), Amelia.lake@ncl.ac.uk (A.A. Lake), Elaine.stamp@ncl.ac.uk (E. Stamp), s.alvanides@ncl.ac.uk (S. Alvanides), john.mathers@ncl.ac.uk (J.C. Mathers), a.j.adamson@ncl.ac.uk (A.J. Adamson).
[1] These authors contributed equally to this work.

0195-6663/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.appet.2009.05.012

and hypermarkets (Atkins & Bowler, 2001). During the 1980s British food retailing was transformed by a small group of retail corporations (Wrigley, 1998). By 1990, 60% of the UK 'grocery market' was controlled by five food retailers (Sainsbury, Tesco, Argyll (Safeway), Asda and Gateway (Somerfield)) (Henderson & Crosthwaite, 1992). The dominant position of these large companies with their considerable buying powers was facilitated by a revolution in the sourcing and physical distribution of products via enhanced logistics and development of sophisticated IT systems which allowed "just-in-time" supply (Wrigley, 1998). The rise of the large supermarkets was accompanied by the demise of smaller independent grocery shops (Atkins & Bowler, 2001).

During the 1980s, food supply outlets in British cities moved to out-of-town sites, which created the idea of 'food deserts', defined as 'populated urban areas where residents do not have access to an affordable and healthy diet' (Cummins & MacIntyre, 1999) with strong implications for accessibility to certain groups of disadvantaged consumers.

To date there has been little research on the impact of food access on obesity risk (White, 2007). A UK study found no significant relationship between food outlet availability, proximity or price and dietary patterns (White, Bunting, et al., 2004). Evidence from this and other studies appears to indicate that in the UK, food access does not have a significant effect on food consumption (White, 2007).

Between 1960 and 1993 the UK Family Expenditure Survey described an increase from 10% to about 21% in the proportion of food expenditure on food eaten away from the home (Warde, 1997). Eating out has increased markedly in the last decade and has become 'embedded' in our culture (Riley, 1994). From the 1960s, foods consumed outside of the home have been influenced as a result of immigrants from South Asia and Hong Kong. Additionally, since the 1980s there have been increasing numbers of American owned or inspired fast food outlets (Atkins & Bowler, 2001). The catering industry has expanded to provide an increased number and more varied choice of food outlets. The venue choice for eating out is related to education level, social class, ethnic group and age (Warde & Martens, 1998). Several recent studies including Ellaway, Anderson, and Macintyre (1997) in Glasgow, have demonstrated a significant association between deprivation and BMI, along with many other health outcomes. An individual's geographical location when they wish to eat out is also important. National level data has indicated that McDonald's outlets are more likely to be found in economically/socially deprived neighbourhoods in Scotland and England (Cummins, McKay, et al., 2005).

The dynamic nature of diet and its strong relationship with demographic, economic, social and health factors, mean that in order to understand dietary change and to promote a healthier diet we need to understand this change in its context. Understanding this change or transition in nutritional patterns may be of value in combating diet related chronic diseases (Popkin, 1993).

A recent review (Giskes et al., 2007) highlighted a number of understudied environmental factors that are 'implicated' in the obesity epidemic including fast food/convenience stores, marketing of unhealthy foods and availability of larger portions. This study addresses that evidence gap by examining the influence of the foodscape on dietary patterns and BMI. The hypothesis is that the food environment influences food intake and BMI both cross-sectionally and longitudinally. Using personal information, cross-sectional and longitudinal dietary and anthropometric data (ASH30 Study) in combination with foodscape information (sourced retrospectively from the Yellow Pages–Business telephone directory listings) this study links the changing foodscape to changes in diet and anthropometry over 20 years (1980–2000).

Methods

The ASH30 longitudinal study methods and dietary results have been described in detail previously (Lake, Adamson, et al., 2004; Lake, Rugg-Gunn, et al., 2004; Lake, Mathers, et al., 2006).

The ASH30 Study in brief

In 1980 dietary and anthropometric information was collected from 405 11–12-year olds attending seven state schools in Northumberland, North East England (Hackett et al., 1984a,b). Between 1997 and 2000 a range of methods were used to contact these original participants. The result was that 298 of the original cases (aged 32–33 years) were retraced throughout the UK and 208 consented to take part in a subsequent study in 2000/01 (the ASH30 Study). The majority of the sample (78%) remained within the Northumberland and Tyne and Wear area (Lake et al., 2006). This analysis focuses on the 115 individuals who remained within the original study areas of Morpeth, Newbiggin and Ashington.

Dietary survey, anthropometric measurements and socio-economic status

In both 1980 and 2000, food intake was characterised and quantified by two 3-day food diaries followed by an interview on the fourth day to clarify uncertainties and to determine portion sizes. In 1980, food portion sizes were estimated using calibrated food models (Hackett, Rugg-Gunn, et al., 1983) while in 2000 a photographic food atlas (Nelson, Atkinson, et al., 1997) was used. Foods consumed were allocated to one or a combination of up to five groups which comprise The Balance of Good Health food groups (BGH) from the National Food Guide (Food Standards Agency, 2001) according to specifications suggested by Gatenby, Hunt, and Rayner (1995). Consumption of foods within groups was quantified by expressing the weight of food consumed from each of the five BGH food groups as a percentage of total weight of food consumed. Dietary change was expressed as the difference in percentage contribution made by each BGH food group to total weight of food eaten comparing 2000 with 1980 (2000 − 1980).

