Does food retail access influence dietary intake?

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Abstract

The extent to which the food retail environment, including the availability, price and quality of foodstuffs, has an impact on what people eat remains unclear. This study aimed to determine whether the retail environment, of a household's usual main food store or of the area surrounding the home, is independently associated with the dietary intake of individual householders.

The study employed a cross-sectional design and comprised simultaneous surveys of all retail outlets selling foodstuffs, and of households and the individuals living in them in the city of Newcastle upon Tyne, UK in 2000-2002. 5044 adults aged 16-97 years living in 3153 households provided data, including a 134-item food frequency questionnaire (FFQ) and detailed socio-demographic information. Detailed data on 33 commonly consumed foods was obtained from 560 food stores. Indices of relative intakes of fruits and vegetables, non-starch polysaccharide and total fat were derived from the FFQ.

Availability of foodstuffs was generally good across the city, but poorer people lived closer to stores selling a wider range of foodstuffs, and fresh fruits and vegetables were more costly in more affluent areas. Diet, and related behaviours, attitudes and knowledge were strongly socio-economically patterned, with higher fat intake and lower fruit and vegetable intake, poorer dietary knowledge, more frequent food shopping at discount and convenience stores, and travel on foot or using public transport to food stores were all more common among less affluent and less educated households. In multilevel regression analyses, no area level variables were associated with variation in any of the dietary indices. Overall, variation in dietary intakes was most strongly associated with social, demographic and behavioural variables, and dietary knowledge.

Dietary quality, in Newcastle upon Tyne at least, is not strongly associated with food retailing. Access to healthy foods in the retail environment may be an important pre-requisite of a healthy diet. However, where such access is uniformly good dietary quality is most importantly associated with individual lifestyle choices, which may be driven socio-economic factors. Public health interventions to improve diet need to focus on the knowledge and behaviours needed to acquire, prepare and consume a healthy diet, as well as the economic means to do so.

Dedication

To my father, RHRW.

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Acknowledgements and Declaration

Contributions and declaration of authorship
As with any large-scale epidemiological study, I alone could not have undertaken this research. Thus, many people have played a role and I have credited all those who have contributed and identified both my and their contributions clearly below.

The original idea for the research was my own, but some earlier work that acted as a methodological pilot study was conducted together with Simon Raybould,[1] who also played a role in this study. The ideas that underpinned this study were refined by a research team, including John Mathers, Ashley Adamson and Simon Raybould. Led by me, this group developed the original protocol and won funding for the study from the Food Standard Agency (FSA) for England. This funding supported all fieldwork and led to a report,[2] of which I was lead author and contained primarily descriptive analyses. This thesis represents a significant and original extension of the work undertaken for the FSA grant.

Jane Bunting, Liz Williams and Simon Raybould were employed as members of the research team that undertook the fieldwork and, together with Ashley Adamson and John Mathers, contributed to the development of detailed methods for the study. Jane Bunting and Liz Williams oversaw data collection for the retail study and the main surveys and supervised Thomas Clavel, Kelly Guthrie, Laura Hoban, Hannah Mathers, Shamini Nair, Jeanette Rabe, Joanne Rothwell, Debbie Summerson, Katja Weiner and Petra Wigand, all students, who helped identify food retail outlets and collected, entered and checked data from shops. Michael Crilly, of Newcastle City Council Planning Department, facilitated access to their retail planning database; and Consignia provided access to the Postcode address file via Edinburgh University, which also provided access to digitised road network data. Emma Hutchinson, Astrid Macintyre, Terry Lisle, Angela Jones, Pauline Winship, Pat Barker and Laura Ritson provided secretarial support at different stages of the project. Jean Adams provided invaluable help with creating tables and proof reading. Fraser Chalmers and Juliet Schick provided support with computing throughout and Ruth Wood provided invaluable help with constructing and manipulating databases. Jenny Woolfe and Louis Levy of the Food Standards Agency provided advice during the planning stages.

All data analyses were undertaken by me, except for the multilevel modelling, which was executed by Vicky Ryan and the spatial analyses, which were undertaken by Simon Raybould and Seraphim Alvanides. In both of these instances, analyses involved specialised skills (statistical and geographical respectively) and software packages (MLWin and Arc-Info respectively) that were beyond my technical expertise. Vicky Ryan also provided critical comments and checked my statistical analyses. However, in all cases I initiated and guided the analyses.

The written work presented here is all my own, but I have received critical comments from members of the research team, as well as my supervisors Paula Whitty, John Mathers and Nick Freemantle.

Raj Bhopal and Senga Bond, both former colleagues, as well as Martin Eccles and my father all encouraged me at times over a very long period to submit an MD thesis. However, without the love, support and encouragement of my partner, Jean, I am unlikely ever to have completed it.

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Ethics and governance

The research was conducted within the usual guidelines and standards for health and social research, and received ethical approval from the Newcastle and North Tyneside Joint Universities and Health Authorities Research Ethics Committee. All individuals consented to participate in the research. All data were anonymised as soon as feasible and kept securely under the terms of the Data Protection Act. Strict confidentiality has been maintained at all times.

Conflict of interest

I declare that, so far as I know, there was no conflict of interest in the conduct of this research involving either me or other members of the research team.

Publications

Some of the descriptive analyses presented in this thesis were published in a report to the Food Standards Agency.[2] Some of the background chapter was included in a review paper for the Government's Foresight Obesity project, which has since been published.[3] I was the sole or lead author of these works. A number of other papers, in particular presenting the multilevel modelling analyses in this thesis are in preparation.

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Abbreviations

COMA	The Department of Health's Committee on the Medical Aspects of food policy
df	Degrees of freedom
ED	Enumeration district
EPIC	European Prospective Investigation of Cancer
FFQ	Food Frequency Questionnaire
GIS	Geographical Information System
GPS	Global Positioning System
HQ	Household Questionnaire
IQ	Individual Questionnaire
IQR	Inter-Quartile Range
NSP	Non-Starch Polysaccharide
PAF	The Post Office's Postcode Address File
SD	Standard Deviation
TDS	Townsend Deprivation Score
UK	United Kingdom

Glossary of terms

Areal Unit	A geographical area used as a unit for quantitative analysis
Centroid	The geographically central point of an areal unit
Enumeration District (ED)	A small areal unit that is, technically, the area from which one 'enumerator' collects data in the Decennial Census. In urban areas this usually contains about 150 households. Enumeration districts are nested within Parliamentary Wards. In Newcastle upon Tyne local authority district there are 605 EDs within 26 Parliamentary Wards
Global Positioning System (GPS)	An electronic device that is able to identify its exact position on the ground (to within 50 metres) using co-ordinates of the Ordnance Survey National Grid. It works by tracking several satellites simultaneously, which emit signals indicating their position relative to the Earth's surface.
Geographical Information System (GIS)	A computer software package (e.g. ArcInfo) which has the ability to analyse and represent data spatially (geographically). A principal use is in the creation of maps to illustrate patterns derived from spatially representative data. These can include polygons (bounded areas) with different characteristics, vectors (lines joining two or more points on a map), contours (lines joining points with a similar value for a variable (e.g. height above sea level), physical features (e.g. roads, rivers, green space etc.) and symbols to represent a range of features (e.g. shops, people, houses etc.). GISs can also be used to undertake analysis of data representing spatially distributed attributes
Townsend Deprivation Score (TDS)[4]	An ecological (i.e. population-based) score representing an areal unit and derived from four Census variables: % Car ownership, % home ownership, % unemployment and % homes overcrowded (with more than 1.5 persons per room). These measures of population characteristics are converted to Z-scores (i.e. with a normal distribution and a mean of zero) and then summed with equal weight to create an overall score (with a mean of zero for the population from which they are derived). The score is widely used in health and social research to provide an indicator of socio-economic disadvantage for areal units (e.g. EDs). Scores used in this study are standardised for England and Wales (i.e. Zero is the mean TDS for all areas in England and Wales)

Section 1 – Rationale & Methods

The thesis is presented in two sections, with four chapters in each. In this first section, I describe the context and scientific rationale, as well as the methodological challenges of the research in Chapters 1 and 2. Next, I present the aim and research questions in Chapter 3. Finally, I present the methods of each element of the research in Chapter 4.

In Section 2, the results are presented in two chapters corresponding to the main methods of investigation (retail and population surveys), together with a further chapter reporting the combined analysis of the individual, household and environmental data, including multi-variable models (Chapters 5-7). In Chapter 8, the results are discussed and interpreted, taking into account the strengths and limitations of the methods and existing knowledge. The implications of the work and conclusions are then presented, together with recommendations for policy and future research. Further methodological details and results are given in appendices.

1. Introduction

Diet is an important determinant of health in western societies, being causally related to a range of health outcomes, in particular chronic non-communicable diseases such as cardiovascular diseases, diabetes, cancers and obesity.[5] Current concern about the rapidly growing problem of excess body weight has led to renewed interest in the contribution of diet and its relationship to the complex interplay between personal choice and environmental drivers of health behaviours.[6]

The 'healthiness' of dietary intake in the United Kingdom (UK) and other developed nations is strongly patterned both socio-economically and spatially,[1 7-14] and is known to be associated with a wide range of factors at individual, household and area levels. Research conducted between the 1960s and 1990s in the fields of retail distribution and geography showed wide variations in retail availability of foods.[15-18] Both of these phenomena have changed over time. However, it remains unclear whether food retailing is an important determinant of the wide variations seen in dietary behaviour. The term 'food desert' was coined in the UK in the mid-1990s to describe geographical areas, usually urban, where it is difficult to buy a range of foods at a reasonable price, in particular where it may be hard to purchase the food necessary to eat healthily at a reasonable price.[19 20] The term rapidly gained political currency[20 21 22 23 24] yet, although further research has demonstrated wide variations in the spatial distribution of retailed food availability, [20 25-31] no research has demonstrated definitively whether what food is available in retail outlets, or its price or other characteristics, is independently associated with, or directly influences, what people eat.

The research presented in this thesis aimed to determine the relationship between contextual factors at individual, household and neighbourhood levels, and retail access to a 'healthy' and affordable diet, and thus answer the question of whether food deserts exist and, if so, for whom and in what form. Building on the work undertaken to answer these secondary research questions, it further aimed to determine whether dietary intake is independently associated with factors relating to food retail access (the primary research question).

Cross-sectional surveys of food retailing, household food purchasing behaviour and individual dietary behaviour were undertaken and analysed using multilevel statistical techniques, taking into account contextual factors at individual, household and area levels in Newcastle upon Tyne, UK.

