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Assessing the Impact of Improved Retail Access on Diet in a 'Food Desert': A Preliminary Report

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Summary. If poor food retail access in deprived areas of British cities is linked, as suggested in many of the policy debates of the late 1990s, via compromised diets/undernutrition to poor health and widening health inequalities, what is the impact of a sudden and significant improvement in food retail access likely to be on the food consumption patterns of residents? In this paper, we describe and provide preliminary results from the first-ever UK study of a major retail provision on diet in a 'food desert'—a 'before/after' study of food consumption patterns in the highly deprived, previously poor food retail access area of Seacroft, Leeds, experiencing a sudden and significant change in its food retail access as a result of the opening of a large superstore by the UK's leading food retailer. We suggest that this study has the potential to provide some of the missing links between poor food retail access, compromised diets/undernutrition, poor health and compound social exclusion that characterised statements on the topic of 'food deserts' in the health inequalities and social exclusion debates of the late 1990s, and that its findings may have significant implications for policy debate.

Introduction

As noted in the introduction to this collection of papers, areas of poor access to retail provision of healthy affordable food where the population is characterised by deprivation and compound social exclusion became known in UK policy debate in the 1990s as 'food deserts'. Here, we leave to other papers in the issue (Clarke *et al.*, 2002) the question of how most appropriately 'food deserts', if they exist, might be identified—that is to say, the issue of how to derive indicators of absolute and relative access to food retail provision in British cities. Instead, we ask the question: if poor food retail access in these deprived areas is indeed linked, as suggested in many of the policy debates of the late 1990s, via compromised diets/undernutrition, to poor health and widening health inequalities, what is the impact of a sudden and significant improvement in food retail access in such an area likely to be on the food consumption patterns of residents? That is to say, accepting—as the Department of Health (1999) noted in its action report *Reducing Inequalities in Health*—that the food choices people can make are shaped by the avail-

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ability and affordability of food locally, what might the impact on diet be anticipated to be, and what can actually be observed to occur, as a result of a *non-healthcare intervention* (in this case, a retail provision intervention) in such an area?

In this paper, we describe and provide interim results from what is believed to be the first study of this type in the UK—a major 'before/after' study of food consumption patterns in a highly deprived, previously poor food retail access area (Seacroft) of a British city (Leeds) experiencing a sudden and significant change in its food retail access as a result of the opening of a large food superstore by the UK's leading food retailer (Tesco) under a Regeneration Partnership scheme involving the local authority and local community. The focus of the study is firmly on the impact of a significant change in food retail provision in this highly deprived area on food consumption patterns. We do not extend that focus on diet to general health and well-being although, as noted in the introductory paper (Wrigley, 2002), a comparative study (Petticrew *et al.*, 2002) which does propose that extension is being conducted in Glasgow with Department of Health funding and should begin to produce findings by 2003. In addition, our associated qualitative focus group studies (see the 'pre-intervention' findings of Whelan *et al.*, 2002, in this issue) inevitably touch on these wider issues and they will be further addressed in the 'post-intervention' period.

Our purpose here is to outline the structure, objectives and possible implications of this first-ever UK study of a major retail provision intervention on diet in a 'food desert'. The results we report relate largely to the pre-intervention ('before') phase of the research and our identification from these results of major hypotheses to be examined in the post-intervention ('after') phase. Analysis of the post-intervention survey was, by default, in its preliminary phase as this special topic was being prepared for *Urban Studies* during autumn 2001. Nevertheless, from our initial analysis of that survey, we are able to offer for the first time in the UK some potentially important evidence concerning the effect of a retail provision intervention on diet in a 'food desert'—in the process evaluating a critical hypothesis concerning the extent to which we might expect one of the most 'at risk' groups of residents in nutritional terms to remain untouched by that intervention.

The Research Area and the Nature of the Intervention

Our research focuses on four contiguous postcode areas in the area of Seacroft and Whinmoor (Figure 1), a large and highly deprived local authority housing estate area on the edge of Leeds and some 6 kilometres from the city centre. As figures at the ward level from the 1991 Census indicate (Table 1), the area contains approximately 15 000 households with a population in the region of 38 000 and was characterised in 1991 and remains characterised—relative to the position in the city as a whole and with sub-area variation—by low levels of owner-occupation/high levels of local authority renting, and significant and compound social deprivation. Indeed, the Department of the Environment, Transport and the Regions (2000) ward-level indices of deprivation place Seacroft in the top 5 per cent of most deprived wards in England. However, the area is less diverse in ethnic terms than the city as a whole. Essentially, it is a low-income, socially deprived, white area of the city which by the late 1990s was regarded as emblematic of those areas of the city which had failed to share in the significant economic revitalisation of the local economy during the 1990s—a polarisation which had left Seacroft and other peripheral estates such as Middleton not only largely untouched by the vibrancy of the city's economy, but also exposed to increasingly visible affluence in other parts of the city and surrounding areas. Moreover, as the accompanying paper in this issue by Clarke *et al.* (2002) demonstrates, by the end of the 1990s not only was east Leeds an area characterised by pockets of poor food retail provision (in both absolute

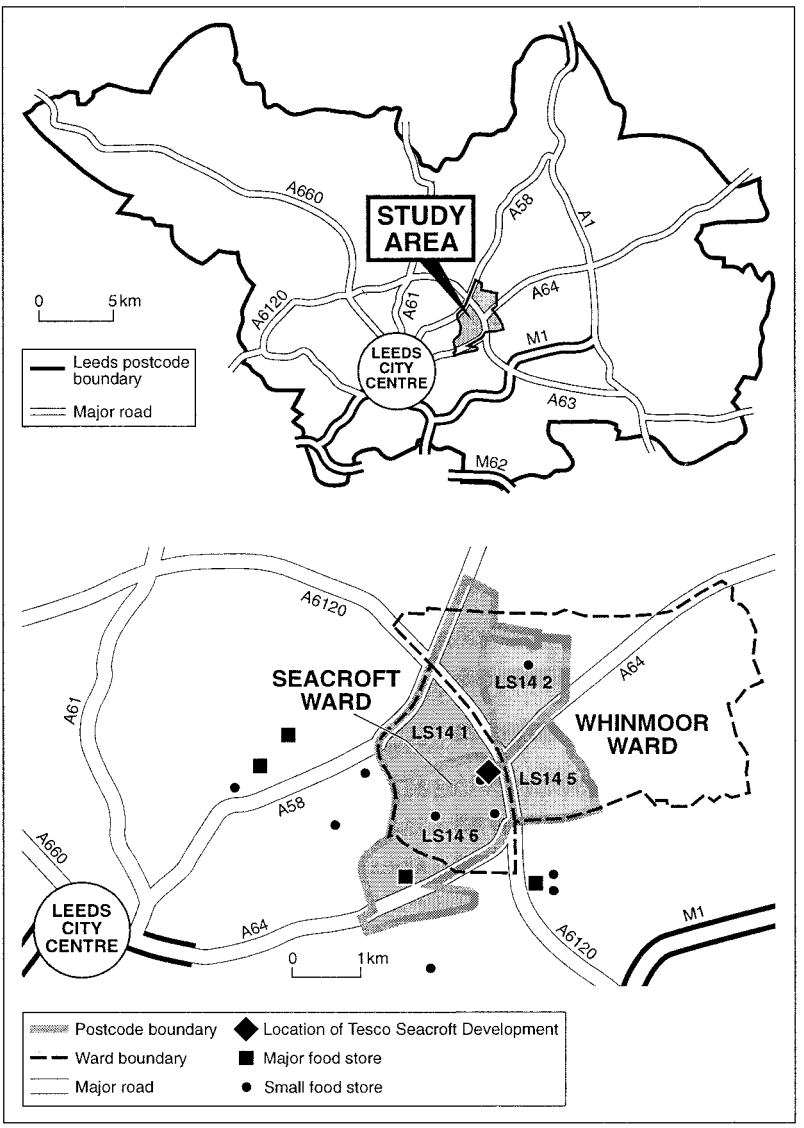

Figure 1. The research area, its content and the site of the retail provision intervention.