Between 1980 and 2000 intakes of foods containing fat and/or sugar, and milk and dairy foods decreased ($p < 0.01$ and $p = 0.031$ respectively), while intakes of fruit and vegetables increased ($p < 0.01$). Intakes of bread, other cereals and potatoes ($p = 0.002$, $r = +0.219$), fruit and vegetables ($p < 0.01$ $r = +0.256$) and meat, fish and alternatives ($p = 0.026$ $r = +0.158$) 'tracked' (preservation of relative position (Wardle, 1995)), from adolescence to adulthood (Lake et al., 2006).

In 1980 and 2000 height and weight were measured by a trained researcher and BMI calculated. Earlier work in the ASH30 Study established that relative BMI, an index of adiposity, tracks from adolescence to adulthood (Craigie et al., 2009).

Socio-economic status (SES) was assessed at the individual, rather than neighbourhood level. Using the 1970 Registrar General's definitions (Registrar General, 1970) of social class and following the pattern used in 1980 (Hackett et al., 1984a,b) social class was divided into four groups. Group 1 defined as 'high' combined social classes I and II, group 2, labelled 'middle' was social class III, group 3 described as 'low' was made up of classes IV and V. Group 4 comprised of the unclassifiable VI, the retired or unemployed VII and the unknown VIII. This assessment was conducted in the same way at both time points to ensure comparability between 1980 and 2000 socio-economic groupings.

Foodscape data

Historic Yellow Pages directories from the appropriate time periods (1980 and 2000) were used to collect retrospective data about the food environments. The addresses of all food-related outlets in the study area were recorded systematically. The Royal Mail's online postcode finder was used to search postcode databases using the addresses collected for subsequent geo-referencing purposes. Any problematic addresses that could not be linked to a postcode in this manner were found using a combination of Yell (www.yell.com), Multimap (www.multimap.-com) and Google (www.google.co.uk). The data from the 1980 Yellow Pages were then cross-referenced with the Goad shopping centre plans from the 1980 Morpeth and Ashington districts. The Goad plans identify individual retail and business units. No additions were made to the data collected from the Yellow Pages.

Classifications of the food environment were based on the Yellow Pages categories. Three categories were eventually settled upon for both 1980 and 2000 (Table 1); some amalgamation of the categories listed in the Yellow Pages took place, for example greengrocers, supermarkets and newsagents were categorised as 'household food shopping'; take-aways, restaurants and fish and chip shops as 'foods eaten out of the home'; and bakers and sandwich shops listed as 'baked goods'.

Locating food outlets and creating individual microenvironments

Foodscape information from 1980 and 2000 were mapped using the Geographical Information System (GIS) software ESRI ArcGIS 9.1 and 1:10000 scale maps. The geo-referencing process used a template of all 'NE' postcodes in the North East from EDINA Digimap (EDINA, 2006), a collection of 'online maps and spatial data of Great Britain'. The individual outlet data were then mapped against this 'grid' of postcodes to give a representation of the spatial distribution of the food outlets. A similar process of geo-referencing and mapping was then used to illustrate the locations of individuals taking part in the ASH30 Study ($n = 115$) in both 1980 and 2000.

Within the ASH30 Study, in 2000 home postcodes were collected but equivalent data were not obtained for 1980. Due to the rigidity of school catchment areas at the time, we used school postcodes as an indicator of the home environment for participants when aged 11–12 years old.

Table 1
Classification of the foodscape.

Year	Yellow Pages Classification	Sub-category
1980	Greengrocers	Household food shopping
	Supermarkets	
	Newsagents and vendors	
	Fish and chip shops	Foods for consumption
	Takeaway food	away from home
	Restaurants	
	Bakers and confectioners	Baked goods
	Confectioners retail	
2000	Greengrocers	Household food shopping
	Supermarkets	
	Grocers and convenience stores	
	Newsagents	
	Off licenses and wine merchants	
	Health food shops	
	Pizza delivery	Foods for consumption
	Fish and chip shops	away from home
	Public houses	
	Takeaway food	
	Restaurants	
	Bakers	Baked goods
	Sandwich shops	

A 1000 m radius buffer zone was formulated around each individual's postcode in 1980 (school postcode) and 2000 (home postcode). The choice of size of buffer radius varies within the literature. This large radius buffer zone was chosen in order to take into account both the locational uncertainty because of the use of school postcodes in 1980 and the increased car ownership in 2000. Within each buffer the type and number of food outlets were counted creating food microenvironments for each individual at two points in time.

Analysis

Pearson correlation analyses were used to test for significant ($p \leq 0.05$) relationships between variables using SPSS Version 14.

Results

Changes in the location of the sample

In 1980 the seven schools were located within the three urban areas of Morpeth, Ashington and Newbiggin. Therefore the 1000 m radius buffer zones were located in these urban centres. In 2000, home postcodes indicated that individuals were more dispersed across the study area; the 1000 m radius buffer zones reflect this change in location (Fig. 1).

Socio-economic status

Statistical analysis using both correlation and analysis of variance (ANOVA, which allows the identification of significant relationships between ordinal and interval level variables) revealed no association between the socio-economic position of the individual in 1980 and their BMI in 1980 ($p = 0.843$). Likewise, there was also no observed correlation between socio-economic status and BMI in 2000 ($p = 0.850$).

Movement between socio-economic groups was minimal 1980–2000 (Table 2) and importantly, statistical investigation also revealed that there was no significant association between change in socio-economic group over time and change in BMI ($p = 0.059$).

Gender

There was no association between gender and 1980 BMI ($p = 0.224$). There was an association between gender and 2000 BMI—men had a significantly higher mean BMI than women ($p = 0.037$). There was no significant association between gender and change in BMI ($p = 0.131$). The dataset was not split by gender in order to maintain a robust sample size.

Table 2
Movement between socio-economic groups (1980–2000) according to the Registrar General's definitions of social class.