It is perhaps important to stress that I have approached this work largely from the pragmatic perspective of an academic public health physician, and not as a specialist in geography, nutrition, food retailing or multilevel statistics. My primary aim was to understand better and find solutions to the widely observed problem of social inequalities in diet, and to respond objectively and scientifically to the existing UK policy emphasis on so-called 'food deserts' and the emerging strategy to tackle growing levels of obesity. Understanding the extent to which diet is affected by food retail access, versus for example individual dietary knowledge, could influence profoundly the future development of public health interventions to promote healthy eating, and thus reduce the incidence of a range of major chronic diseases.

2. Background: current knowledge, local and policy context

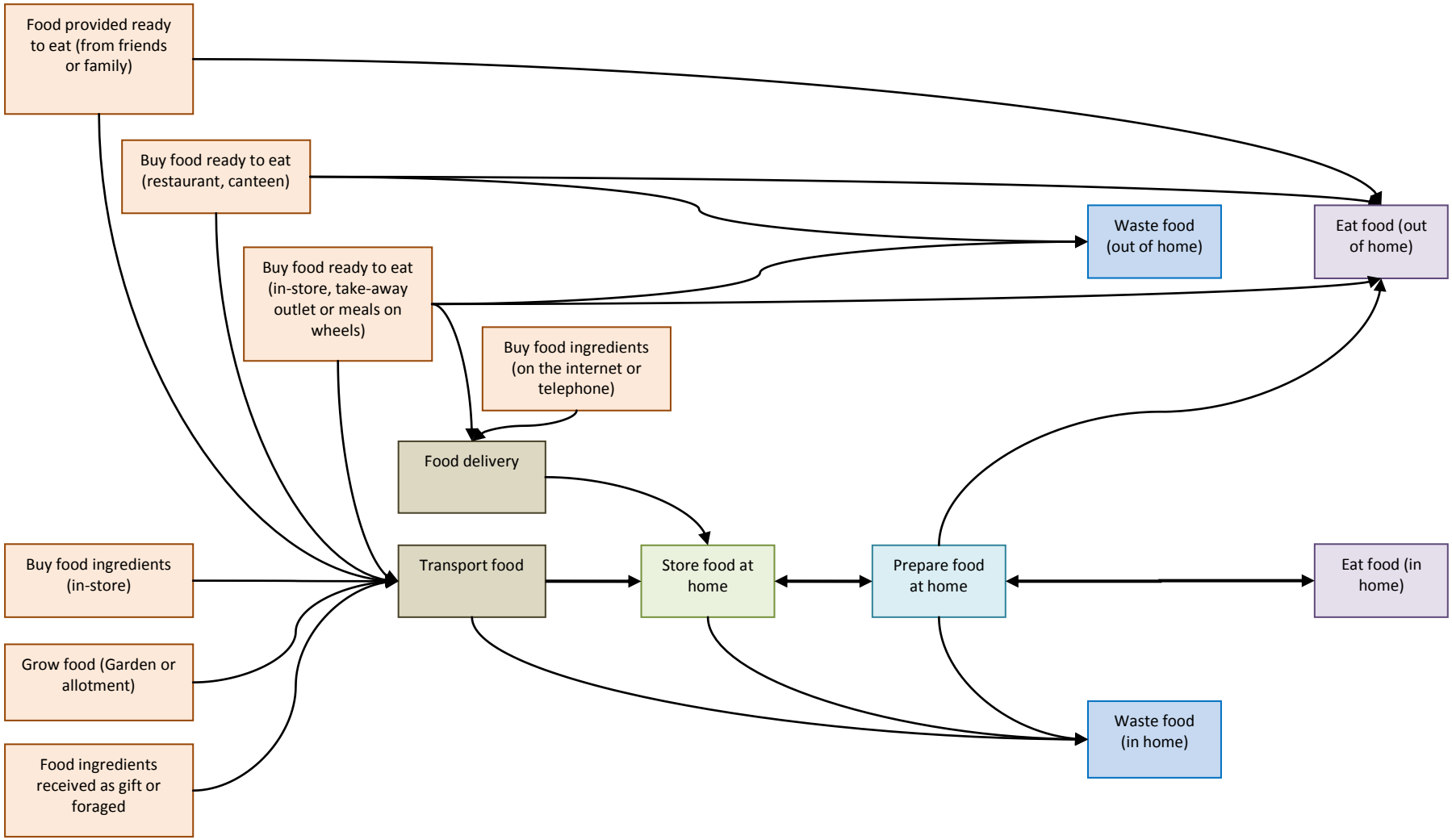
2.1 Introduction

Diet has long been known to influence health and, over a long period, research effort focused predominantly on the relationship between nutrient intakes and human physiology. A significant body of literature has also focused on the role of individual choice in determining dietary intake and associated behavioural processes. Most recently, attention has turned to the means by which humans acquire their food in modern societies and the influence that social and structural factors can have on these processes.

Logically, one can view these processes as a series of human behavioural choices, leading from the acquisition of food to its consumption.[*] At its simplest level, for example, one might pick some berries from a hedgerow and eat them immediately, as our hunter-gatherer ancestors must have done, and as many communities around the world continue to do. However, the impact of agrarianism, industrialisation and commerce dictate that such a hand-to-mouth existence is no longer a tenable way to achieve a balanced and healthy diet in a modern post-industrial society, much as we might yearn for its simplicity. Several hundred thousand years of human development have led to a more complex set of behavioural processes that we must all now negotiate to feed ourselves. In Figure 1 I have illustrated these processes and the relationships between them schematically, from the perspective of individuals and households (as opposed to, for example, institutions or the food industry). Food can be *acquired,* depending on availability, ready to eat as meals or snacks, or as ingredients from which to prepare meals, usually at home. In most cases this will involve a financial transaction (e.g. buying ingredients or a meal), but some food may be grown in a garden or allotment, received as a gift or even foraged from a hedgerow. Unless the food is eaten out of the home, the food will next need to be *transported*, either in a householder's chosen transport or using a delivery service associated with the vendor (e.g. take-away restaurant or supermarket home delivery service).

[*] The term consumption is used here to mean eating food, but is also widely used in the academic literature on retailing to mean the purchasing of foodstuffs.

Figure 1: Relationships between behaviours involved in food consumption



All food brought into the home, unless eaten immediately, will then need to be *stored* in such a way that it remains wholesome and edible (e.g. in a fridge, freezer or dry store cupboard). Food ingredients may then need to be *prepared* before eating (e.g. washed, chopped or cooked). Food may be *wasted* at various stages in the process, either inside or out of the home. Most usually, food waste occurs after storage or preparation, but on occasions food may be damaged in transit or found to be unfit for consumption after purchasing (e.g. that rotten soft fruit at the bottom of the punnet). Such food may be returned to the store for a refund, though for simplicity this pathway is not shown. Food ready to eat may be stored for eating later, and left over food from a snack or meal may be returned to storage for eating (or wasting) later. It is impossible to show every possible eventuality, but Figure 1 aims to show the main pathways in these processes and the links between them. It is clear from this schematic representation of a set of complex and interrelated processes that there is a relationship between food retailing and eating, but there are many factors that might affect this relationship. In this chapter I review the academic and policy literature relating to our understanding of these issues, working back from the evidence on the social and spatial patterning of dietary intake to the social and spatial patterning of food retail access, and then exploring the relationship between retail access and dietary intake. Finally, I discuss the relationship between food retail access and measures of obesity, as this offers further insights into relevant research methods.

Searches of the health and social sciences academic and policy literature were undertaken using electronic databases (MEDLINE, EMBASE and ASSIA) to December 2008, in order to find relevant existing publications. Search terms and relevant synonyms were used in combination relating to: food and eating; retailing and consumption; excess body weight; socio-economic factors; geography, economics and policy; and study designs and methods. Searches were limited to human populations and the English language, but not by date.

2.2 Current evidence on food access, diet and obesity

2.2.1 The social and spatial patterning of dietary intake

The nutritional quality of dietary intake in the UK is strongly socio-economically patterned.[1 7 8 10 22 32-39] Less healthy diets (defined by current national recommendations – i.e. diets high in total saturated fat, high in refined carbohydrates, or low in fibre)[40] are more commonly found among those in lower socio-economic groups, as well as among the elderly, teenagers, young adults, and men. Many factors are thought to contribute to dietary behaviour at a household or 'family' level, including factors associated with the individual consumer, those in the

household responsible for acquiring, transporting, storing and preparing food for the table (see Figure 1). Such factors include: availability and access to food, disposable income; gender; the knowledge and skills of those purchasing, preparing, storing and serving food; influences such as advertising; and practical constraints within the household such as the availability and adequacy of facilities for preparation, cooking, cold and dry storage, and the consumption of food.[1 5 9 10 41-49]

Such research on the social patterning of diet has been replicated in other developed countries, in particular the USA.[50] A recent development in this field has been the emergence of studies focusing on wider 'environmental' determinants of diet outside the home.

In the early 1990s, the socio-economic patterning of health variables, including health-related behaviours, were shown to have significant spatial patterning.[11] In studies from Scotland[11 14 51 52] and elsewhere,[1 50 53 54] the influence of area of residence has been shown to be a predictor of dietary patterns, over and above individual or household socio-economic factors.

Most recently, the focus of research interest has shifted to the potential environmental causes of observed inequalities in diet, in particular food retailing. This development is discussed further below, with a particular emphasis on the UK context.