and relative terms) but, within that area, parts of Seacroft and Whinmoor stood out as potential 'food deserts' with distinctly low levels of food retail provision per household. Indeed, using the 500-metre radius criterion for defining a 'food desert' increasingly adopted in ministerial statements (see the policy summary by Wrigley, 2002, in this issue), our research revealed that only 32 per cent of respondents in our Seacroft/Whinmoor 'pre-intervention' study had access within 500 metres of their homes to what, following the East London and The City Health Authority's (ELCHA, 1999) study could be termed 'green retailers'. ('Green retailers' being essentially those retail outlets—multiple food retailers, greengrocers, certain smaller independent food stores—selling a reasonable variety of fresh fruit and vegetables). That is to say, on average almost 70 per cent of the respondents in our Seacroft/Whinmoor 'pre-intervention'

Table 1. Characteristics of the research area, 1991 Census ward-level data

	Overall size	
	Population	Households
Seacroft	18 983	7 792
Whinmoor	19 010	7 637

	Social characteristics (percentages)					
	Owner-occupied households	No-car households	Lone-parent households	Males Unemployed	Females Unemployed	White
Great Britain	66.4	33.4	3.8	9.8	4.7	94.5
Leeds	61.4	41.3	4.1	10.1	4.4	94.2
Seacroft	27.5	61.1	8.9	18.9	7.0	98.4
Whinmoor	49.8	43.2	5.2	9.8	4.4	97.7

sample were beyond reasonable walking distance (500 metres) of such stores and, at worst (for respondents in LS14 1) that figure reached almost 90 per cent.

Traditionally, the retail facilities of Seacroft/Whinmoor had centred on a district centre built by the local authority in the 1960s. But by the 1990s (see Figure 2) that centre and those facilities had become extremely degraded. In 1998, the UK's largest food retailer Tesco, as part of a wider adoption of regeneration-based schemes within its retail development strategy (Butterick, 2000), sought planning consent to redevelop the entire district centre based around a 70 000 square feet sales area superstore, promising the city council that priority in employment in the new store would be given to long-term unemployed residents of the area. The retail policy context of the proposed scheme, and its subsequent approval and development via a Regeneration Partnership with the local authority and local community, are discussed in greater detail in the accompanying paper by Wrigley *et al.* (2002). It is sufficient here to note that during the project design stage in 1999 of the ESRC/Sainsbury 'Food Deserts in British Cities' LINK award, knowledge that a major food superstore would be opening on the site of the old district centre during autumn 2000, and that access to food retail provision in parts of the area would suddenly be significantly improved, was available. As a result, it was possible to plan and schedule a major 'before/after' study of food consumption patterns in the area around that anticipated opening—Wave 1 (before) of the study being planned for the summer of 2000 and Wave 2 (after) being planned for the summer of 2001.

Appreciating the Issues under Investigation

The key issue to be tested in the study was the extent to which the retail provision intervention in the area, and the improved physical access to high-quality 'healthy' foods for many of its residents that would follow the intervention, could be expected to lead to changes in diet. We were conscious, however, that, for low-income households, physical access does not necessarily imply *economic access* and that, despite the quality and range of 'healthy' foods that would be offered by the new store, some residents of the area might effectively see no improve-

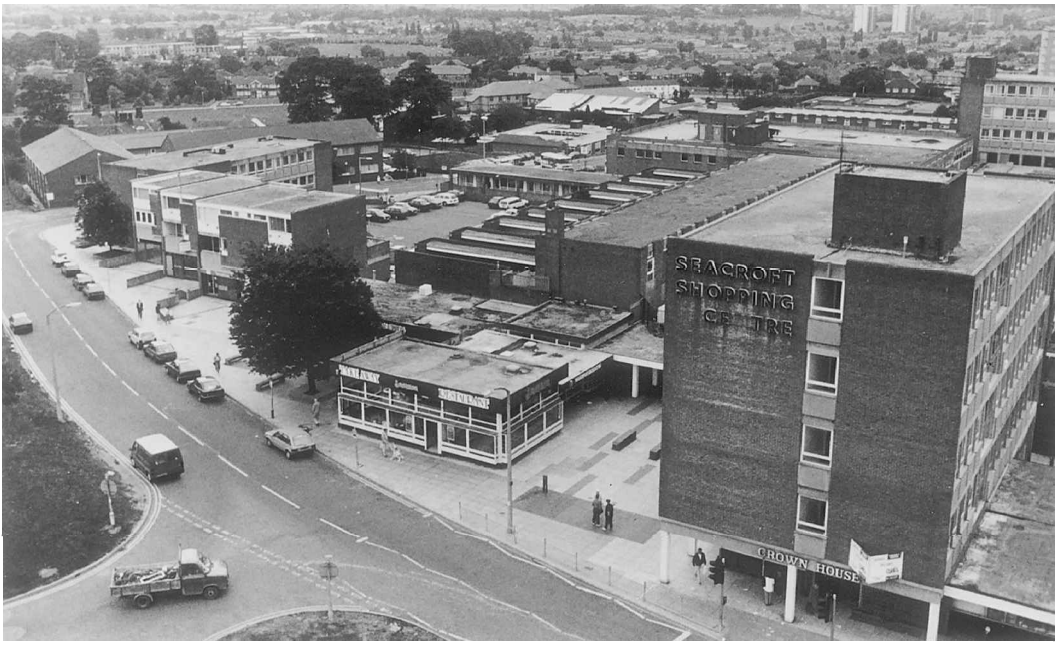

Figure 2. The Seacroft district centre in the early 1990s, pre-demolition. *Source:* reproduced with permission from an original photograph by Ross-Parry Picture agency.

ment in their overall food access simply because they would not be able to afford to use the Tesco superstore. In addition, as suggested by Barratt (1997) and others, low-income customers might specifically choose to avoid exposing themselves to the variety of a large superstore, feeling that they could not afford to be tempted away from their usual pattern of food purchasing/consumption, potentially 'wasting' their money in the process. In this latter context, it is important to note that the evidence exists in the UK (for example, Nelson and Peploe, 1990) to suggest that the lowest-income groups are the most 'efficient' purchasers (when measured in grams per pound of expenditure) of 'filler foods', but are generally less efficient at buying certain 'healthy' foods such as fruit and vegetables.

Moreover, as stressed by the Low Income Project Team of the Nutrition Task Force (Department of Health, 1996), food purchasing and consumption patterns are a function not only of economic access and physical access (affordability and availability), but also of choice—constrained in turn by social/cultural norms, food preparation facilities/practices, nutritional knowledge and motivation to consider health, etc. As a result, even if a retail provision intervention in a deprived area such as Seacroft were significantly to shift the pattern of sourcing of food by households in the area, it does not necessarily follow that this will shift choice and result in the increased consumption of 'healthy' food items. It will simply open up that possibility for some households. Overall, our expectation, therefore, was that the effects (if any) of improved retail access in the research area were likely to reveal themselves in rather complex and subtle ways.