Socio-economic status (SES)	% (n)
No change in SES	
Low–low	20.0 (6)
Mid–mid	47.9 (23)
High–high	18.8 (6)
Increase SES	
Low–mid	31.3 (15)
Mid–high	46.9 (15)
Low–high	28.1 (9)
Decrease SES	
High–mid	14.6 (7)
Mid–low	53.3 (16)
High–low	16.7 (5)

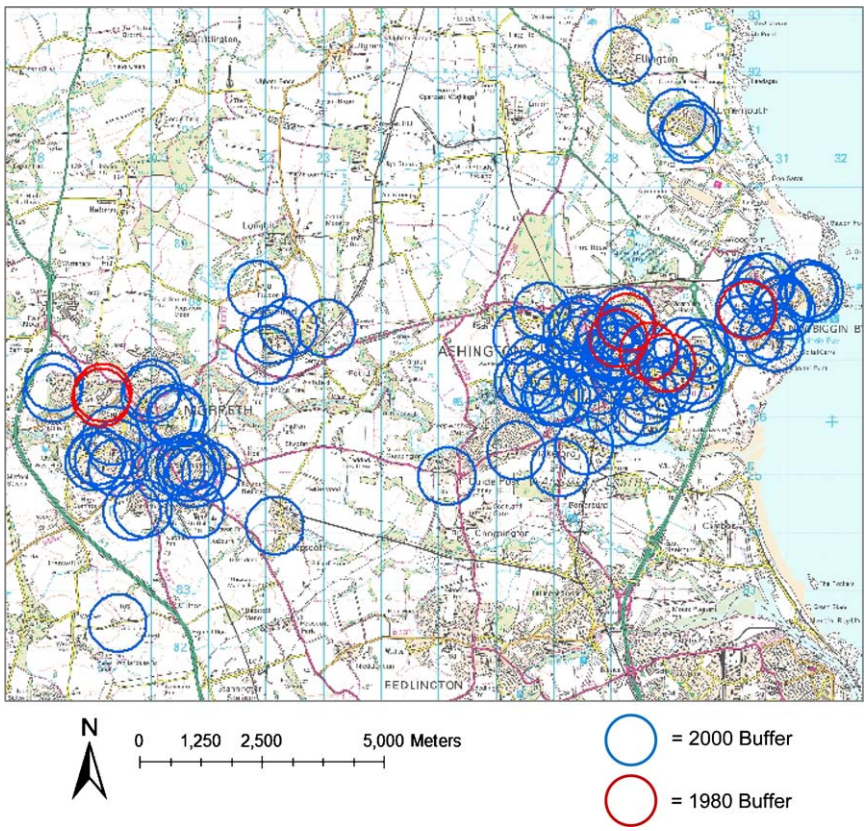

Fig. 1. An illustration of the 1000 m radius buffer zones around each individual's postcode, 1980 and 2000.

Changes in the wider 'foodscape' and in the individual's food microenvironments

Over 20 years the geography of the wider foodscape in the study region changed dramatically in terms of number, range, location and spread of food outlets. The overall number of food outlets increased by 79.4%. Between 1980 and 2000 the overall number of 'household shopping' outlets increased from 56 to 65 (16%). The overall number of 'foods for consumption away from home' outlets increased from 27 to 97 (259%). This group also increased within the 1000 m radius buffer zones of individuals (Fig. 2). However, the average number of 'household shopping' and 'baked goods' outlets

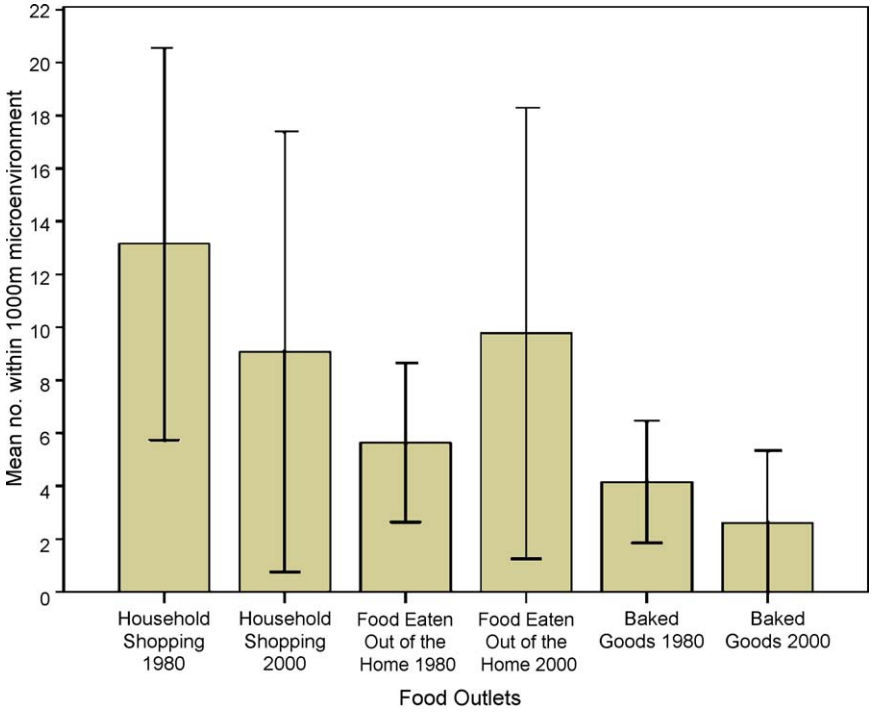

Fig. 2. Change in the mean number of food outlets within the 1000 m radius buffer zones of individuals in 1980 and 2000 (n = 115). Error bars indicate 1 standard deviation.