2.2.2 The social and spatial patterning of food retail access

Much research has documented the changing landscape of food retailing in the post-war era, both in the US and UK. There are no comprehensive reviews, though the work of several British authors provides useful summaries.[20 55-59]

Research from the UK and the US documents a major retail revolution in food supply since the 1960s.[18 60-69] The causes of these developments can be attributed to both supply and demand factors: changes in food retailing have been driven by the industrialisation of agriculture and commercial forces, but these in turn have been influenced by socio-economic and cultural shifts, such as growing numbers of women in employment and increasing car ownership.[70] Together these factors led during the 1960s to 1990s to a greater demand for "one-stop" shopping and a greater willingness to travel to shops viewed as offering better value for money, quality and range of goods – a demand that was readily met by the major retailers.[20]

Thus, the most visible change over this period was the rapid growth of large multiple/chain owned supermarkets, often in out of town locations, usually on main arterial or circular roads near to major urban conurbations.[16 71-73] This resulted in a decline in the numbers of smaller

general and specialist grocery shops in town centres and suburban areas, which were unable to compete with the higher turnover and lower prices of supermarkets.[16 18 74-77] The emerging pattern of modern retailing has thus been dominated by a small number of major retailers in the UK (e.g. Tesco, Asda, Sainsbury, Morrison, etc.) with a predominance of large, out-of-town supermarkets carrying a huge range of lines at low prices, and smaller local stores increasingly diversifying to become all encompassing 'convenience' stores maintaining higher prices driven by their relatively low turnover in order to compete.[55]

It was in this climate that concerns first emerged about the lack of food retail provision in some urban areas and the concept of 'food deserts' was coined, linking the retail revolution with the socio-economic patterning of diet highlighted above. The term is usually used to describe urban areas (usually socio-economically deprived) where it is difficult to buy a range of food necessary to eat healthily at a reasonable price.[19 55 78-82] It is reported to have been used first by a resident of a public sector housing scheme in the West of Scotland in the early 1990s.[23] It was picked up and used by the Policy Working Group of the Government's Low Income Project Team of the Nutrition Task Force in 1995.[22] The concept was then investigated by the Social Exclusion Unit's Policy Action Team 13 in its review of shopping access for people living in deprived neighbourhoods.[21] The concept had immediate appeal to the media and policy-makers, and rapidly became enshrined in government policy:[20 79] it was mentioned in the National Health Strategy (Our Healthier Nation)[83] and the government's independent enquiry into health inequalities (the Acheson Report).[24] However, the concept has little scientific basis, since no studies then or since have provided conclusive evidence of a link between variations in food retailing and variations in dietary intake.[80]

By the mid-1990s, the economic climate had begun to change again and two factors influenced further developments: the introduction of planning guidance aimed at revitalising urban centres; and the rapid emergence in the UK of a new European-style 'deep discount' supermarket (e.g. stores such as Aldi, Netto and Lidl), selling a limited number of lines at prices that undercut the major supermarkets.[84] Together these factors led to a further change of track by the major retailers, with the introduction, in addition to out-of-town superstores, of new, smaller formats in a diverse range of settings (e.g. Tesco Metro stores in city centres and Tesco Express stores in petrol stations). Although this recent trend might have been expected to fill gaps in retail provision in urban areas, smaller format stores tend to be more expensive than larger stores under the same fascia, a practice known as 'price-flexing'.[84] However, although this practice was criticised by the Competition Commission (see below), multiple-owned small stores retain a competitive edge over independent convenience stores by

virtue of the economies of scale that underpin them (e.g. massive distribution networks and own brand products).[84] Hence, this diversification posed a further threat to independently owned general and specialist grocery stores,[16 18 74-77] notably leading to further 'desertification' of urban areas. There was also evidence that the major supermarket chains were diversifying in more affluent areas, but avoiding the less profitable poorer areas.[62 72]

These and other factors led to concern about the evolution of food retailing in the UK that was not restricted to the public health arena. In 1999, the Director General of Fair Trading (DGFT) referred to the Competition Commission for investigation under the Monopoly Provisions of the Fair Trading Act (1973) the supply of groceries from multiple supermarkets on the grounds that:[73]

a) in the public's perception, grocery prices were higher in the UK than in other comparable EC countries and the USA

b) there was an apparent disparity between farm-gate and retail prices, suggesting multiple supermarkets were profiting from the crisis in farming

c) the rise of out-of-town supermarkets was contributing to continuing decay of many urban high streets (the so-called 'food deserts' problem).

The commission's report found evidence of a high level of consumer satisfaction with supermarkets, but identified three pricing practices undertaken by the main players that distorted competition and gave rise to complex monopoly situations, two of which operated against the public interest. These were:

a) most of the multiple supermarkets persistently sold some frequently purchased items (such as baked beans and white bread) at below cost prices and this contributed to a situation in which the majority of their products were not fully exposed to competitive pressure and thus distorted competition. This practice of below-cost selling, when conducted by Asda, Morrison, Safeway, Sainsbury and Tesco (the 'big five' at the time), i.e. those players with significant market power, operated against the public interest.

b) A number of players engaged in 'price-flexing', i.e. varying prices for the same product in different geographical locations, without reference to cost. This practice, when undertaken by Safeway, Sainsbury and Tesco, was also deemed to be against the public interest.

c) Most of the main commercial players also adopted pricing structures that, by focusing competition on a relatively small proportion of their lines, restricted active competition on the majority of their lines. However, there was no evidence that this practice contributed to excessive profits.

Somewhat surprisingly, the Commission, despite considering a number of possible remedies, was unable to recommend any remedial action in which the level of intervention would not be disproportionate to the problem identified. They, therefore, suggested self-regulation by the adoption of a voluntary code of conduct by the grocery retail sector. They did, however, separately recommend that the 'big five' (Asda, Morrison, Safeway, Sainsbury and Tesco) should be required to seek the DGFT's approval to acquire or develop any new, large stores.[73] This was later a key issue in the acquisition of Safeway by Morrisons in 2004, which resulted in the Competition Commission requiring many Safeway stores to be sold to competitors by Morrisons.

As well as developing formats and pricing strategies to meet commercial demands over the last 30 years, the major food retailers have responded to consumer demand by massively expanding the range and quality of foods available.[85] A key development attributable to this sector (and M&S in particular) has been the 'ready meal'. This concept has been developed consistently by all the major supermarkets to include a diverse range of convenience foods. Such foods have been criticised for their 'healthiness', in particular their high fat, sugar and salt content, but have become hugely popular and profitable.[84 86] Another development was the introduction of 'economy' lines (e.g. Tesco 'Value' products) by all the major supermarkets, in direct response to the commercial threat posed by the discount supermarkets.[84 87] Most supermarkets have also introduced 'quality' ranges (e.g. Tesco 'Finest'), in order to compete with the major high-end retailers, such as M&S and Waitrose. These developments, as well as huge diversification into non-food sales and a large number of mergers and acquisitions, have enabled the key competitors to retain market domination and maintain generally low food prices.[84] This is a critical issue because, although the big players have been blamed for the demise of local, independent grocers, they have also been responsible for delivering considerable value to consumers.

2.2.2.1 Food retail access

With the emergence of concerns about 'food deserts' a new strand of research evolved in the UK (and more recently in the USA), aimed at assessing food retail access for individuals and households. Whilst the focus of earlier research on retailing had been on the numbers, type and size of stores, this new work focused in addition on assessing the range, cost and quality

of foods available to households in stores in geographically defined neighbourhoods. Early work defined methods, for example using a range of 'healthy food basket' methods[29 88-94] and definitive studies have demonstrated a mix of findings. Although some early studies suggested that foods may be more expensive and less available in poorer areas,[29] more recent studies have failed to replicate these findings, showing instead that 'healthy' foods tend to be as, if not more, available in poorer areas and are lower in price.[20 27 84 92 93 95] However, these studies have demonstrated consistent differences between types of store – larger general grocery shops, not surprisingly, generally have greater availability, lower costs and better quality fresh produce than smaller grocery stores.

Another strand of work has explored modes of transport used and physical proximity to food stores by socio-economic variables, as well as the attitudes and preferences of low-income consumers. This research has demonstrated that use of a car predominates as the mode of travel to and from shops to buy food in the UK. However, car ownership and use of a car to travel to and from shops is socio-economically patterned and is thus an important determinant of choice of main food store.[25 30 41 67 68 70 81 88 93 96-100] The research on food shopping also shows that carrying shopping, as well as the problems of storing larger quantities of food, remain important barriers for the poor, elderly and disabled in making best use of supermarkets.[25 30 68 70 81 93 99 100] Nevertheless, these groups demonstrate sophisticated strategies for 'economic' shopping, utilising a wide range of store types including markets, discount stores, supermarkets and convenience stores to buy the food they need to feed their families from week to week.[101 102]

2.2.2.2 The cost of a healthy diet

One of the key concerns in the 'food deserts' debate has been the question of whether a 'healthy' diet costs more than an 'unhealthy' diet. There has been a modest amount of research on the cost of a nutritionally adequate diet, including studies to define a 'modest but adequate' diet,[89] but no published reviews. In a study in the Hampstead area of London, Mooney showed that two diets, one meeting and one not meeting contemporary nutritional guidelines, differed in cost with the 'healthier' diet consistently costing more.[88] However, she also showed that both more-healthy and less-healthy diets were consistently cheaper in more deprived than more affluent neighbourhoods but failed to draw attention to this in her conclusions. For this reason, her study has been widely misquoted as demonstrating that healthy food costs more in more deprived areas.

More recent research using 'realistic' family food baskets has showed that availability of a 'healthy' diet increased from 1990-1994, while the real cost declined in supermarkets.

Availability of a range of healthy foods remained poor and the cost of these remained higher than average in local grocers.[98]

One interesting analysis of cost relates to 'economy' line products (mentioned above). Cooper and Nelson analysed a range of such products for nutritional content and found them to be as healthy, if not healthier, than equivalent standard products and excellent value for money.[87] Whilst many regard such products as inferior on grounds of taste, they can clearly play a role in eating healthily on a low income.

One of the few studies to come from outside the UK (or US) presented an economic analysis aimed at predicting the food choices individuals might make in order to reduce their food budget (by simulating the choices made by low-income French consumers).[103] Increasing cost constraint decreased the proportion of energy contributed to diet by fruits, vegetables, meats and dairy products, replacing these with cereals, sweets and added fats, thus reducing overall nutrient density – a pattern similar to that observed in the diets of lower socio-economic groups. The authors concluded that economic measures will be needed to promote healthier diets effectively among the poor, as no matter how good the level of access, ultimately the poorest cannot afford the healthiest diet.

2.2.3 The relationship between retail access and dietary intake

So far, I have referred to separate bodies of work that have looked at the socio-economic patterning of dietary intake and retail access. Only a small number of studies have attempted to assess whether food retailing is independently associated with, or directly influences, diet. This body of work can be divided into three groups: (1) ecological studies that have compared food retail access and diets within geographical areas, but did not look specifically at where individuals bought their food; (2) studies that explored cross-sectionally the relationship between food retailing and dietary intake in individuals; and (3) experimental studies that explored whether changes in retail provision resulted in changes in diets of individuals who lived near to and/or shop in specific retail outlets. There are advantages and disadvantages of each of these types of study in exploring this problem and these are discussed further below.