The Nature of the Survey

A two-wave (before/after) study was designed with the waves exactly one year apart to avoid seasonality variation. Each wave involved a respondent-completed, but interviewer placed and collected, seven-day food

consumption diary, supplemented in each wave by a wide-ranging interviewer-administered household questionnaire exploring issues of: household composition, social benefits and income; education and work status; disabilities and long-term health problems; smoking habits; attitudes to healthy eating; food store choice; mode of travel to stores; car ownership/access; perceived constraints on choice of foods bought, etc. As in the *National Food Survey* (Gregory *et al.*, 1990), the diary and questionnaire were to be completed by the person primarily responsible for the domestic food arrangements of the household.

The fieldwork was contracted to and completed by Europe's largest market research firm and the survey was designed by the academic team in Southampton, with technical advice from the market research firm and assistance from specialists in store development/planning, nutrition and market research at our LINK award industrial partner, J. Sainsbury plc. The survey instruments and methods were piloted in February 2000 and subsequently modified and refined. The main phases of the survey were completed in June/July 2000 and 2001, approximately 5 months before and 7/8 months after the opening of the new superstore in November 2000. A separate 'repeatability study' was also undertaken during Wave 2 of the main survey, involving 140 households, in order to measure the extent of random or systematic error in the information being reported by respondents within the 7-day food consumption diaries, and to assess the likely effect of this on our results. (For detailed discussion of the technical aspects of the survey design and execution, see Warm *et al.*, 2002.)

In order to be able to assess the anticipated complexity and subtlety of the effects (if any) of improved retail access in the research area using information from both waves of the survey and to provide, using data solely from Wave 1, a significant resource for analysing the determinants of diet among the low-income residents of a 'food desert', it was our view that a 'pre-intervention' *achieved* sample of 1000 residents would be necessary. To obtain this size of sample in a highly deprived neighbourhood in which survey response rates in the UK have traditionally been low, required us to assume that we would need to establish contact with approximately 3000 households in the research area. That is to say, we assumed that two-thirds of the households contacted would refuse to participate in what was a relatively time-consuming survey involving an implicit commitment to repeating the process one year on. Moreover, our assumption was that panel attrition between Waves 1 and 2 of the survey, separated by a year, was likely to present difficulties in an area of compound deprivation—although published evidence of the likely scale of that problem was rather scarce (but see the results of the Cardiff Consumer Panel Study of the early 1980s—Wrigley *et al.*, 1985). As a result, the minimum target for the *achieved* 'post-intervention' sample size in Wave 2 which we set for the market research firm was 600 respondents. In addition, we designed a system of monetary incentives (in the form of non-food retail shopping vouchers) structured to maximise recruitment to Wave 1 of the survey and retention of the respondents into Wave 2 of the survey. In the event, our sample design and the professional efforts of the fieldwork team, ensured an achieved sample of 1009 respondents in Wave 1 and 615 respondents in Wave 2.

Clearly, in any attempt to use these respondents as a representative sample of the population of this highly deprived study area, it is important to be sensitive to a number of potential biases—in particular, bias introduced by varying success in recruiting respondents of different demographic/socio-economic/educational/locational/attitudinal categories to participate in Wave 1 of the survey and, subsequently, bias introduced by differential rates of attrition between respondent groups which occurred across the two waves of the survey. Detailed analysis of these issues is provided elsewhere (Warm *et al.*, 2002) but is, in part, hampered at the time of writing by the lack of availability of 2001 Census ward-level statistics. Here, it is

sufficient to note that this is a dominantly female respondent sample (as can be anticipated by the use of the NFS definition of the appropriate respondent within the household), that most of the respondents are not in full-time employment (only 20 per cent with a further 19 per cent in some form of part-time employment), that almost three-quarters have only minimum (GCSE level) or no educational qualifications, that 68 per cent draw some kind of state benefit, and that they are located in households who largely rent their properties (59 per cent), have low self-reported incomes (at least 55 per cent under £15 000 per annum) and have some degree (75 per cent), often a large degree, of material deprivation based on a Townsend index. Our suspicion, but this is yet to be confirmed by the 2001 Census information, is that the Wave 1 sample underrepresents to a degree younger respondents, particularly those under 25 years of age (although we have 91 cases in Wave 1 of respondents in that age-group). In addition, we have evidence (see Appendix 1) of some relatively slight, but possibly significant, differential attrition bias being introduced between Waves 1 and 2—with the non-respondents in Wave 2 compared with the sample in Wave 1 being very slightly skewed towards what we will subsequently describe as the most 'at risk' groups in nutritional terms: the youngest age-groups, those with the lowest educational attainment, the heaviest smokers, etc. However, as a result of intense efforts to minimise attrition bias problems by the survey design and fieldwork teams, the notable feature of Appendix 1 is how limited these problems appear to be.

Food Consumption Patterns in the Pre-intervention Period

As noted in the introduction to these papers (Wrigley, 2002), strong and consistent evidence exists in the UK associating increased levels of fruit and vegetable consumption with reduced risks of many chronic diseases. Indeed, as Wynn once stated

> Of all the many possible nutritional factors, the strongest inverse correlates with death-rates within the United Kingdom and in other developed countries are the consumption of fresh vegetables and fruit (Wynn, 1987, p. 79).

Here, we use such consumption as a proxy measure for a healthy diet and consider the patterns and determinants of fruit and vegetable consumption amongst our sample of 1009 residents in Seacroft/Whinmoor during the pre-intervention period.

Benchmarks and Averages

There are two potential benchmarks against which we can compare our results. The first is the National Diet and Nutritional Survey (NDNS) of British adults aged 16–64 years (Gregory *et al.*, 1990)—a national representative cross-sectional study of these groups conducted during 1986 for the Ministry of Agriculture, Fisheries and Food (MAFF) based on 7-day dietary records from over 2000 respondents. The second is the annual National Food Survey (NFS)—the longest running continuous survey of household food consumption and expenditure in the world which involves approximately 6000 households each year and is based on a 7-day diary of household food and drink purchases.

Calculated from the 1986 NDNS, the national average fruit and vegetable consumption (excluding potatoes and potato products) of British adults is 3 portions per day (21 portions per week), whilst based on the 1999 NFS it is approximately 3.9 portions per day (approximately 27 portions per week). However, it is important to note that the averages which can be derived from the NFS come from a survey designed to assess *household* food expenditure and consumption and are an overestimate compared with those from the NDNS. In particular, the NFS does not measure intake of the individual directly and moreover presumes that what is purchased is actually eaten and that there is no waste (i.e. the averages derived from the NFS do not take account of the non-edible portion).

Neither do the NFS averages account for differential sharing out of the food purchased between members of the household.

However, when benchmarking the average fruit and vegetable consumption of the Seacroft/Whinmoor respondents against these national averages, it is important to bear in mind that our survey respondents are predominantly female and biased somewhat towards the older age-groups in the study area. Evidence from the NFS and NDNS, and from other studies in the UK (Margetts *et al.*, 1998; Thompson *et al.*, 1999), have shown that men are more likely than women to be lower consumers of fruit and vegetables and that there is also a strong age gradient in such consumption, with the 55–64 year old age-group eating twice as much fruit and vegetables as those under 25 years. As a result, when compared with an equivalent sample of low-income respondents without these gender and age characteristics, we can expect the reported fruit and vegetable consumption levels of our Seacroft/Whinmoor respondents to be upwardly biased in relation to the NDNS averages. That is to say, we believe that the appropriate national averages to compare our survey results against lie somewhere between the NDNS (lower) and NFS (upper) limits.