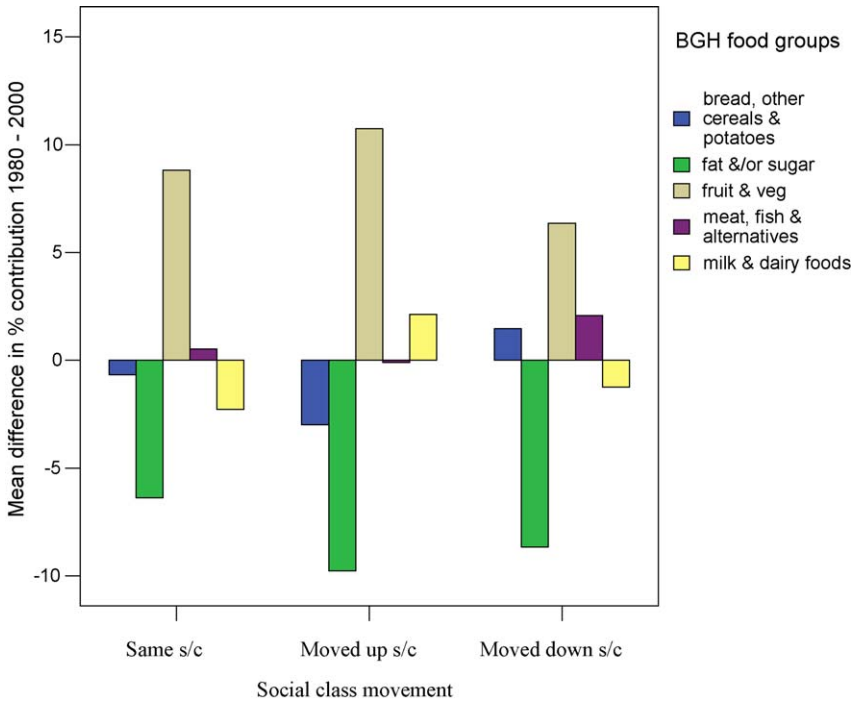

Fig. 3. Mean change in percentage contribution to total food weight 1980–2000 from the five BGH food groups according to movement in social class.

within the collective buffer zones decreased 1980–2000 (Fig. 2). In 2000, there was also a clustering of 'household shopping' and 'baked goods' food outlets around urban centres, even though the respondents home postcodes had dispersed.

The type and number of the three categories of food outlets within each 1000 m radius buffer zone were counted for 1980 and 2000 postcodes. The number of individuals who had no food outlets within their 1000 m radius buffer zone increased from none in 1980 to 9 in 2000 (7.8%). 'Baked goods' outlets within 1000 m became the most scarcely available to our sample in 2000, relative to 'household food shopping' and 'food for consumption away from the home' respectively.

Food intake and change in food intake

The intake (1980 and 2000) and change in food intake (2000–1980) according to the BGH food groups for these 115 individuals remaining in Ashington, Morpeth and Newbiggin followed a similar pattern to the larger sample (Lake et al., 2006). This pattern also remained consistent when stratified by change in SES (see

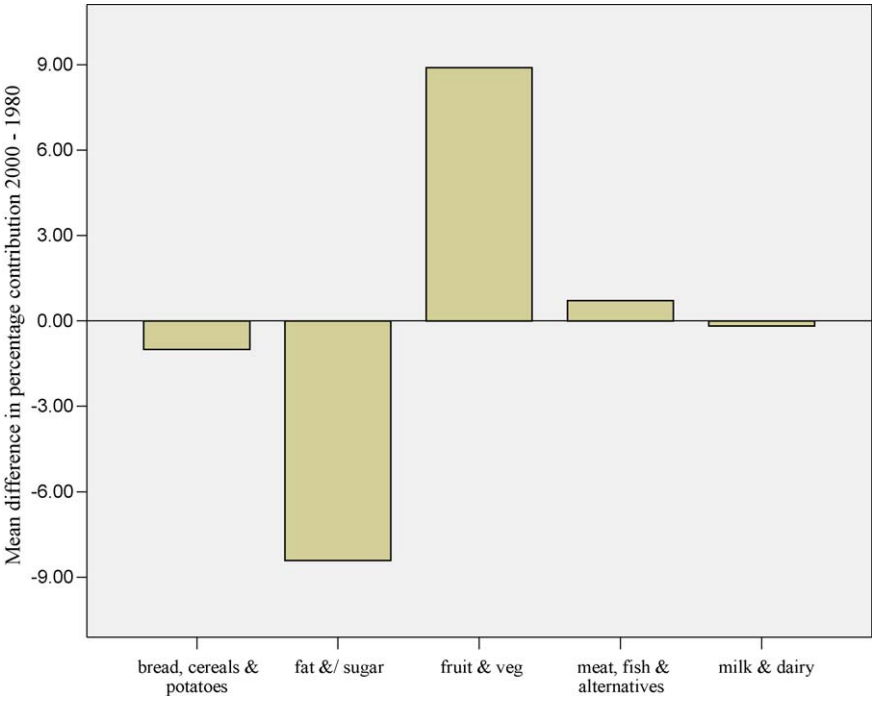

Fig. 4. Mean change (2000–1980) in percentage contribution to total food weight from the five BGH food groups ($n = 115$).

Table 3
Relationship between food outlets (1980, 2000, 1980–2000) and BMI (1980 and 2000), change in BMI (1980–2000) and BGH food intake (1980 and 2000), $n = 115$.