2.2.3.1. Ecological studies

This group of studies has typically looked at the correlation between a measure of food access in geographical areas and a separate measure of diet in the same areas, and drawn conclusions about association or causality. For example, Morland and colleagues (2000), analysing data from the Atherosclerosis Risk in Communities (ARIC) study in the USA, demonstrated that both black and white American fruit and vegetable intake was higher in census tracts with

more supermarkets, and concluded that the local food environment is important for diet.[104] However, they did not have data on where people bought their food and only accessed data on a limited range of grocery stores (supermarkets). Thus, they assumed that everyone bought their food at supermarkets in their own census tract – a fact that we know from other retail research is unlikely to be true.[15 70 100] Whilst ecological studies can be conducted rapidly taking advantage of readily available data over a large area and population, ultimately they are limited in their ability to demonstrate independent associations. Apart from assumptions made about the link between the retailing and dietary data (i.e. the ecological fallacy[105]), such studies are reliant on secondary analysis of existing data, which often provides a crude assessment of food retail access (e.g. 'presence of a supermarket'). The context of food retailing in the US is also somewhat different from the UK and such studies may not provide results generalisable to the UK context. For example, throughout much of the USA, food retailing is very heavily dominated by multiple supermarket chains, which together with a significantly greater reliance on the car than in European countries, results in a much greater predominance of out-of-town food shopping in peripheral shopping malls.

2.2.3.2 Individual level studies

A small number of studies have measured socio-economic factors and food purchasing at an individual level (with or without self-reported details of store type, proximity etc.).[106-109] Two papers from Turrell and colleagues in Brisbane, Australia, explored the socio-economic patterning of food purchasing behaviour at an individual level. Both papers report analyses using the same data set, including in a sample of 1003 households. The earlier publication explored the relationship between socio-economic position and food purchasing, showing that people from more disadvantaged households were less likely to purchase healthier foods than people from more affluent backgrounds.[109] In the later study, the relationship between household food purchasing and small area measures of socio-economic position was investigated using multilevel modelling. The authors found that, although there were spatial variations in healthy food purchasing, area of residence did not independently influence food purchasing, over and above individual socio-economic characteristics.[106] Neither of these studies related diet to retail factors.

Rose and Richards (2004) explored the relationship between intake of fruits and vegetables and supermarket access among a nationally representative sample of 963 food stamp recipients (i.e. a low income population).[107] They found that, after controlling for confounding variables, easy access to supermarket shopping (measured by distance and time to the household's usual main food store and car ownership) was associated with higher fruit

consumption. Whilst a study unique in demonstrating a relationship between retail access and diet, the finding may not be generalisable, as it is based on a very low income population. It also collected all retail access data by self-report from low-income householders, thus offering no objective assessment of retail exposure. The only other study that has related retail access to dietary intake at an individual level, comes from New Zealand, and involved secondary analysis of a national health survey (N=12529 adults).[108] Data were available on dietary intakes and to this were added data on proximity to the closest supermarket and convenience store. Closer proximity to a supermarket or convenience store was not associated with higher vegetable intake. However, closer proximity to a convenience store was associated with lower consumption of vegetables. The study did not measure actual retail access to fruits or vegetables, and the assessment of intakes was relatively crude. Importantly, it did not identify where households did their food shopping, so also made the assumption that access in the local neighbourhood is important.

These studies, whilst shedding light on the socio-economic (and in some cases spatial) patterning of food purchasing, and to an extent its relationship with diet, do not answer satisfactorily the question of whether differential food retail access leads to differential consumption food patterns.

2.2.3.3 Quasi-experimental studies

Two studies have taken advantage of 'natural experiments' involving the development of a new, large supermarket (in both cases a Tesco store) in previously poorly served areas of the UK. The Leeds 'Seacroft' study suffered from a weaker design, having no control area and a sample size too small to detect small, but clinically significant changes (e.g. of around a half a portion (40g) of fruit and vegetables – representing around a 20% increase above current population levels[7]) in behaviour.[110] The authors reported a positive impact on fruit and vegetable consumption, particularly among those who switched to the new store, though at best this was 3.08 portions of fruits and vegetables per week among 239 participants in both before and after waves of data collection, who had a low fruit and vegetable intake at baseline (i.e. a mere 0.44 portion per day – or 35g/day of fruits and vegetables). A controlled study from Glasgow, in contrast, showed little effect on fruit and vegetable consumption among local residents or 'switchers'.[111] Unadjusted changes were similar in magnitude to those seen in Leeds (0.29 portion increase among the intervention group and 0.44 portion increase among the control group), supporting the suspicion that the effects measured in Leeds, without a control group, may have been confounded by a secular change.[57]

The Glasgow study,[111] provides the most robust and convincing evidence to date that food retail access *per se* does not have a profound effect upon dietary consumption, in the UK at least. However, this study was conducted in a very limited context on people living around one supermarket and does not provide a picture of food retail and dietary behaviour at a population level (i.e. including a range of shop types) or evidence more broadly to suggest that variations in food retail access lead to variations in dietary behaviour (e.g. across the socio-economic spectrum). Natural experiments are notoriously difficult to undertake and key problems include the identification of a viable control area/population and attributing changes in individual diets to changes in retail access.

2.2.4 The relationship between retail access and obesity

The research presented above does not provide strong evidence that food retailing in isolation affects diet and it is reasonable therefore to conclude that it may not have a profound impact on obesity. That is not to say that other factors, such as price, are not important but at present there is little evidence of a systematic relationship between food retail access and obesity.

One recent review has summarised some of the evidence presented above and discussed it in relation to obesity, coming to similar conclusions.[57] The authors suggested that a systematic difference between the findings of studies from the US and other developed countries points towards important contextual differences between the US and elsewhere. The implicit suggestion is that the US is a more unequal society where issues such as food retail access are genuinely worse for the poor and, in particular, African Americans. Evidence from a range of studies of health inequality, as well as studies of the retail environment, support such an hypothesis.[112]

There is also one recent US study that has explicitly looked at the relationship between food retailing and obesity. This is another study from Morland *et al*, involving secondary analysis the ARIC data[113] and suffers from the same methodological limitations as its predecessors (i.e. an ecological design with secondary analysis of existing data).[50 54 104 114-116] Obesity among black and white Americans was associated with lower numbers of supermarkets and higher numbers of convenience stores in census tracts of residence. However, there was no evidence that individuals shopped within their own census tracts and these results may be confounded by the socio-economic characteristics of neighbourhoods, thus simply indicating that fatter people *live* in poorer areas, in which there are fewer supermarkets and more convenience stores.

One other, relatively new area of research deserves mention here. Recent studies have begun to explore the role of food prepared (and sometimes eaten) outside the home in predicting obesity. Whilst ready-prepared food purchased outside the home can be nutritionally inferior to home prepared food and can contribute significantly to energy intakes, an association with BMI has not been demonstrated in adults.[117]

However, from the US, Thomson *et al* have shown longitudinally a relationship between frequency of consumption of food from fast food restaurants in American girls (aged 8-19 years) and development of obesity.[118] In addition, two studies have shown there to be more fast food restaurants in poorer, predominantly black areas in the USA,[119 120] and one has demonstrated fewer healthier options available in restaurants in such areas.[119]

In the UK Macintyre *et al* failed to find socio-economic patterning by small area of out-of-home food outlets in Glasgow,[121] but did find that McDonald's fast food restaurants were more likely to be found in more deprived areas in England and Scotland.[121] In Australia, Reidpath *et al* [122] also found density of fast food outlets to be greater in more deprived areas.

One other way in which retail access might be associated with body weight is that energy expenditure associated with food shopping must vary by method of shopping and mode of transport. Thus, for example, purchasing food on the internet self-evidently involves the lowest energy expenditure, whereas walking 500m or more to do food shopping, especially if accompanied by small children in a buggy or pram is likely to have a significantly higher energy expenditure, with shopping by car or public transport somewhere in between.

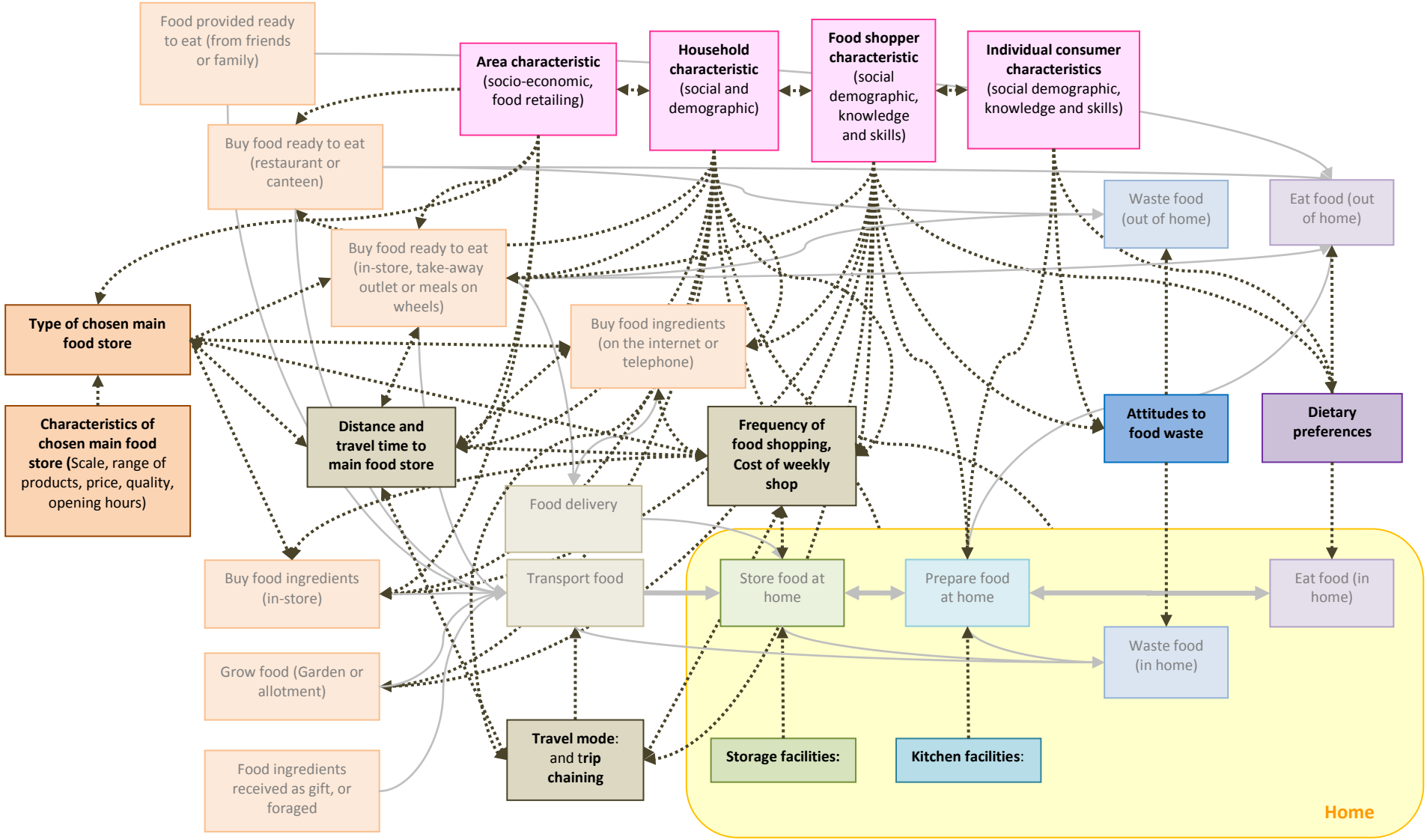
2.3 A hypothesised causal framework for the relationship between dietary intake and food retail access