Fruit and Vegetable Consumption Levels

Figure 3 shows the distribution of fruit and vegetable consumption (excluding potatoes and potato products) by our Seacroft/Whinmoor sample of 1009 respondents in the pre-intervention period. The median level of reported consumption across the sample was 2.43 portions per day (17 portions per week) and 64 per cent of respondents had consumption levels falling below the NDNS national average (78 per cent below the NFS derived average). Recalling, therefore, that we believe the appropriate national average to compare our survey results against lies somewhere between the NDNS (lower) and NFS (upper) limits, we believe that around 70 per cent of our respondents in this deprived area had fruit and vegetable consumption below the national average. Moreover, only 10 per cent of our respondents met the government's national *target* (as recommended by the Department of Health) of at least 5 portions per day. Conversely, about 10 per cent of our respondents reported eating less than one portion per day. Particularly striking (Figure 4) is the consumption of fruit (including fruit juice) where the median consumption level of 1.29 portions per day disguises the almost 50 per cent of respondents who consume less than one portion per day and a modal fruit consumption of *zero*. Indeed, 11 per cent of our sample reported eating no fruit and drinking no fruit juice whatsoever in the week of the Wave 1 survey.

Breaking these consumption figures down geographically reveals interesting sub-area variation within the study area. As Table 2 and Figure 5 illustrate, within an overall context of low fruit and vegetable consumption by residents of this deprived area, there was sub-area variation from levels which approximated to the NDNS national average (in LS14 2) through to levels (in LS14 6) where more than 75 per cent of respondents were reporting fruit and vegetable consumption below the national average (83 per cent below the NFS (upper) limit and 70 per cent below the NDNS (lower) limit), with a striking 13.5 per cent of respondents reporting no consumption of fruit or fruit juice whatsoever in the week of the survey.

As Table 2 indicates, there are clearly associations between these sub-area variations in fruit and vegetable consumption and sub-area variations in levels of extreme material deprivation (measured by a Townsend index), low self-reported household income, housing tenure type, car access levels and household age/composition profiles. LS14 6, for example, is a sub-area characterised not only by extremely poor diet but also by survey respondents exhibiting many of the conventional markers of compound social exclusion. It is also a sub-area in which our survey suggests that young mothers with children living in local authority housing are common. Conversely, LS14 2, where re-

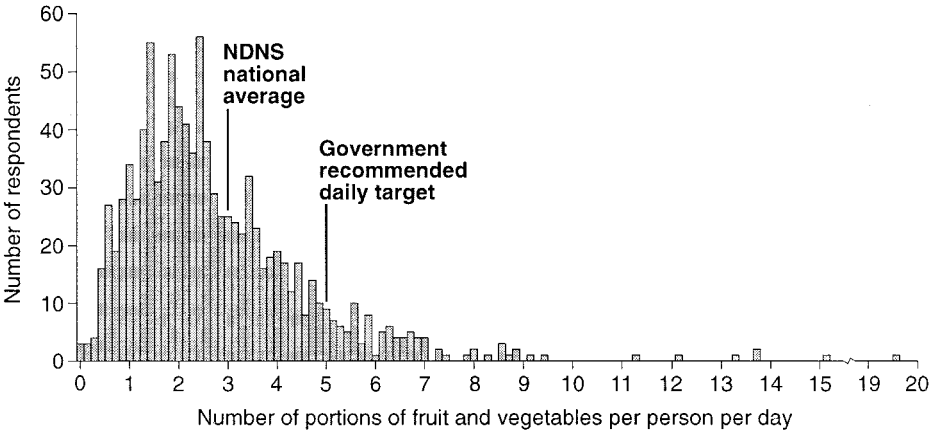

Figure 3. Distribution of fruit and vegetable consumption among 1009 respondents in the pre-intervention period.

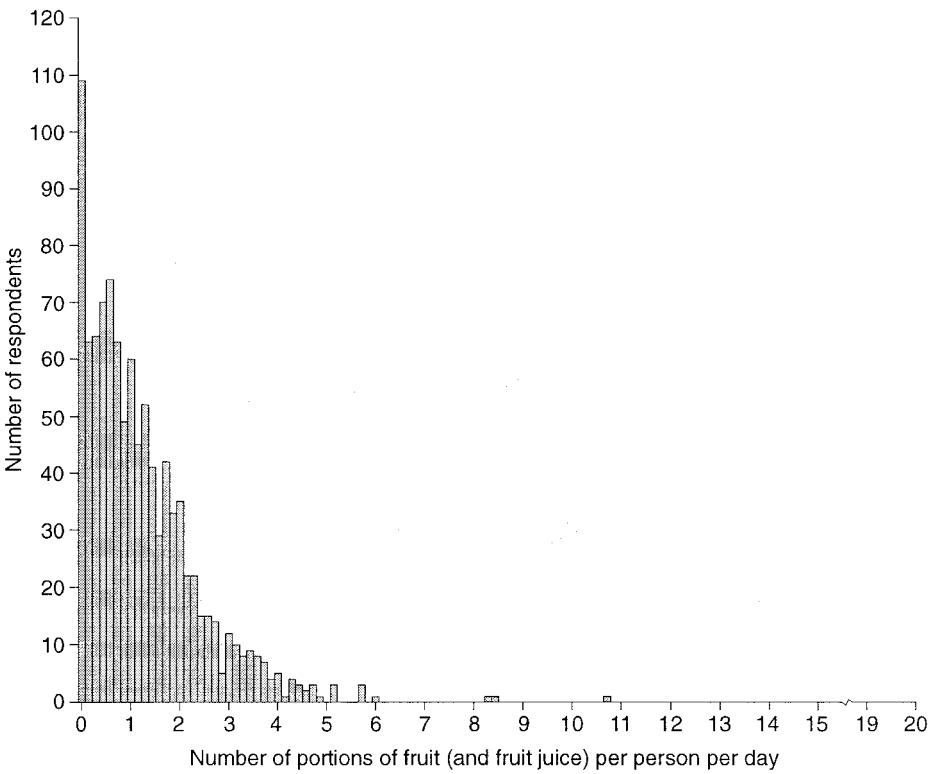

Figure 4. Distribution of fruit consumption among 1009 respondents in the pre-intervention period.

ported fruit and vegetable consumption levels approximated to the NDNS national average, shows the least evidence of extreme material deprivation and social exclusion. However, in the context of a study area where overall access to retail provision of healthy and affordable food was poor in the pre-intervention period, both sub-areas had *relatively* better levels of physical access, although in significantly different ways. In

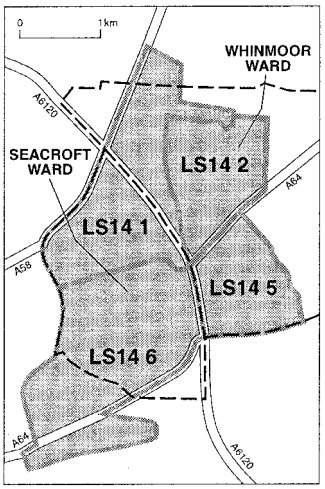

Figure 5. Sub-areas of the study area.

contrast, LS14 1 and LS14 5 were sub-areas with uniformly poorer levels of physical access in the pre-intervention period.

To what extent then can we systematise these observable associations at the sub-area level and assess the determinants of poor diet (proxied by low fruit and vegetable consumption) at the individual respondent level? And what, if any, is the nature of the association between variation in physical access at the local level and diet in the pre-intervention period?