	1980			2000			1980–2000		
	Household food shopping	Food for consumption away from the home	Baked goods	Household food shopping	Food for consumption away from the home	Baked goods	Change in household food shopping (%)	Change in food for consumption away from the home (%)	Change in baked goods (%)
1980									
BMI	−0.15 (0.11)	−0.15 (0.10)	−0.15 (0.10)	–	–	–	–	–	–
Bread, other cereals and potatoes	−0.04 (0.68)	−0.16 (0.10)	−0.06 (0.53)	–	–	–	–	–	–
Fats and/or sugars	0.01 (0.90)	−0.03 (0.71)	−0.05 (0.59)	–	–	–	–	–	–
Fruit and veg	0.00 (0.98)	0.01 (0.94)	−0.08 (0.40)	–	–	–	–	–	–
Meat, fish and alternatives	0.11 (0.26)	0.06 (0.52)	0.05 (0.60)	–	–	–	–	–	–
Milk and dairy foods	−0.05 (0.63)	0.14 (0.14)	0.14 (0.12)	–	–	–	–	–	–
2000									
BMI	–	–	–	0.10 (0.27)	0.00 (0.97)	0.05 (0.60)	–	–	–
Bread, other cereals and potatoes	–	–	–	0.07 (0.47)	0.11 (0.23)	0.13 (0.18)	–	–	–
Fats and/or sugars	–	–	–	0.08 (0.39)	0.02 (0.84)	0.05 (0.60)	–	–	–
Fruit and veg	–	–	–	−0.12 (0.20)	−0.11 (0.25)	−0.12 (0.21)	–	–	-
Meat, fish and alternatives	–	–	–	−0.02 (0.80)	−0.02 (0.86)	−0.02 (0.86)	–	–	–
Milk and dairy foods	–	–	–	0.04 (0.65)	0.04 (0.68)	0.01 (0.88)	–	–	–
1980–2000									
Change in BMI (%)	0.17 (0.07)	**0.18** (**0.05**)	**0.19** (**0.04**)	0.05 (0.58)	−0.03 (0.75)	0.01 (0.88)	−0.06 (0.54)	−0.06 (0.50)	−0.02 (0.82)

Coefficients shown, significance in brackets—significant results emboldened.

Fig. 3). Overall, between 1980 and 2000, percentage contribution to total food weight from foods containing fat and/or sugar decreased by 8.4% while fruit and vegetable intake increased by 8.9% (Fig. 4), largely in line with health promotion messages.

Food intake, BMI and the 1000 m radius buffer zones

No statistically significant correlations were found between the number and type of food outlets within an individual's 1000 m radius buffer zone in 1980 or 2000 and their intake of the five BGH food groups in 1980 and 2000 (Table 3). In addition, there were no statistically significant correlations between measured BMI in 1980 or 2000 and the number and type of food outlets in their 1000 m radius buffer zone in 1980 or 2000 (Table 3).

Change in BMI and the 1000 m radius buffer zones

Percentage change in BMI between 1980 and 2000 was related to the type and number of food outlets within each individual's 1000 m radius buffer zones in 1980 (Table 3). There were statistically significant positive relationships between percentage change in BMI and two aspects of the measured foodscape in 1980, 'foods eaten out of the home' and 'baked goods' ($r = +0.18$ $p = 0.05$, $r = +0.19$ $p = 0.04$). As the number of food microenvironments ('foods eaten outside of the home' and 'baked goods') increased within individual's 1000 m radius buffer zones, BMI also increased. 'Household food shopping' (1980) was not significantly related to change in BMI ($p = 0.07$) and there was no relationship with the 2000 foodscape and change in BMI. The change in the number and type of food outlets available to individuals over time (1980–2000) was not associated with percentage change in BMI over the same time period (Table 3); an elevated availability of food between 1980 and 2000 did not result in elevated BMI for example.

Discussion

To date, there has been little research on the relationship between food access and obesity (White, 2007). The present study has shown that the relationships between an individual's food intake, BMI and the wider food environment or foodscape is complex. While there was a weak association between change in BMI and aspects of the food environment in 1980, this was not apparent in 2000.

Food and anthropometric data were collected from two time points when individuals were 11–12 years old, at middle school and living in Northumberland, and at age 31–32 years, when many of the respondents had partners, families and most were working. During these 20 years other major life events will have occurred such as attending secondary school, going to university, leaving home, travelling, undertaking work, becoming financially independent, moving house, meeting and cohabiting with partners and having children (Lake et al., 2004a,b, 2006, 2009). In parallel with these individual changes, there have been other major environmental changes including the end of coal mining in the region (Robinson, 1994), the increased availability and variety of foods provided through large supermarkets, the 'food scares' of the late 1980s and 1990s, increased nutrition and health promotional messages which may have shaped how each individual's diet changed. While this study has not shown an association between food intake and the foodscape, this is not evidence that a relationship does not exist. Capturing food intake data and measuring the food environment is a complex process. This study served as an exploratory exercise for the assessment of the foodscape and future research should look to develop more nuanced tools for this purpose. This study used retrospective geographical methods to link the foodscape in 1980 and 2000 with food intake, BMI and change in BMI.

Dietary changes within this sample between 1980 and 2000 mirrored those within the wider population over the same time period. Using the National Food Survey (NFS) (Department for Environment Food and Rural Affairs & National Statistics, 2001) as the most suitable comparison, allows us to see that ASH30 individuals increased their consumption of fruit and vegetables by 10.6%, ahead of the national increase of 7%, 1975–2000. The ASH30 sample had decreased their intake of foods containing fat and/or sugar more than the National Food Survey's record (−8.8%

compared with −1%). This may be explained by the cross-sectional nature of the NFS which restricts its potential for examining the progression of individuals from adolescence to adulthood, a time that is likely to be associated with a decrease in consumption of fatty foods as demonstrated within the ASH30.