The significant volume of research on the process of acquiring and consuming food outlined above has not yet definitively answered the question of whether retail access is independently associated with dietary intake. However, it has identified a wide range of potentially important factors that may be causally associated with dietary intake. In Figure 2, I have added these factors to the model illustrated in Figure 1, to provide a framework for the research. Factors that appeared in Figure 1 are shown in faded colours and text in Figure 2 to help emphasise the new material.

Thus, for example, the acquisition of foods, whether ready to eat or ingredients which can be turned into meals or snacks, must ultimately be related to whether or not the desired foods are available in one or more food stores to which the householder has access. Questions of

access, whether determined by availability or cost, are related to the type of store, if only at the level that some stores (e.g. a greengrocer) will not sell a wide range of foods. However, store locations are determined by a range of factors and thus the nature of a neighbourhood where a household lives may therefore affect their immediate access to a range of shops. For example, large supermarkets are usually built on major connecting transport routes (often urban ring-roads) to ensure access for the largest number of car drivers, since this is the most commercially viable strategy. Questions of access, however, are not simply a question of what stores are available and what is available in stores; householders have perceptions of, and make choices about, different types of store, and these are reflected in known demographics of customers (e.g. Marks & Spencer (premium quality and cost, aimed at aspirational middle classes) versus Aldi (European deep discounter, aimed at cost-conscious lower social groups)). Such perceptions and choices reflect social characteristics at individual, food shopper and household levels. Other factors may affect choices made about where to shop, such as distance from food stores, the kind of area in which stores are found, modes of transport available to a household, time available for shopping and proximity of chosen food stores to other places visited in everyday life. Thus, for example, a householder may choose, for the sake of convenience, to do food shopping on the way home from work, after dropping children at school, or after visiting family or friends (known as 'trip-chaining'[73]). If you have access to a car (or are able to afford using a taxi), you can fill the boot with as many food shopping bags as it will take; those without a car are unlikely to be able buy more food than they can carry on foot (unless they are prepared to push or pull a trolley home).

Figure 2: Factors at individual, household and area levels influencing the behaviours involved in food consumption



Individual dietary preferences come into play in the acquisition, preparation, storage and consumption of food. Such individual preferences may affect both the diet of that individual (i.e. independent choice), but also impact on the diets of others in their household. In particular, the preferences of whoever buys the food and whoever prepares the food in a household are likely to affect what everyone else in the household eats. The views of dominant members of a household may also have effects that render the choices of individuals less than independent (e.g. if the main wage earner insists on a particular meal pattern). Perceptions also extend to attitudes to food waste, which may have an impact on overall diet. Finally, the physical facilities of a household are likely to be determined by access to resources overall, including the size of house, and may place constraints on the diet that can be consumed. Thus if the kitchen facilities are limited, this may affect what meals can be prepared and the volume and nature of foods that can be stored safely.

All of these factors are illustrated in Figure 2 and their potential relationships with the behavioural processes highlighted in Figure 1 are shown with dashed lines. There are many of these and, in particular, social and demographic factors at individual, food shopper and household level are anticipated to have an impact on a wide range of other factors and behaviours. This diagram is used again later to identify the data to be used in analyses of these complex relationships.

2.4 Methodological limitations of existing research and key requirements of future studies

Most of the studies highlighted above have methodological limitations. The three main types of study identified have the following problems:

- *Ecological studies* make the assumption that individuals shop in their own neighbourhood, have no assessment of availability in a household's usual main food store for comparison and are therefore liable to ecological fallacy,[105] unable to determine independent associations or establish causality. These studies usually rely on routine data, which often provide crude estimates of food retail access or dietary intake.
- *Cross sectional studies* usually offer no comparison of local availability versus availability in a household's usual main food store. They are often underpowered and the widespread lack of multilevel analysis means studies are unable to take into consideration the relationship between factors at individual, household and neighbourhood levels. Their design means they are unable to infer causality, but can determine strength of independent associations.

- *Natural experiments* can suffer from poor control, lack of generalisability and, often fail to measure access to the wider retail environment beyond a single store. However, they are able to infer causality, providing that the source of household's main food shopping is identified.

In this body of research, a key barrier seems to be that small-scale cross-sectional studies and secondary analyses are relatively easy to undertake, but evaluations of natural experiments or major epidemiological studies are costly and difficult to execute well. Considerable co-operation from the retail sector is needed to mount such studies successfully.

Ideally studies are needed where both retail factors (e.g. access, availability and price) and diet are measured as applicable to the same individuals, preferably longitudinally, so that any direction of causation can be inferred, and preferably with an experimental component, so that change in diet can be observed, contingent on change in retail access. Only one such study has been conducted to date,[111] albeit with a quasi-experimental design, which had the limitations of scale and scope noted above. Further studies are warranted in a range of contexts before firm conclusions can be drawn. In planning the study reported here, the following considerations were taken into account:

- The need for a study of sufficient scale to be able to measure variations in diet and retail access across a representative cross-section of the (UK) population
- Exposure measurement which is sophisticated and takes account of a range of putative causal factors as illustrated in Figure 2, including:
    - the different elements of food retail access that could impact on diet (i.e. availability of a range of commonly consumed foods, their price and their quality, and the types of food retail outlet in which foods are available)
    - food retail access *both* in the store(s) where a household or individual usually buys their food *and* in the vicinity around their home, so that the differential effects of these can be distinguished.
    - the relationship between individuals and households (because it is known that food acquisition and preparation are usually undertaken at a household level) and between households and neighbourhoods (because groups of households will be exposed to similar environmental characteristics in a local area, including food retailing).

- Outcome assessment which measures dietary intake at an individual level as accurately as possible, given the scale and cost of undertaking such measurements at a population level.
- The need to control adequately for potential confounding factors in the relationship between food retail exposure and dietary intake, including in particular socio-economic factors which are known to strongly influence both diet and retail access

In the absence of an opportunity for a major natural experimental evaluation of a new retail development, a large-scale, cross-sectional epidemiological study was planned to address these methodological issues. The proposed study was planned to include simultaneous detailed assessments of exposure to: social and retail environments at small area and household levels, identification of the usual food shopping practices of households, a detailed assessment of social, behavioural and economic factors at individual and household levels, an accurate assessment of dietary intake at individual level, and a data structure that would permit multilevel assessment of the relationships between these exposures and the quality of individual dietary intake.

2.5 Review of key methodological research to support study design

In order to undertake such a study, it was necessary to develop a suitable design and appropriate methods, drawing on existing methodological literature to ensure optimal exposure assessment and outcome measurement. The key issues explored in the supporting literature are discussed further below.

2.5.1 Choice of setting, study population and sample size considerations

2.5.1.1 Why Newcastle upon Tyne was chosen as the study area

Newcastle is a relatively compact city, comprising both urban and semi-rural areas, illustrated in Figure 3. Grey shading in this and subsequent maps represent built up areas. The city centre is north of the River Tyne and is recognisable by the convergence of roads and rail routes and a number of bridges across the Tyne. The city centre is about 15 km from the North Sea coast and the city is about 12 km north to south and 15 km east to west. It is bounded by the River Tyne to the south, rural Northumberland to the north and west and sub-urban North Tyneside and Whitley Bay to the east. A prominent feature is the 'Town Moor', an area of grazing land belonging to the 'Freemen of the City', in the middle of the district, just to the north of the city centre in Moorside ward (see Figure 4), which I mention to aid interpretation of mapped data in later chapters. The city has recognised areas of socio-

economic deprivation on the riverside to the east (Byker, Monkchester and Walker wards) and west (West City, Benwell, Elswick and Scotswood wards) of the city centre and in the outer west and northwest of the city (parts of Fawdon, Blakelaw and Woolsington wards). It has suffered economically from the closure of coal mines, shipyards and other industries over the last 50 years.

Newcastle was felt to provide a suitable study area for the proposed work for the following reasons:

- The north east is often considered a microcosm of the UK, having a population with a social and demographic structure similar to the whole nation.[123]
- Its size is sufficient to provide wide geographical and social variations in the population, and yet small enough to be studied in its entirety, thus avoiding the problem of needing to select, randomly or otherwise, smaller areas for analysis.
- High quality spatially referenced data relating to physical and social environments has been prepared for the city and was available from local sources.
- It was local to the research team and has been used as the study location for a number of relevant previous studies, in particular studies of dietary intake that have provided further inputs to the development of our methods (see further below).