Determinants of Poor Diet in the Pre-intervention Period

To assess the determinants of low fruit and vegetable consumption at the individual respondent level, we fitted binary logistic/logit regression models (Wrigley, 1985) of the form

$$\log_e \frac{P_{LOW\,|\,i}}{P_{HIGHER\,|\,i}} = \beta_0 + \beta_1 X_{1i} + \ldots + \beta_K X_{Ki}$$

where, the *X*s represent a range of potential explanatory variables and the βs are model parameters to be estimated. That is to say, models which assessed the log-odds of a respondent being a 'low' rather than 'higher' fruit and vegetable consumer—where 'low' consumption in the context of our sample is defined as 2 or less portions per day (396 respondents) and 'higher' consumption is defined as 3 or more portions per day (333 respondents). Drawing on information from the household questionnaires, we experimented with a wide range of potential explanatory variables (involving both individual respondent and household characteristics) and several model specifications. We also tested our results for robustness using the standard diagnostic procedures for logistic regression described in the urban and regional analysis literature by Wrigley (1984), Wrigley and Dunn (1984) and Dunn

Table 2. Sub-area variation in fruit and vegetable consumption, markers of deprivation/social exclusion and physical access to food retail provision in the pre-intervention period

	LS14 1	LS14 2	LS14 5	LS14 6
Average weekly fruit and vegetable consumption	19.99	22.09	19.12	17.92
Percentage below NDNS national average	63.7	49.7	66.9	69.1
Percentage below NFS national average	75.6	69.7	80.1	83.1
Percentage owner-occupied	35.6	74.3	42.2	26.1
Percentage extremely deprived	15.0	3.4	9.1	20.1
Percentage having income < £15 000[a]	52.5	31.0	57.0	66.0
Percentage with low educational attainment	68.5	61.4	75.2	79.2
Percentage age 17–24 years	7.5	5.5	5.8	14.4
Percentage having children in household	47.6	39.9	37.1	50.5
Percentage > 500 metres to nearest 'green retailer'	89.5	42.1	80.2	49.8
Distance to main foodstore used (in km)	2.96	3.88	2.48	1.38

[a]These are minimum figures. The percentages refusing to state income are not included.

et al. (1987) which, by the late 1990s, were routinely available via the Professional Statistics option of SPSS 7.5 (Norusis, 1997).

The best-fitting model (based on backward stepwise elimination of potential explanatory variables using a likelihood-ratio criterion) for this sample of 729 'low' versus 'higher' consumers of fruit and vegetables included just six explanatory variables. The parameter estimates and goodness-of-fit measures of this model are provided in Appendix 2. Here, we simply summarise its results (see Table 3) and note that, in some of the model specifications considered, a material deprivation (Townsend index) variable replaced educational attainment in the best-fitting model.

Overall, the model suggests that poor diet (proxied by low fruit and vegetable consumption) amongst this large sample of Seacroft/Whinmoor respondents in the pre-intervention period is strongly associated with younger respondents, who are heavy smokers, have children under 16 in the household, are low educational attainers (or are materially deprived) and who express negative attitudes to the importance of healthy eating (specifically, agreeing with the statement 'I don't really care what I eat' and disagreeing with the statement 'I mostly eat a healthy diet'). The model predictions (see Appendix 2) consistently suggest that respondents of this type will have a 95 per cent chance of being low fruit and vegetable consumers. In contrast, the model predictions suggest that older respondents (45–64 or 65 plus), who have never smoked or are ex-smokers, who have no children under 16 in the household, slightly higher educational attainment and who express positive attitudes to the importance of healthy eating, are likely to have a less than 20 per cent chance of being a low fruit and vegetable consumer.

Interestingly, despite the fact that 42 per cent of our respondents in Seacroft/Whinmoor come from households with no access to a car for food shopping, we could find no evidence relating household access to a car to levels of fruit and vegetable consumption. Neither could we find evidence of any simple relationship between levels of fruit and vegetable consumption and distance to the main food store frequented by respondents. However, there was clear evidence of complex coping mechanisms being used by our respondents to overcome access constraints in food shopping. For example, almost 10 per cent of our respondents relied on lifts in a car not belonging to the household to access their main food store. And of the 12 per cent of our respondents whose primary mode of travel to their main food store was walking, only half typically walked back home burdened with shopping. Typically, these respondents used a taxi for their return journey, as did a smaller proportion (one-fifth) of the 16 per cent of our respondents whose main mode of transport to their main food store was by bus.

Clearly (and as Whelan *et al.* 2002 note in their accompanying focus group studies), access issues in food shopping posed important constraints on many of our car-less respondents and required complex coping mechanisms. But how, and to what extent, could these constraints be seen to translate into

Table 3. Summary of best-fitting model results

Explanatory variables included in best-fitting model	Low fruit and vegetable consumption associated with
Age of respondent	Younger (particularly 17–24 age-group)
Smoking	Heavier (particularly 'heavy', i.e. >12 per day)
Children	Larger number in household
Attitudes to healthy eating (2 variables)	Negative expressed attitudes
Education	Low educational attainment

poor diet? To examine this issue, we must consider the linkage between store choice of our respondents and diet.

Store Choice and Poor Diet in the Pre-intervention Period

As Table 4 indicates, large and significant differences in average levels of fruit and vegetable consumption could be observed in the pre-intervention period between groups of respondents classified on the basis of the type of retail outlet in which they mainly shopped for such items. In particular, the respondents who reported using what could be classified as limited-range/budget stores—the Netto, Lidl and Kwik-Save discount food stores (see Burt and Sparks, 1994; Wrigley, 1993), the predominantly frozen-food-oriented stores, Jack Fulton and Iceland, or the small local Co-operative store in the heart of the Seacroft estate—had significantly lower levels of fruit and vegetable consumption. So, who were these limited-range/budget store shoppers in the pre-intervention period and what were their characteristics compared with those who opted to shop for fruit and vegetables elsewhere, particularly in the full-range major-retailer supermarkets?

Table 5 describes some of the characteristics of our respondents grouped by main retail source for fruit and vegetable purchasing and highlights in italics some of the most important differences between those groups. Not surprisingly, and in line with the results of our previous analysis,[1] the limited-range/budget store shoppers can be seen to be more dominantly the younger, heavy smoking, materially deprived respondents with children under 16 in the household. But, in addition, these shoppers also report lower incomes (under £15 000 per annum) than those who shop in the large major-retailer stores. In contrast, those with better diets (as proxied by fruit and vegetable consumption), and who are far more likely to purchase their fruit and vegetables from other sources (small local greengrocers, market stalls, etc.), appear significantly more likely to be elderly, non-car-owners and non-car-users for food shopping, but are almost as likely as the limited-range/budget store shoppers to report low incomes.

Table 4. Average consumption of fruit and vegetables per week (portions) by reported main fruit and vegetable retail source in the pre-intervention period

Limited-range/ budget stores[a] ($n = 112$)	Large major-retailer stores[b] ($n = 631$)	Other sources[c] ($n = 169$)
15.44	19.48	22.29

[a]includes Netto, Lidl, Kwik-Save, Co-op, Iceland, Jack Fulton.

[b]includes Tesco, Asda, Sainsbury, Safeway, Morrisons.

[c]includes local greengrocers, market stalls (city centre).

Note: the 97 'missing' respondents in this table (1009–912) consist of 38 who did not respond to the question on main fruit and vegetable retail source and 59 who cited a store which could not be classified under categories 1, 2 or 3 in the table.