Earlier UK research found that factors other than the distance to the nearest supermarket are likely to influence fruit and vegetable intake (Pearson, Russell, et al. 2005). In 2000 the adults participating in the study had dispersed away from the urban centres, yet their intake of fruit and vegetables had increased by 8.9%. Over the period when intake of foods containing fat and/or sugar decreased by 8.4% the opportunities to purchase food consumed outside of the home increased dramatically. Much of this dietary change from adolescence to adulthood could be generational; adolescent eating patterns are frequently described as unhealthy, and while evidence suggests that diet and eating patterns developed in adolescence 'track' to adulthood (Lake et al., 2006, 2009), adults are perceived to have 'better' diets. In this ASH30 sample it has also been shown that fruit and vegetable intake 'tracked' i.e. those that had a lower intake in 1980, relative to their peers, maintained a lower intake in 2000 (Lake et al., 2006, 2009). A cross-sectional rather than longitudinal observation may reveal a different relationship with a changing foodscape and changing dietary habits dependent upon availability.

In the UK, people are spending a smaller proportion of their income on food and more is being spent on foods eaten out of the home (The Strategy Unit Cabinet Office, 2008). Foods consumed outside the home tend to be higher in fat and sugar (DEFRA Surveys, 2007). Between 1995 and 2005 sales in the fast food sector increased by 73% (Mintel, 2006)—this reflects our observed 259% increase in outlets retailing food to be consumed outside the home. UK time diary analysis comparing data collected in 1975 (n = 1274) with data collected in 2000 (n = 8522) (Cheng, Olsen, et al., 2007) reported a decline in the overall time spent eating at home while time spent eating away from the home had increased significantly across all socio-economic groups.

There was a weak positive correlation between change in BMI and some aspects of the food environment in 1980. This suggests that the physical environment in which the respondents spent some of their childhood may have some impact on change in BMI from early adolescence to adulthood. Subsequently, this raises important policy relevant issues such as the location of food outlets in relation to schools, discussed in the recent government obesity strategy for England (Department of Health, 2008).

The real strength of this research is its longitudinal design, which allowed us to assess the relationship between the adolescent food environment and subsequent adult BMI and consumption patterns—this is a novel and valuable approach which renders few comparisons. Cross-sectional scrutiny of BMI and food availability revealed little association, findings aligned with those of a previous Newcastle-based study by White et al. (2004), and those of Jeffery, Baxter, et al. (2006) who utilised a similar methodology of 'buffering' individuals to create individual food environments, however problematically, only accounted for the availability of 'fast food' in Minnesota, USA. Maddock (2004) and Mehta and Chang (2008) also accounted solely for the 'fast food' environment and found positive correlations between BMI and food availability at the US state and county levels, contradicting the results found here. Several hypotheses are forwarded for these contradictions, including the lack of acknowledgement for the entire foodscape, the assessment of said food environment within large area geographies that may bear little direct impact upon the behaviours of individuals in reality, and the US context of these studies that may mask important differences in attitudes towards food. Findings from non-UK-based studies may not be fully transferable to the UK (Townshend and Lake, in press). Morland and Evenson (2009), found equivocal results in their US study, with positive associations between obesity and household shopping (supermarkets) and negative associations between obesity and food to be consumed out of the home (fast food) at the census tract level; both of these associations are in contrast to the lack of association documented in this study, however once again, using buffer zones to denote neighbourhood environments in this study is a relative strength. Individuals in these cross-sectional studies were also required to self-report their heights and weights, whereas in the ASH30 Study, heights and weights were accurately measured by trained researchers.

Not having home postcode information in 1980 was a major limitation of this study, and could be exacerbated by the inherent inaccuracy of using postcodes as a source of address data. This study has made the assumption that the respondents, in 1980, were living close to their schools and that they spent time in the environment around the school. In defence of this method, one of the most significant effects of increased parental choice of schools has been the erosion 'of pre-existing patterns of catchment areas' and in 1980, the number of parents willing to trade off 'geographical convenience' for educational benefits was perhaps far fewer than it is today (Parsons, Chalkley, et al. 1996). Furthermore, postcodes were the only source of address data available, and their use is not without precedent.

Another limitation is that the use of 1000 m radius buffer zones around a participant's school postcode in 1980 and home postcode in 2000 makes a number of large assumptions and falls within the concept of the 'local trap', as does most of the research in this area (Cummins, 2007). The lack of time-space or ethnographic data for this sample both in 1980 and 2000 is an acknowledged weakness and will be addressed in the future work of this research group.

The clustering of the retailers around the urban centres of Ashington, Morpeth and Newbiggin is interesting. It is possible retailers decided to remain within one shopping area while the individual's home postcodes in 2000 illustrated greater dispersal. The 7.8% increase in respondents living with no food outlets within their 1000 m radius buffer zone could be due to increased car access which lessened the necessity to live in close proximity to food outlets or other amenities. Other explanations could be that there was a clustering of food outlets around schools in 1980 or that independent food stores have closed and the respondents in 2000 had fewer local food outlets.

This study involved innovative secondary use of existing data in an analysis linking the disciplines of nutrition and geography. Though the lack of home postcode data for 1980 may be considered a weakness of this study, the authors believe that it does not diminish the findings of this work, which uses a unique data set to illustrate changes in food intake and changes in BMI in relation to the changing food environment. A recent study has shown the importance of telephone directories as a reliable source of complete lists of stores, regardless of size (Wang et al., 2006). However, Wang et al. (2006) concede that these directories may give a considerably higher count of stores than actually exist because of stores that have advertised and subsequently closed. Whilst this is a limitation, the fact that advertisements in the Yellow Pages have to be renewed annually makes it unlikely that the data were out of date and this was confirmed through e-mail correspondence with Yell.com. Classification of the types of food outlet in the buffer zones was problematic as they were based on Yellow Pages classification which was dynamic between 1980 and 2000. The distinction between retail and food service outlets (described in this research as 'household shopping' and 'foods for consumption away from home') are becoming 'blurred' (DEFRA Surveys, 2007) as take-away type food becomes more available in

retail outlets and branded foods such as pizzas from known pizza restaurants have become available from supermarkets for home consumption.