Figure 3: Map of Newcastle upon Tyne and surrounding area, showing main physical features

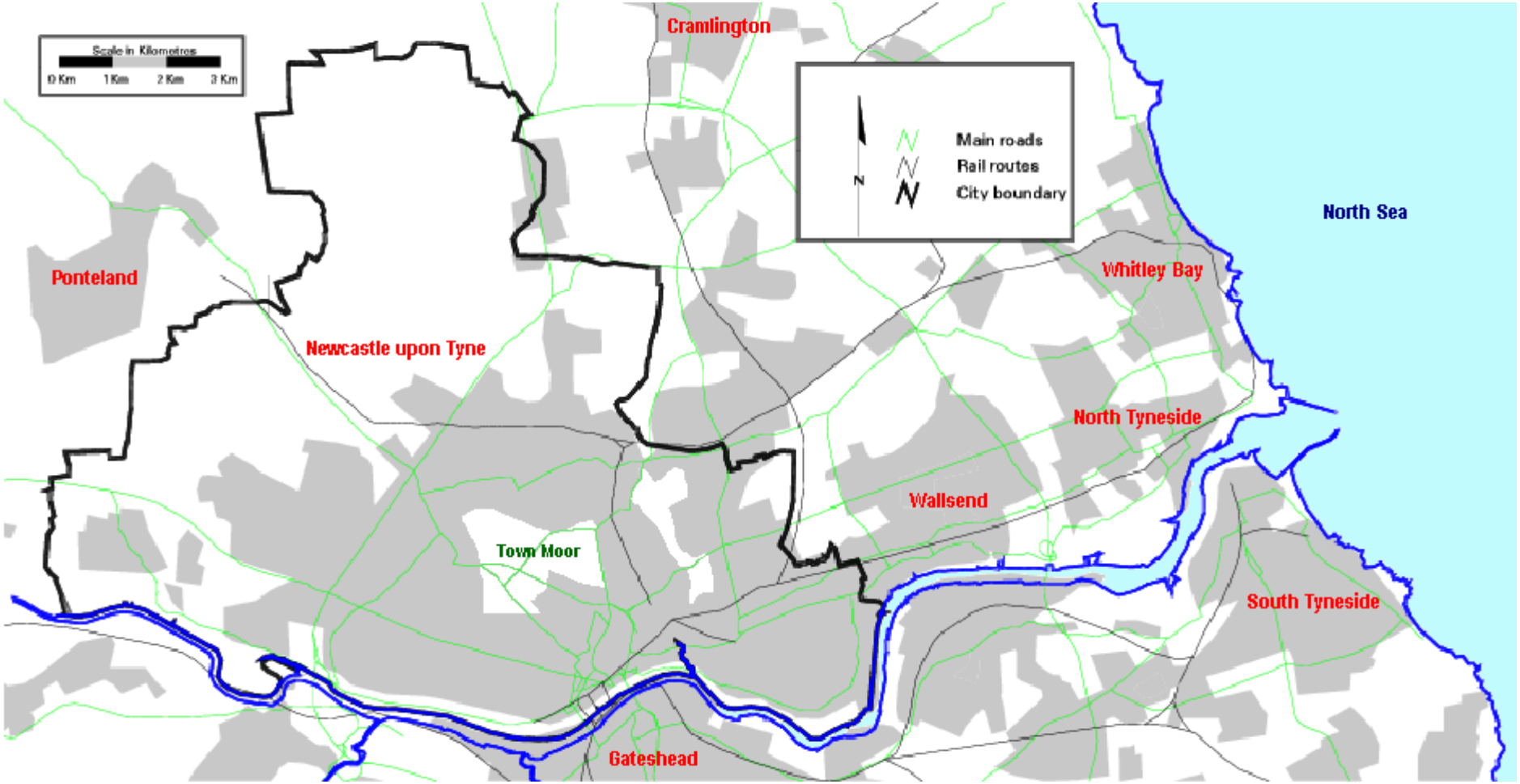
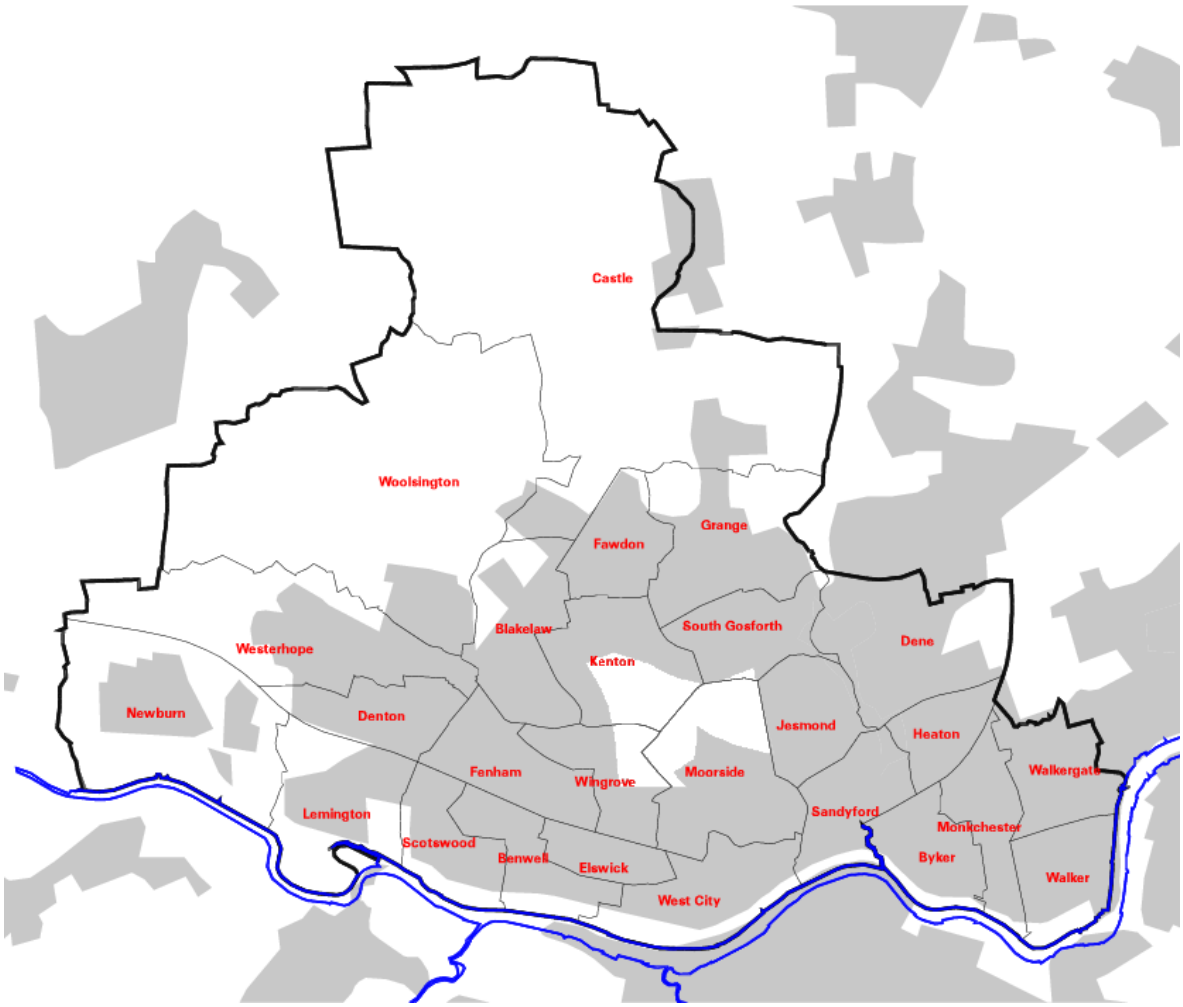


Figure 4: Map of Newcastle upon Tyne showing ward boundaries



2.5.1.2. Sample size

The estimation of required sample size for this study was, essentially, pragmatic and driven ultimately by cost considerations. However, the sample size needed to satisfy two requirements: (a) the achievement of an even spatial distribution of households across the study area (i.e. geographically representative) with sufficient density to enable mapping of individual and household data with sufficient spatial resolution; and (b) the need to achieve a representative sample of individuals in Newcastle, of sufficient size to enable multivariable and multilevel analyses of dietary and spatial data with acceptable statistical confidence limits.

The absolute sample size needed to meet requirement (a) was impossible to estimate. In principle, the larger the sample size the greater degree of precision that can be achieved in spatial analyses, though there is a level beyond which additional data bring diminishing additional benefits. Experience from other local geographical studies suggested that a sample of approximately 5,000 individuals in approximately 3,000 households would provide sufficient spatial resolution for the city of Newcastle.

The sample size needed to meet requirement (b) was similarly difficult to estimate in the absence of comparable prior multilevel studies. There is also debate concerning the numbers needed at different levels of hierarchy to support multilevel analysis.[124 125]

2.5.2 Exposure assessment: measuring the retail environment

2.5.2.1. Sampling food stores

To provide an accurate assessment of the retail environment applicable to individual households, a method was needed that would enable comprehensive assessment across all areas inhabited by the sample population of households, as well as all stores regularly used by those households from which dietary data would be collected. Any method based on sampling food stores for data collection, as used in most previous UK studies,[20 27 29 58 92] would not provide such a comprehensive assessment, thus dictating that a census of food stores was necessary. Identification of the stores used by households would also allow verification of the completeness of the census, as well as the addition of stores used outside the area of residence, for example close to a more distant place of work.

2.5.2.2. Assessment of the food environment within stores

Reviews of the literature on variations in food retail access [3 57 112 126] reveal a range of methods of assessment, from a crude classification of food stores by type or scale, to a detailed in-store assessment of the availability, quality and price of groceries offered. Many ecological studies have erroneously attributed individual outcomes to the presence or otherwise of food stores in residential neighbourhoods. A more definitive study requires a more detailed assessment of not only what types of grocery store are accessible to households but also what is available in them and at what quality and price. Such a detailed level of analysis requires the use of an inventory based assessment method that can be readily applied in the field across a variety of store types. Moreover, because of the requirement in this study to focus on the availability of a 'healthy' diet, the inventory must include healthy products, such as fresh fruits and vegetables, as well as other foods considered to form a balanced diet and perhaps less healthy alternatives for contrast. The existing literature on such methods was reviewed, focusing on UK studies that were context specific.

Four previous UK studies using a 'shopping basket' method were identified and reviewed. Mooney et al (1990) costed two shopping baskets of comparable items (30 items in total). They considered the price of a range of packet sizes and used the cheapest cost when more than one brand was available. No fresh fruit or vegetable items were included, though the range of products considered was extensive.[88] Sooman et al (1993) assessed the price and

availability of 10 'healthy' and 10 comparable 'less healthy' foods (e.g. semi-skimmed milk versus whole milk).[14] The foods included were not necessarily the foods most often eaten and no fruit or vegetables were included in the list of items. Barratt et al (1997) generated a shopping list based upon local food diary data. They applied the survey to only a small number of shops.[98] Donkin et al (2000) assessed the availability and cost of 71 foods in a small area study. This number of food items surveyed was considered too large to be used in a large-scale survey. The food items were chosen because they met current dietary guidelines, but this did not necessarily reflect what was actually consumed.[92 93]

A number of conclusions were drawn from this brief review, which subsequently informed the study design. The inclusion of a range of fresh fruit and vegetables in any standard basket was considered important, since consumption of fruit and vegetables is a major element of government guidance on healthy eating.[127] The inclusion of both 'healthy' and 'less healthy' enables comparisons of the 'healthiness' of foods available in different stores.