To assess more fully the characteristics of the poorer diet of limited-range/budget store shoppers compared with the majority of respondents who opted to shop for fruit and vegetables in the full-range major supermarkets, we modelled the log-odds of being a 'budget' store shopper rather than a 'major supermarket' shopper. That is to say

$$\log_e \frac{P_{BUDGET\,|\,i}}{P_{MAJOR\,|\,i}} = \beta_0 + \beta_1 X_{1i} + \ldots + \beta_K X_{Ki}$$

Once again, drawing on the household questionnaire information, we experimented with a wide range of potential explanatory variables and model specifications. In this case, we also included a range of variables relating to the respondent's perception of what limited the choice of food which he/she buys—cost of food/food budget, ability to carry and transport food home, not much space to store food at home and difficulty of getting to shops because of age or disability.

Based on a sample of 550 respondents (which for technical reasons included only those whose main food store was also that mainly used for fruit and vegetable purchasing), the best-fitting model included just five

Table 5. Characteristics of respondents in pre-intervention period by main retail source for fruit and vegetable purchasing (percentages)

	Limited-range and budget stores ($n = 112$)	Large major-retailer stores ($n = 631$)	Other sources ($n = 169$)
Age (years)			
17–24	*13.4*	9.7	5.3
25–34	*26.8*	19.2	17.8
35–44	25.9	21.6	23.1
45–64	21.4	29.8	19.5
65 +	12.5	19.8	*34.3*
Smoking			
Never	21.6	32.2	27.7
Ex	12.6	25.1	25.3
Light	19.8	17.4	18.1
Heavy	*45.9*	25.4	28.9
Children			
Yes	*59.0*	44.7	42.2
No	41.0	55.3	57.8
Deprivation score			
0	14.4	27.5	20.2
1, 2	58.5	61.7	63.1
3 or above	*27.0*	10.8	16.7
Income (£)			
Below 10 000	*52.8*	37.9	56.1
10 000–14 999	*23.1*	14.8	9.1
15 000–19 999	8.3	11.3	9.8
20 000 +	4.6	16.1	6.1
Car ownership			
Yes	58.9	62.8	40.2
No	41.1	37.2	*59.8*
Transport mode from main store			
Car	60.7	69.5	40.5
Other	39.3	30.5	*59.5*

variables and is summarised in Table 6. In addition, it should be noted that the variable 'mode of transport on return from store' was close to remaining in the best-fitting model and that use of a limited-range/budget store was associated with *walking* home from the store. Parameter estimates and goodness-of-fit measures for this model are provided in Appendix 3.

The results of this model suggest, as anticipated, that use of limited-range/budget stores by our Seacroft/Whinmoor respondents for fruit and vegetable shopping is associated, as before, with markers of deprivation and negative motivation to consider health. But significantly, *physical access* constraints in food shopping (distance to and the need to walk home from the store) are also revealed as important as are, by implication, *economic access* constraints—with use of limited-range/budget stores being concentrated amongst the lowest-income groups.[2.]

Pre-intervention Findings and Issues Raised for the Post-intervention Study

In summary then, we find that in the pre-intervention period, poor diet (proxied by low fruit and vegetable consumption) is associ-

Table 6. Summary of best-fitting model results

Explanatory variables included in best-fitting model	Use of limited-range/budget store as main fruit and vegetable source associated with
Income	Low household income (< £15 000 per annum)
Smoking	Heavy smoking (> 12 per day)
Deprivation	Higher material deprivation
Attitudes to healthy eating (1 variable)	Negative expressed attitudes
Distance to fruit and vegetable retail store	Closeness to store

ated with respondents who are young, heavy smokers, typically with children in the household, characterised by one or more markers of deprivation and expressing negative attitudes to the importance of healthy eating. Many of these findings (for example, that relating to the age gradient in fruit and vegetable consumption) reinforce earlier results in the UK. However, having noted that there are also clear suggestions amongst our Seacroft/Whinmoor sample that complex coping mechanisms are being used by many of our respondents to overcome access constraints in food shopping, we find more novel evidence that the group with the poor diets are more highly concentrated amongst those who report their main retail source for fruit and vegetables as being smaller limited-range/budget stores. To what extent the far more limited range of fruit and vegetables available in such stores is a factor in causing the low fruit and vegetable consumption of this group, or whether this group simply gravitates to ('chooses') or is constrained by physical and economic access to this type of food store, are questions which we cannot strictly answer from the cross-section. Nevertheless, we report evidence that both physical access and economic access constraints are important in the use of limited-range/budget stores rather than full-range major-retailer supermarkets by our respondents.

A major question which emerged, therefore, from our pre-intervention study can be expressed as follows.

> Are the respondents who use the smaller limited-range/budget stores as their main fruit and vegetable source, and who are differentially represented amongst those with the poorest diets, so isolated from the majority of residents in the area that they will remain untouched by the retail provision intervention—that is to say, by the improved access to high-quality food retailing in the area following the opening of the Tesco superstore?

Clearly, this is a hypothesis which we needed to consider urgently as the information from the 'post-intervention' survey conducted 7–8 months after the opening of the Tesco superstore at Seacroft Green became available to us in the late summer of 2001. It is to preliminary results from the post-intervention survey and to initial tests of this hypothesis that we now turn.

Food Consumption Patterns in the Post-intervention Period: A Preliminary Appraisal

A Significant Upward Shift in Fruit and Vegetable Consumption amongst Those with the Poorest Diets in the Pre-intervention Period

Mean consumption of fruit and vegetables in the post-intervention period shows a small rise (from 2.77 to 2.92 portions per day). But most of that rise is attributable to differential attrition between respondent groups across the two waves of the survey. Indeed, comparing fruit and vegetable consumption in

Table 7. Fruit and vegetable consumption of the 60 respondents taking part in both waves of the survey who had the lowest levels of consumption (under 1 portion per day) in Wave 1

Change between Waves 1 and 2	Fruit and fruit juice	Vegetables	Fruit and vegetables
Increased	37	37	45
Decreased	8	9	7
No change	15	14	8

Waves 1 and 2 solely for the 615 respondents who completed both waves, the increase is merely from 2.88 to 2.92 portions per day. However, the picture of extremely limited overall change across the sample conveyed by this single statistic masks a more important picture of both large and more subtle changes in food consumption patterns in the post-intervention period.

In particular, a significant upward shift in fruit and vegetable consumption in the post-intervention period is observable amongst those who had the poorest diets in Wave 1. As Table 7 indicates, of the 60 respondents who took part in both waves of the survey and who had the lowest levels of fruit and vegetable consumption in Wave 1—under 1 portion per day—three-quarters increased their fruit and vegetable consumption. Mean fruit and vegetable consumption of those 60 respondents more than doubled from 4.13 to 9.83 portions per week, whilst their average fruit (and fruit juice) consumption increased five-fold from 0.77 to 3.92 portions per week. Table 8 then extends this analysis to the wider group classified in our pre-intervention period analysis as having poor diets—i.e. to those consuming two or less portions of fruit and vegetables a day. Of this wider group, 239 took part in both waves of the survey, and 60 per cent increased their fruit and vegetable consumption. Mean fruit and vegetable consumption of this group increased by one-third from 9.17 to 12.25 portions per week and their mean fruit (and fruit juice) consumption increased by almost two-thirds from 2.82 to 4.59 portions per week.

Clearly, the post-intervention fruit and vegetable consumption of those with the poorest diets in the pre-intervention period appears to be significantly different. But to what extent, and in what ways, might this improvement in diet of the most 'at risk' group in nutritional terms in the pre-intervention period be linked to the retail provision intervention? Here we concentrate on just one facet of what is clearly a highly complex issue. We focus on the degree of switching away from limited-range/budget stores as a fruit and vegetable source—in the process, evaluating the hypothesis which had emerged from our pre-intervention study concerning the extent to which respondents using those stores might remain untouched by the retail provision intervention. We provide below what we believe are some intriguing and potentially important results. However, by necessity, we leave to later papers a full analysis of the complex and subtle ways improved retail access in the research area revealed itself.