Conclusions

Eating habits, other health related behaviours and the development of obesity are related to a complex set of behavioural factors. Understanding the environmental context in which these behaviours are exercised is an important part of developing long term interventions to tackle improvement in eating behaviours. It is generally accepted that the wider environment should be supportive of the recommendations that health promotion makes. Understanding the role played by food access in determining dietary choices and, ultimately, obesity will require sophisticated, multidisciplinary research methods to describe and interpret the dynamic foodscape and its relationships with food choice behaviours.

Acknowledgements

The authors thank the Wellcome Trust for funding the original ASH30 Study (grant number 057995/Z/99/Z), Professor Andrew Rugg-Gunn for his foresight in establishing the ASH30 Study, Dr Allan Hackett, Liverpool John Moores University, for the 1980 data collection, Dr Angela Craigie, Megan Gibbons and Dr Charly Mulvaney for the 2000 ASH30 Study data collection, Professor John Matthews and Simon Webster for their statistical advice and the original ASH30 participants for their contributions. The digital maps and postcode directories used hold Crown Copyright from EDINA Digimap a JISC supplied service.

Source of funding: Amelia A Lake and Ashley Adamson are both funded by NIHR (National Institute for Health Research) Personal Awards. The views expressed in this publication are those of the author and not necessarily those of the NHS, NIHR or Department of Health.

Conflicts of interest: None.

References

Atkins, P., & Bowler, I. (2001). *Food in society. Economy, culture, geography*. London, New York: Arnold.

Booth, S. L., Sallis, J. F., Ritenbaugh, C., Hill, J. O., Birch, L. L., Frank, L. D., et al. (2001). Environmental and societal factors affect food choice and physical activity. Rationale, influences, and leverage points. *Nutrition Reviews, 59*(3 Pt 2), S21–39 (discussion S57–65).

Cheng, S.-L., Olsen, W., Southerton, D., & Warde, A. (2007). The changing practice of eating. Evidence from UK time diaries, 1975 and 2001. *The British Journal of Sociology, 58*(1), 39–61.

Connors, M., Bisogni, C. A., Sobal, J., & Devine, C. M. (2001). Managing values in personal food systems. *Appetite, 36*(3), 189–200.

Craigie, A. M., Matthews, J. N. S., Rugg-Gunn, A. J., Lake, A. A., Mathers, J. C., & Adamson, A. J. (2009). Raised adolescent body mass index predicts the development of adiposity and a central distribution of body fat in adulthood: a longitudinal study. *Obesity Facts, 2*(3), 150–156.

Cummins, S. (2007). Commentary: investigating neighbourhood effects on health. Avoiding the 'Local Trap'. *International Journal of Epidemiology, 36*(2), 355–357.

Cummins, S., & MacIntyre, S. (1999). The location of food stores in urban areas. A case study in Glasgow. *British Food Journal 101(545–553).*

Cummins, S. C. J., Mckay, L., & Macintyre, S. (2005). McDonald's restaurants and neighborhood deprivation in Scotland and England. *American Journal of Preventive Medicine, 29*(4), 308–310.

DEFRA Surveys Statistics and Food Economics Division. (2007). Food service and eating out: an economic survey.

Department for Environment Food and Rural Affairs & National Statistics. (2001). *National Food Survey 2000. Annual report on food expenditure, consumption and nutrient intakes*. London: The Stationery Office.

Department of Health. (2008). Healthy weight, healthy lives: a cross-government strategy for England. London.

EDINA. (2006). ''Digimap Collections.'' Retrieved 21/10/06, 2006, from http://edina.ac.uk/digimap/.

Ellaway, A., Anderson, A., & Macintyre, S. (1997). Does area of residence affect body size and shape. *International Journal of Obesity, 21*, 304–308.

Feather, N. T., Norman, M. A., & Worsley, A. (1998). Values and valences. Variables relating to the attractiveness and choice of food in different contexts. *Journal of Applied Social Psychology, 28*(7), 639–656.

Food Standards Agency. (2001). *The balance of good health*. London: Food Standards Agency.

Foresight. (2007). *Tackling obesities. Future choices—Project report*. London: Government Office for Science.

Gatenby, S. J., Hunt, P., & Rayner, M. (1995). The National Food Guide. Development of dietetic criteria and nutritional characteristics. *Journal of Human Nutrition and Dietetics, 8*(5), 323–334.

Giskes, K., Kamphuis, C. B., van Lenthe, F. J., Kremers, S., Droomers, M., & Brug, J. (2007). A systematic review of associations between environmental factors, energy and fat intakes among adults. Is there evidence for environments that encourage obesogenic dietary intakes? *Public Health Nutrition, 10*(10), 1005–1017.

Hackett, A. F., Rugg-Gunn, A. J., & Appleton, D. R. (1983). Use of a dietary diary and interview to estimate the food intake of children. *Human Nutrition-Applied Nutrition, 37*(4), 293–300.

Hackett, A. F., Rugg-Gunn, A. J., Appleton, D. R., Parkin, J. M., & Eastoe, J. E. (1984a). A two-year longitudinal study of dietary intake in relation to the growth of 405 English children initially aged 11–12 years. *Annals of Human Biology, 11*(6), 545–553.