Both pragmatic and financial constraints dictated that some limitations be placed on the scale of the in-store data collection. For example, it would be impractical to assess all available options of each food and a standard version and size of each product would need to be specified (e.g. the best-selling brand). A maximum of around 30 items was felt to be a practically and economically feasible number to collect. It was also felt important to use data on the local diet to help determine commonly consumed food items to include in the survey.

2.5.3 Outcome assessment: measuring dietary quality in a large population sample

Methods of dietary assessment vary in their validity and reliability, as well as their acceptability and cost. The most robust forms of assessment (e.g. seven day weighed intake) are most costly, least acceptable and thus widely considered unsuitable for large-scale epidemiological studies.[128]. Quality must be traded-off against cost. Methods based on weighing food that is subsequently consumed arguably represent the most valid, followed by diary-based methods over 3-7 days, if supported by appropriate portion size assessment (e.g. using a photographic atlas). However, both these methods are several orders of magnitude more costly than questionnaire based methods. Thus a pragmatic decision was taken to use a self-completion questionnaire-based method and review which of these would provide the most robust data on the quality of dietary consumption. Questionnaire methods primarily employ food frequency questionnaires (FFQs), of which there are many versions, varying primarily in the number of food groups or items assessed.[128-131]

2.5.3.1 Food frequency questionnaires

The main drawback of the FFQ method is that it does not assess actual consumption, but estimates 'usual' consumption. This has the advantage that it is not prone to the wide daily variations in diet, but usually cannot be used as an accurate measure of absolute intakes of nutrients. Nevertheless, FFQs have been used successfully to measure relative intake of macro-nutrients in major epidemiological studies, such as the European prospective Investigation of Cancer (EPIC).[132-135] The EPIC FFQ is one of the more detailed instruments available in a self-completion version, including 134 food groups and is unique in having been validated against weighed intake.[132] Like other FFQs it is imperfect and, in particular, owing to the focus of EPIC, it has a relatively heavy emphasis on fruits and vegetables, and thus overestimates consumption of these.[128 132 133 134] Nevertheless, when used with up to date nutritional information and calibrated to the local dietary context, it provides a cost-effective method of dietary assessment for large population based studies. It was thus chosen as the instrument to use in this study.

2.5.3.2 The use of composite indices to summarise dietary data

Diets are complex and consist of many components. The healthiness of a diet can be measured in a number of ways. For example, the quantity of key micronutrients, such as vitamin C, can be estimated. Macronutrients, such as the percentage of dietary energy attributed to saturated fat or grams of fibre, can also be estimated. Ingestion of specific food groups (e.g. 'fruits and vegetables', 'processed meats' or 'sugar-coated breakfast cereals') can also be assessed, as can individual food items (e.g. potatoes, eggs, or broccoli). Lastly, the type of diet can be identified crudely as omnivore, vegetarian, vegan etc. Such summary variables place differing demands on the quality of the primary data. For example, a relatively crude FFQ would be unsuitable to estimate micronutrients, but could be used to estimate consumption of macronutrients or food groups. The literature on available techniques to summarise FFQ data was reviewed to establish appropriate methods for this study.

A range of published methods were identified and critically reviewed.[10 27 44 92 93 136 137] A number of studies have produced scores based on consumption of foods within groups (e.g. fruit and vegetables) from FFQs.[10 44 138] These result in comparative indices with no attempt at quantification (other than frequency of consumption) and may therefore over or under-estimate the contribution of FFQ items when they are summed equally. Correlations between such scores and measured intakes (e.g. of Vitamin C) are typically weak.[132 139] This method has been extended to derive more global indicators of the 'healthiness' of diets by including a wider range of items, each scored in a particular direction to indicate the item's 'healthiness'.[136]

[138] Thus, in such a score frequency of consumption of sausages (typically a rich source of saturated fat) would be scored in one direction, whilst frequency of consumption of apples would be scored in the opposite direction on a simple scale. Again, in such scores, items or groups within the FFQ are typically given equal weight within the overall indicator. A variant of this method is the calculation of 'healthy' and 'unhealthy' food scores.[10 44] Anderson looked at the ratio of 'healthy' to 'unhealthy' food scores by comparing estimated consumption of fats and carbohydrates,[10] identifying subjects as 'healthy' eaters if their fat score was less than their carbohydrate score.

An alternative approach is to score consumption for specific groups according to whether or not the respondent meets a pre-specified recommended intake. Cade et al[137] used this approach in analysing data derived from the EPIC FFQ and assessed consumption of eight food groups: saturated and polyunsaturated fats, protein, complex carbohydrates, free sugars, fruit and vegetables, dietary fibre and pulses, seeds and nuts.

A key element of the funder's brief for this research was specifically to assess whether food retailing influences fruit and vegetable consumption. Thus assessment of overall fruit and vegetable intake was considered an important primary outcome indicator to develop. However, other components of diet are important markers of its healthfulness, including total and saturated fats, unrefined carbohydrates and fibre (non-starch polysaccharide).

The EPIC FFQ produces frequencies of consumption of foods in groups (e.g. types of beef – roast, steak, mince, stew etc.)(see Figure 6 and Appendix 3). Using estimated values for the portion size consumed and estimated nutritional composition of each food group, estimated nutritional intakes can be derived and then summed across all FFQ items. The validity of this approach is of course dependent on the accuracy of the data sources and the extent to which the FFQ accurately reflects the total diet. It cannot be used to measure absolute intakes. However, this method arguably provides the best available estimate of differential dietary intakes for population based studies.[132 140] It was therefore decided to create a small number of dietary indices from the FFQ data in order to provide meaningful comparative indicators, with a particular focus on fruits and vegetables, total fat and fibre (non-starch polysaccharide).

2.5.4 Calibration of exposure assessment and outcome measurement using local data

Both exposure assessment of the retail environment and individual assessment of diet are highly context specific. To provide a useful assessment of the retail availability of foods consumed by the local population, a food basket tool needs to include items that are likely to be available and regularly consumed. The FFQ method of assessing dietary intake relies on

assumptions concerning portion size and nutrient values, some of which are likely to be context specific. To maximise the likelihood of collecting and applying accurate and relevant data, the availability of existing, supportive local data that could be used to calibrate both exposure and outcome measurements was explored.

A trial of a family-based dietary intervention had recently been conducted in Newcastle upon Tyne,[141] from which detailed baseline data had been collected using 3-day food diaries from a representative sample of 366 adults across the socio-economic spectrum. The data included portion sizes for all foods consumed, and importantly, identified the foods and meal patterns most consumed by Newcastle adults. Analysis of this data could be used to calibrate exposure and outcome assessments involving food in the following ways:

- To identify the most commonly consumed foods in different food groups to inform the development of the retail basket tool
- To identify commonly and rarely consumed foods (in particular regional variations of the British diet) in order to moderate the detailed food group lists in the FFQ
- To determine average portion sizes for foods within individual FFQ groups to apply in estimating weight/volumes of foods consumed.

2.5.5 Area level data and spatial considerations

The concept of food deserts anticipates poorer retail provision in socially deprived areas.[55 79 80 142] In order to explore the relationship between socio-economic status at neighbourhood level and either food retailing or diet, a measure of socio-economic status at neighbourhood level, which could be attributed to shops and households was needed. At the time the fieldwork was conducted, the small area measure most used for such purposes was the Townsend Deprivation Score (TDS).[4] More recently the Index of Multiple Deprivation (IMD) has become widely available and used in many epidemiological studies.[143] The TDS provides a measure of socio-economic deprivation at small area level, calculated from four household level Census variables: % Car ownership, % home ownership, % unemployment and % homes overcrowded (with more than 1.5 persons per room), thus providing a straightforward measure of access to material resources, employment and the home environment. The IMD is a weighted composite of 37 measures derived from routinely available data in seven domains, including income, employment, education, skills and training, barriers to housing and services, crime, the living environment, and health and disability. Whilst the IMD is a more up to date and wider measure of social disadvantage overall, it was felt to be unsuitable for use in this study, since the 'barriers to housing and services' domain includes measures of

proximity to a general practice, a post office, primary school and, most importantly, a convenience store or supermarket. Including such proximity measures in a deprivation index for this study would be inappropriate, leading to a degree of circularity in analyses (i.e. potentially exploring relationships between two proximity measures), thus it was decided to use TDS, which provides a less complicated measure of socio-economic disadvantage.

Descriptive analyses that were included in the initial report on the study to the funder[2] employed TDS calculated from 1991 census data, since 2001 Census data was not then available. However, for this thesis, TDS has been recalculated for small areas (EDs or lower level super output areas (LSOAs), as appropriate) and their aggregates (e.g. 500m buffer zones) using relevant data from the 2001 Census.[144]

Lastly, for a number of analyses, distance parameters needed to be set, including the size of buffer zones (radii) around peoples' homes (for the estimation of retail exposure in the local environment) and the cut off values for proximity mapping (to demonstrate proximity to retail availability across Newcastle). A distance parameter of a 500m radius around peoples' homes was chosen because this is a value that is known to be an acceptable distance for able bodied adults to walk home carrying food shopping.[145 146] It has also been suggested that a shorter distance (250m) is acceptable to elderly people or adults with small children.[145-148]

3. Scientific rationale, aims and objectives

3.1 Brief statement of the scientific rationale

Diet is important for many aspects of human health. Ensuring access to a healthy diet is thought to be important to address growing levels of obesity and its consequences in developed nations. It is often assumed that food retail access, defined in terms of the range, scale and type of food retail outlets, their locations and opening hours and the availability, cost and quality of foodstuffs provided by them, is an important predictor of the 'healthiness' of people's diets (defined by current guidelines). However, although many aspects of this complex set of relationships have been determined, independent associations have not been demonstrated unequivocally. Large scale epidemiological and interventions studies are needed, with accurate exposure and outcome measurement, to determine the nature of these relationships. More specifically, studies are need to distinguish the nature of the association between diet and retail availability in the area surrounding an individual's home and of retail availability in a household's chosen main food store (which is known in most cases to be distant from the home).[73]

3.2 Study aims and research questions

This study aimed to determine the nature of the relationship between dietary intake and retail access to a 'healthy' and 'affordable' diet, taking into account contextual factors at individual, household and neighbourhood levels in a large community-based population sample. The primary research question was:

1. Is food retail access at a household's usual main food store, or in the local neighbourhood, independently associated with dietary intake?