Table 8. Fruit and vegetable consumption of the 239 respondents taking part in both waves of the survey who were classified as having poor diets (2 portions of fruit and vegetables or less per day) in Wave 1

Change between Waves 1 and 2	Fruit and fruit juice	Vegetables	Fruit and vegetables
Increased	130	129	143
Decreased	73	72	72
No change	36	38	24

Table 9. Differential switching of main retail source for fruit and vegetable purchasing by Seacroft/Whinmoor respondents between Waves 1 and 2

Retail Source[a]	Main fruit and vegetable source		Extent of switching away from source (percentage)
	Wave 1	Wave 2	
Tesco, Seacroft Green	—	218	n/a
Asda, Killingbeck	232	159	31
Other major-retailer stores	141	52	63
Limited-range/budget stores	64	26	59
Other sources	155	157	0
Missing observations	23	3	n/a

[a]For definitions see Table 4.

Differential Switching Away from Limited-range/Budget Stores as a Fruit and Vegetable Source

Of the 615 respondents completing both waves of the survey, 45 per cent (276 respondents) claimed to have switched to the new Tesco superstore as their main food retail source, with 35 per cent (218) claiming the new Tesco store as their main fruit and vegetable source. However, that switching was differentially distributed across the retail sources used by the respondents in the pre-intervention period.

Table 9 considers this issue in terms of differential switching of the main source used by respondents for their fruit and vegetable purchasing. As might be expected (see Clarke *et al.*, 2002), and consistent with its established franchise in the area, the closest major retail store to the study area in the pre-intervention period (Asda at Killingbeck) was switched away from less by our respondents than the other major retail stores (Tesco at Roundhay Road, Oakwood and at Cross Gates, Morrisons at Merrion Centre, Sainsbury at Whitkirk, Safeway at Oakwood), all typically well outside the study area. However, much less expected are the results for 'other sources' and limited-range/budget stores. The use of 'other sources'(small local greengrocers, market stalls, etc.) as the main fruit and vegetable source by a quarter of our respondents shows no decline whatsoever in response to the opening of the Tesco superstore. In marked contrast, the use of limited-range/budget stores within and close to the study area shows an almost 60 per cent decline in response to the sudden availability of a full-range, high-quality source of these items in the new Tesco superstore.

Moreover, as Table 10 demonstrates, when we consider (as in Tables 7 and 8) the most 'at risk' groups in nutritional terms in the pre-intervention period, the differential switching out of limited-range/budget stores becomes progressively more striking. Whilst the use of 'other sources' consistently shows virtually no decline between Waves 1 and 2 in response to the availability of a new full-range, high-quality source of these items in the study area, the use of limited-range/budget stores as the main fruit and vegetable source shows an 80 per cent decline for those with poor diets (defined as consuming two or less portions per day) in the pre-intervention period and a 90 per cent decline in the case of those with the worst diets (under one portion per day) in the pre-intervention period. And of those respondents who switch out of limited-range/budget stores for their fruit and vegetable purchasing between Waves 1 and 2, it is interesting to note that: they switch to the new Tesco store rather more than average (42 per cent compared with 35 per cent for the Wave 2 sample as a whole); and, that this figure increases for those nutritionally most 'at risk'—rising to a 70 per cent switch to the new Tesco store for those with the worst diets (under one portion per day in the pre-intervention period).

Table 10. Differential switching of main retail source for fruit and vegetable purchasing between Waves 1 and 2 by those respondents taking part in both waves of the survey with the lowest fruit and vegetable consumption levels in the pre-intervention period

	Poor diets in Wave 1 ($n = 239$)			Worst diets in Wave 1 ($n = 60$)		
	Main fruit and vegetable source (number of respondents)		Extent of switching away from sources	Main fruit and vegetable source (number of respondents)		Extent of switching away from sources
Retail source	Wave 1	Wave 2	(percentage)	Wave 1	Wave 2	(percentage)
Tesco, Seacroft Green	—	101	n/a	—	24	n/a
Asda, Killingbeck	91	58	36	23	15	35
Other major-retailer stores	51	19	63	8	5	38
Limited-range/budget stores	30	6	80	10	1	90
Other sources	54	53	2	15	14	7
Missing observations	13	2	n/a	4	1	n/a

Conclusion: A Potentially Significant Finding and its Implications

On the basis of the figures in Tables 9 and 10, we can return, therefore, to the question posed at the end of our pre-intervention study. In particular, we can *reject* the notion that those respondents who used the smaller limited-range/budget stores as their main fruit and vegetable source in the pre-intervention period, and who are differentially represented amongst those with the poorest diets, have remained so isolated from the majority of residents in the area that they have been effectively untouched by the retail provision intervention. Clearly, this is *not* the case, and the significant shifting away from limited-range/budget stores as the main source of fruit and vegetable purchasing that we have observed in the post-intervention period, lends support to the view that in the pre-intervention period these respondents were in fact *constrained* by physical and economic access to this type of store. Following the retail provision intervention, respondents with the poorest diets in the pre-intervention period have both significantly increased their fruit and vegetable consumption and differentially switched away from limited-range/budget stores. Our view is that this is an intriguing and, potentially, significant finding. It offers evidence for the first time in the UK that a retail provision intervention may have a marked effect on improving the diet of the most 'at risk' groups in nutritional terms, and suggests some intriguing mechanisms by which that impact might be translated through into food purchasing/consumption.

We conclude our paper by reminding readers that this finding, although potentially important to the health inequalities debates in the UK, needs to be interpreted with some caution. Analysis of the post-intervention survey was, by default, in its preliminary phase as this collection of papers was being prepared for *Urban Studies*. We leave to later papers a fuller analysis of the complex and subtle ways improved retail access in the research area revealed itself, and the results of our separate 'repeatability study' measuring the extent of random or systematic error in the information being reported by respondents within the seven-day food consumption diaries. Nevertheless, we believe that what we have outlined here indicates that this first-ever study in the UK of a major retail provision intervention on diet in a 'food desert' has the potential to reveal some of the missing links between poor food retail access, compromised diets/undernutrition, poor health and compound social exclusion that characterised statements on the topic of 'food deserts' in the health inequalities and social exclusion debates of the late 1990s. We offer this paper as both a preliminary statement and notice of our intention to feed further results from this study into public policy debate in the UK during 2002.

Notes

1. Of the 396 respondents classified as having poor diets in the pre-intervention period (defined as two or less portions of fruit and vegetables per day) and who provided the focus of the previous analysis, a greater proportion than in the sample as a whole (15 per cent compared with 11 per cent) reported using limited-range/budget stores as their main fruit and vegetable source, and a smaller proportion (14 per cent compared with 17 per cent) reported using 'other sources' (small local greengrocers, market stalls, etc.).
2. In a separate analysis of the factors affecting and limiting the choice of foods by respondents who bought fruit and vegetables at different types of store, it is important to note that these conclusions on physical and economic access constraints were reinforced by two findings. First, that 60 per cent of the limited-range/budget store shoppers cited 'what is available in the store I can get to' as an important limitation on their choice of food bought compared with 49 per cent of major supermarket shoppers. Secondly, that 80 per cent of limited-range/budget store shoppers cited 'cost of food/food budget' as a limitation on their choice of foods bought compared with 73 per cent of those who used large major-retailer supermarkets.