Hackett, A. J., Rugg-Gunn, A. J., Appleton, D. R., Eastoe, J. E., & Jenkins, G. N. (1984b). A 2-year longitudinal nutritional survey of 405 Northumberland children initially aged 11.5 years. *British Journal of Nutrition, 51*, 67–75.

Henderson, & Crosthwaite, (1992). *Three plus one*. London: Henderson Croswaithe Institutional Brokers Ltd.

Jeffery, R. W., Baxter, J., Mcguire, M., & Linde, J. (2006). Are fast food restaurants an environmental risk factor for obesity? *International Journal of Behavioural Nutrition and Physical Activity, 3*(2), 1–6.

King, D. A., & Thomas, S. M. (2007). Big lessons for a healthy future. *Nature, 449*(7164), 791–792.

Lake, A. A., Adamson, A. J., Craigie, A. M., Rugg-Gunn, A. J., & Mathers, J. C. (2009). Tracking of dietary intake and factors associated with dietary change from early adolescence to adulthood: the ASH30 Study. *Obesity Facts., 2*(3), 157–165.

Lake, A. A., Adamson, A. J., Hyland, R. M., & Mathers, J. C. (2004a). Dietary change and perceptions of change over time. *Nutrition Bulletin, 29*(3), 199–203.

Lake, A. A., Rugg-Gunn, A. J., Hyland, R. M., Wood, C. E., Mathers, J. C., & Adamson, A. J. (2004b). Longitudinal dietary change from adolescence to adulthood. Perceptions, attributions and evidence. *Appetite, 42*(3), 255–263.

Lake, A. A., Mathers, J. C., Rugg-Gunn, A. J., & Adamson, A. J. (2006). Longitudinal change in food habits between adolescence (11–12 years) and adulthood (32–33 years). The ASH30 Study. *Journal of Public Health, 28*(1), 10–16.

Maddock, J. (2004). The relationship between obesity and the prevalence of fast food restaurants. State-level analysis. *American Journal of Health Promotion, 19*(2), 137–143.

McPherson, K., Marsh, K., & Brown, M. (2007). *Modelling future trends in obesity and the impact on health*. Foresight tackling obesities. Future choices(2nd ed.). .

Mehta, N. K., & Chang, V. W. (2008). Weight status and restaurant availability. A multilevel analysis. *American Journal of Preventive Medicine, 34*(2), 127–133.

Mela, D. J. (1999). Food choice and intake. The human factor. *Proceedings of the Nutrition Society, 58*(3), 513–521.

Mintel International Group Limited (2006) Eating Out—Ten-year Trends—UK London Mintel International Group Limited. www.mintel.com.

Morland, K., & Evenson, K. R. (2009). Obesity prevalence and the local food environment. *Health and Place, 15*, 491–495.

Nelson, M., Atkinson, M., & Meyer, J. (1997). *A photographic atlas of food portion sizes*. London: MAFF Publications.

Parsons, E., Chalkley, B., & Jones, A. (1996). The role of geographic information systems in the study of parental choice and secondary school catchments. *Evaluation and Research in Education, 10*(1), 23–34.

Pearson, T., Russell, J., Campbell, M. J., & Barker, M. E. (2005). Do 'food deserts' influence fruit and vegetable consumption? A cross-sectional study. *Appetite, 45*(2), 195–197.

Popkin, B. M. (1993). Nutritional patterns and transitions. *Population and Development Review, 19*(1), 138–157.

Registrar General. (1970). *Classification of occupations 1970. Office of Population Censuses and Surveys*. London: HMSO.

Riley, M. (1994). Marketing eating out. The influence of social culture and innovation. *British Food Journal, 96*(10), 15–18.

Robinson, F. (1994). Something old, something new? The Great North in the 1990s. In P. Garrahan & P. Aldershot (Eds.), *Urban change and renewal. Paradox of place* (pp. 9–20). Avebury: Aldershot.

Swinburn, B., & Egger, G. (2002). Preventive strategies against weight gain and obesity. *Obesity Reviews, 3*(4), 289–301.

The Strategy Unit Cabinet Office. (2008). Food: an analysis of the issues.

Townshend, T., Lake, A. A. (in press). Obesogenic urban form: theory, policy and practice. *Health and Place*, Corrected Proof. doi:10.1016/j.healthplace.2008.12.002.

Wang, M., Gonzales, A., Ritchie, L., & Winkleby, M. (2006). The neighborhood food environment. Sources of historical data on retail food stores. *The International Journal of Behavioral Nutrition and Physical Activity, 3*, 1510.1186/1479-5868-3-15.

Warde, A. (1997). *Consumption, food and taste. Culinary antinomies and commodity culture*. London/Thousand Oaks/New Delhi: SAGE.

Warde, A., & Martens, L. (1998). Eating out and the commercialisation of mental life. *British Food Journal, 100*(3), 147–153.

Wardle, J. (1995). Parental influence on children's diets. *Proceedings of the Nutrition Society, 54*, 747–758.
White, M. (2007). Food access and obesity. *Obesity Reviews, 8*(s1), 99–107.
White, M. J., Bunting, et al. (2004). N09010: do 'food deserts' exist? A multi-level, geographical analysis of the relationship between retail food access, socio-economic position and dietary intake. *Final Report Food Standards Agency*. Newcastle: Newcastle University.
World Cancer Research Fund/American Institute for Cancer Research. (2007). *Food, nutrition, physical activity, and the prevention of cancer: a global perspective*. Washington, DC: AICR.
World Health Organisation. (2003). *Diet, nutrition and the prevention of chronic disease. Technical report series 916*. Geneva: WHO/FAO Expert Consultation.
Wrigley, N. (1998). *How British retailers have shaped food choice*. The Nation's Diet. The Social science of food choice, London & New York, Longman: A. Murcott. p. 112–128.