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Appendix 1. Attrition Bias between Wave 1 and 2 of the Survey

To assess the nature and level of the attrition bias, Table A1 compares some of the characteristics of the non-respondents in Wave 2 with those of the Wave 1 sample. The notable feature is how

Table A1. Assessment of attrition bias: comparing respondent and non-respondent characteristics

	Wave 2 non-respondents ($n = 394$)		Wave 1 respondents ($n = 1009$)	
Characteristics	Number	Percentage	Number	Percentage
Sex				
Male	85	21.6	183	18.1
Female	309	78.4	826	81.9
Age (years)				
17–24 years	40	10.2	91	9.0
25–34 years	81	20.6	200	19.8
35–44 years	82	20.8	227	22.5
45–64 years	105	26.6	270	26.8
65 years +	86	21.8	221	21.9
Children under 16 in household				
Yes	154	39.1	434	43.0
No	220	55.8	534	52.9
Postcode area				
LS14 1	135	34.3	295	29.2
LS14 2	50	12.7	145	14.4
LS14 5	77	19.5	242	24.0
LS14 6	132	33.5	327	32.4
Educational attainment				
GCSE or below	291	73.9	732	72.5
Above GCSE	103	26.1	277	27.5
Household income (£)				
Under 5000	65	16.5	166	16.5
5000–9999	104	26.4	249	24.7
10 000–14 999	46	11.7	139	13.8
15 000–19 999	38	9.6	105	10.4
20 000 +	51	12.9	131	13.0
Refused	73	18.5	177	17.5
Smoking status				
Never	107	27.2	302	29.9
Ex	94	23.9	235	23.3
Light	69	17.5	178	17.6
Heavy	118	29.9	279	27.7
Household deprivation				
0 (least deprived)	98	24.9	257	25.5
1	112	28.4	297	29.4
2	124	31.5	305	30.2
3	45	11.4	120	11.9
4 (most deprived)	6	1.5	15	1.5

limited those problems of attrition bias seem to be—although there is some evidence of the non-respondents in Wave 2 being very slightly more heavily clustered within the 'at risk' groups in nutritional terms (the youngest age-groups, those with the lowest educational attainment, the heaviest smokers, etc.). In addition, those living in one of the more deprived sub-areas (LS14 1) are more heavily represented amongst the non-respondents, as are male respondents in the survey (i.e. males who are primarily responsible for the domestic food arrangements of the household).

Of the original 1009 respondents in Wave 1, the non-respondents were made up of 9 per cent who had moved residence, 13 per cent with whom

no contact could be made (despite 4 attempts to establish contact with the non-respondent household), 13 per cent who, having participated in Wave 1, refused to participate in Wave 2 and 4 per cent who returned an unsatisfactorily completed food consumption diary.

Appendix 2. Determinants of Poor Diet in the Pre-intervention Period: Parameter Estimates of Best-fitting Model, Goodness-of-fit Measures and Model Predictions

Parameter estimates of the best-fitting logistic/logit regression model reported in the text are shown below. In the case of the categorical explanatory variables in the model, what Wrigley (1985, pp. 132–136) terms a 'cornered effect' coding scheme, or what SPSS (see Norusis, 1997, p. 49) terms an 'indicator variable' coding scheme has been employed. That is to say, an arbitrary 'anchor' or 'base category' in each variable has been coded zero and the parameter estimates associated with the other categories of that variable should be interpreted as differences from that base category (see Table A2).

Goodness-of-fit measures for this type of model are discussed by Wrigley (1985, pp. 49–52) and in the SPSS *Professional Statistics* 7.5 manual (Norusis, 1997, pp. 47–49). The Nagelkerke R^2 (Nagelkerke, 1991) provides a logistic regression analogue to R^2 of conventional linear regression but, as with all logistic regression R^2 analogues, needs to be interpreted with care. In the case of the best-fitting model reported in the text, the Nagelkerke $R^2 = 0.35$, suggesting that about 35 per cent of the 'variation' in the response variable has been explained by the model. However, based on an alternative method of assessing the overall fit of the model—the so-called prediction success table (Wrigley, 1985, p. 50), the overall prediction success of our best-fitting model correctly predicts 73 per cent of the observed responses ('low' fruit and vegetable consumption, or 'higher' consumption).

Predicted probabilities of low fruit and vegetable consumption for groups of respondents with different characteristics can quite readily be

Table A2. Parameter estimates

Explanatory variable	Parameter estimate ($\hat{\beta}$)	Standard error
Age of respondent (years)		
17–24	2.527	0.448
25–34	1.250	0.333
35–44	1.019	0.305
45–64	0.213	0.253
65 +	Base	—
Smoking status		
Never	Base	—
Ex	0.378	0.245
Light	0.616	0.261
Heavy	1.267	0.236
Educational attainment		
GCSE or below	0.452	0.204
Above GCSE	Base	—
Number of children under 16 in household	0.206	0.097
Attitude to healthy eating 1[a]		
Disagree	1.120	0.248
Neither/Don't know	0.495	0.301
Agree	Base	—
Attitude to healthy eating 2[a]		
Disagree	− 0.499	0.201
Agree/Don't know	Base	—

$\hat{\beta}_0$ (constant) = − 1.527.

[a]Attitude to healthy eating variables are: 1 'I mostly eat a healthy diet'; and, 2 'I don't really care what I eat'.

Table A3. Predicted probabilities of being a low fruit and vegetable consumer

	Representative groups				
	1	2	3	4	5
Age (years)	17–24	17–24	45–64	45–64	65 +
Smoking status	Heavy	Heavy	Ex	Never	Never
Children in household	2	1	0	0	0
Educational attainment	Low	Low	Higher	Higher	Higher
Attitudes to healthy eating	Negative	Negative	Positive	Positive	Positive
Predicted probability of being a low fruit and vegetable consumer	0.99	0.98	0.19	0.14	0.12

obtained from the best-fitting model by simply re-expressing the logit expression in the text in its logistic form as

$$\hat{P}_{\text{LOW}\,|\,g} = \frac{e^{\hat{\beta}_0 + \hat{\beta}_1 X_{1g} + \ldots + \hat{\beta}_K X_{Kg}}}{1 + e^{\hat{\beta}_0 + \hat{\beta}_1 X_{1g} + \ldots + \hat{\beta}_K X_{Kg}}}$$

where, $\hat{\beta}$s are the parameter estimates from the fitted model and X_{Kg} are the typical group values for explanatory variables 1, … , K.

In this way, we can obtain the predicted probabilities of being a low fruit and vegetable consumer for particular respondent types/groups. An example is shown in Table A3.

Appendix 3. Store Choice and Poor Diet in the Pre-intervention Period: Parameter Estimates of Best-fitting Model and Goodness-of-fit Measures

Parameter estimates and goodness-of-fit statistics for the best-fitting model (based on backward stepwise elimination of potential explanatory variables using a likelihood-ratio criterion) reported in the text are shown in Table A4. For further discussion of how to interpret these see Appendix 2. The Nagelkerke R^2 for the best-fitting model is 0.25, but the overall prediction success of the model is 87.1 per cent.

Table A4. Parameter estimates for the best-fitting model

Explanatory variable	Parameter estimate ($\hat{\beta}$)	Standard error
Income (£)		
< 15 000	0.786	0.355
15 000–19 999	0.231	0.550
20 000 +	Base	—
Smoking status		
Heavy	0.720	0.275
Never/Ex/Light	Base	—
Attitude to healthy eating[a]		
Disagree	−0.571	0.278
Agree/Don't know	Base	—
Household deprivation	0.346	0.142
Distance to fruit and vegetable store	−0.762	0.177

$\hat{\beta}_0$ (constant) = −1.324.

[a]Attitude to healthy eating variable is: 'I don't really care what I eat'.