Owing to the complex nature of the data sets required to answer this primary question, a number of secondary research questions, as follows, were addressed *en route*:

2. Do so-called 'food deserts' exist, and if so in what form? (i.e. How does the number and type of food stores and the availability of commonly eaten foods differ between neighbourhoods in Newcastle? If they do exist, do 'food deserts' particularly affect certain areas or groups in the population?)

3. Do certain types of household or individual choose to buy their food at certain types of food store, and which factors are associated with such choices?
4. What social and environmental factors within households are associated with dietary intake?

The remainder of this thesis is presented in the order of the work undertaken to build the data sets needed to answer the primary research question. Thus, in both the methods and results chapters, details of the retail survey are presented first, followed by the household and individual surveys. A final results chapter presents analyses demanding the integration of the data sets. Thus, results responding to the secondary questions are presented before those responding to the primary question.

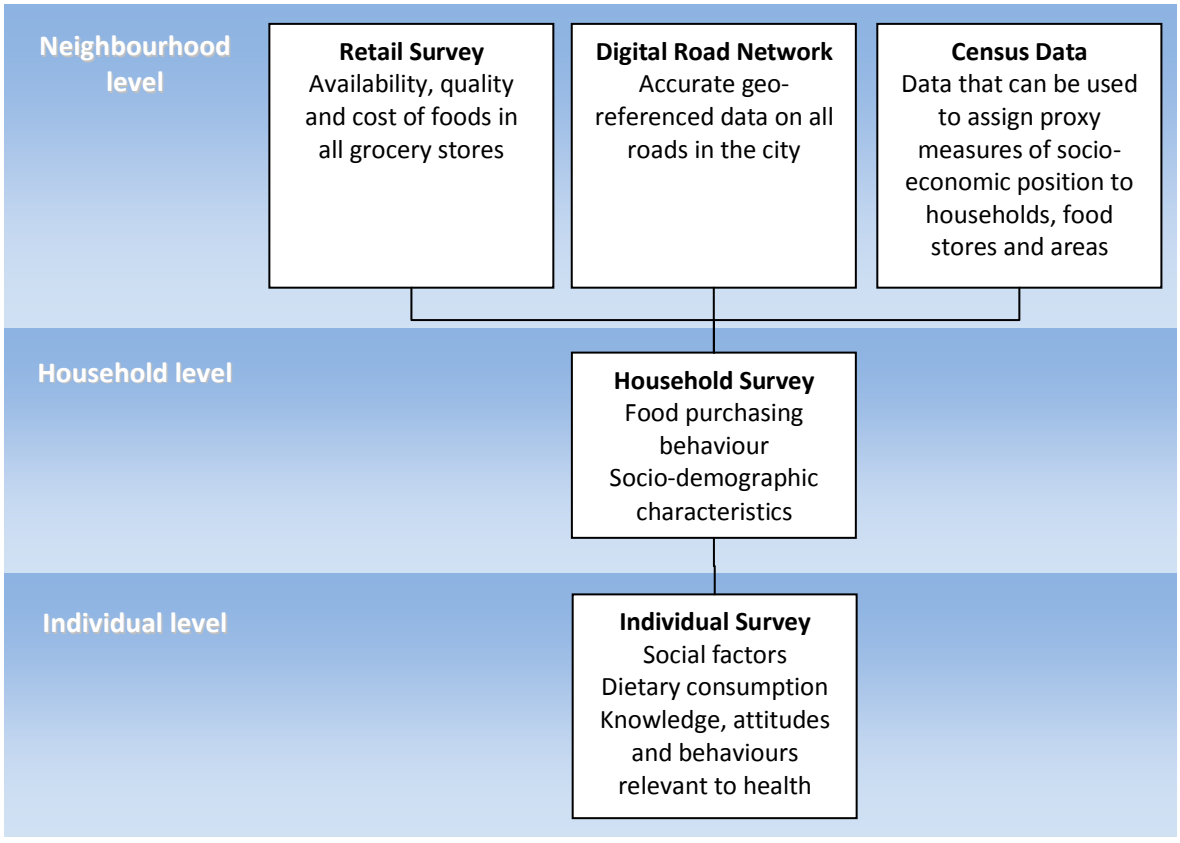
4. Methods

In this chapter the methods of each element of the research are described. Developing and finalising the methods for this large and complex study required a considerable amount of methodological work, the details of which are explained below and in related appendices.

4.1 Study design

The study was cross-sectional in design, bringing together contemporaneous survey data on the price, quality and availability of a range of commonly eaten foods from food retail outlets, data on access to retail outlets by private and public transport and socio-economic data on local areas, and data on the dietary and food shopping habits of a representative sample of adults. The three levels of data (area (neighbourhood), household and individual) were linked and analysed spatially using geographical information systems (GIS) and statistically using simple, multi-variable and multilevel techniques, in order to explore the relationship between food retailing, contextual factors and dietary patterns (see Figure 5).

Figure 5: Study design – Sources of data collated at the three levels



Data on retail availability of food was collected using a separate survey of all food retailing outlets in Newcastle. Data on neighbourhood socio-economic characteristics and the road network were derived from data sets collected for other purposes (see section 4.5). Data from households and individuals were collected using two linked surveys, so that all individuals were sampled from households. Each of these methods are described in turn below.

4.2 Research Governance

The research was conducted within the usual guidelines and standards for health and social research, and received ethical approval from the Newcastle and North Tyneside Joint Universities and Health Authorities Research Ethics Committee. All individuals consented to participate in the research. All data were anonymised as soon as feasible and kept securely under the terms of the Data Protection Act. Strict confidentiality was maintained at all times.

4.3 Setting

The research was undertaken in the city of Newcastle upon Tyne (population n≈260,000), in north east England (see Figure 3 (physical geography) and Figure 4 (ward boundaries) in Chapter 2).

4.4 Retail Survey

The retail survey aimed to assess access to food stores and the availability, quality and cost of foods in every retail outlet selling food in the city of Newcastle.

4.4.1 Identification and recruitment of food stores

To conduct a census of all shops selling food in the city, shops were initially identified from a local database of commercial premises provided by the Newcastle City Council Planning Department. However, on initial visits to stores, this database was quickly found to be hugely inaccurate, so instead one of the retail survey team visited every street in Newcastle and identified all food retail outlets. Food stores were then visited by a member of the survey team, who first approached the shop staff in order to seek permission to conduct the survey (see details under 'survey procedure' below).

4.4.2 Development of the data collection sheet

A data collection sheet was developed to assess availability, price and quality of food sold by food retail outlets in Newcastle (see Appendix 1). The data collection sheet recorded

information on the type, size, opening hours and location of the shop and the range, cost and quality of 33 commonly consumed food items.

4.4.1.1 Development of the shopping basket

The data collection sheet incorporated a 'shopping basket' of foods commonly consumed by the Newcastle population. Several previous UK shopping basket studies were identified and reviewed[14 88 92 93 98] and their methods considered in the design of our shopping basket survey. From these surveys, a long list of potential food items was derived to include in our 'basket'. A notional maximum of around 30 items was set to ensure the survey could be conducted cost-effectively.

Evidence was sought from local research of the most important food items to include. The Family Food and Health Study Database[141] was examined and the foods most frequently consumed by Newcastle residents were considered for inclusion within the shopping basket. Certain 'healthier' foods that were typically eaten by Newcastle residents had a comparable 'less healthy' alternative that was also eaten at a similar frequency (e.g. semi-skimmed milk v. whole milk, wholemeal bread v. white bread). Other commonly consumed foods were perceived as being 'healthier' (e.g. pasta, low fat yoghurt) or 'less healthy' (e.g. crisps, chocolate bars, biscuits).

In addition, meal structure was examined using the Family Food and Health database.[141] 'Healthier' and 'less healthy' households were identified according to their consumption of fat, starch and vitamin C (the latter used as a proxy measure for fruit and vegetable consumption). The food diaries of families falling into 'healthier' and 'less healthy' households were examined and their dietary habits and consumption patterns compared. It was apparent that a distinguishing feature of a 'healthier eating' household in Newcastle was not only the exclusion of 'less healthy' foods, but the inclusion of fruit and vegetables. The ten most commonly consumed fresh fruit and vegetables were identified from the database and included in our shopping basket.

The full shopping basket comprised 33 popular food items of which 10 were fresh fruits and vegetables (shown in green text in table 1), 11 'healthier' foods (of which 4 were fruit or vegetable items: pure fruit juice, baked beans, frozen peas and tinned tomatoes – also shown in green text in table 1), healthier items which are not fruit and vegetables (shown in blue text in), 10 'less healthy' foods (shown in red text in table 1) and 2 'neutral foods' (cheddar cheese and eggs, shown in black text in table 1). These 'neutral foods' were key components of the typical Newcastle diet, but could not be considered to be 'healthier' or 'less healthy', since this

is dependent on their overall contribution to the diet (i.e. whilst both eggs and cheese are relatively high in fat, they are also high in other important nutrients, such as protein or calcium). Within these lists there are also 6 paired equivalent 'healthier' and 'less-healthy' foods: semi-skimmed and whole milk, chicken and sausages, Weetabix and Frosties breakfast cereals, wholemeal and white bread, pure fruit juice and non-diet carbonated drinks, and tinned tuna and tinned meat (these pairs are highlighted with blue shading in). These pairs were compared for price and availability.

Table 1: List of foods surveyed in retail outlets

Fresh Fruit and vegetables	'Healthier' foods	'Less healthy' foods	'Neutral' foods
Apples	Chicken	Sausages	Cheddar cheese
Oranges	Tuna (in brine)	Tinned meat	Eggs
Bananas	Semi-skimmed milk	Whole milk	
Tomatoes	Wholemeal bread	White bread	
Cucumber	Weetabix cereal*	Frosties cereal*	
Lettuce	Pure fruit juice	Carbonated drink	
Peppers	Frozen peas	Crisps	
Broccoli	Tinned tomatoes	Biscuits	
Carrots	Baked beans	Kit Kat	
Onions	Pasta	White sugar	
	Low fat yoghurt		

*Non-branded equivalents to these two branded cereals were also allowed

For fruit and vegetables, quality was assessed through direct observation by checking whether the skin was intact, discoloured or bruised. Firmness, freshness and texture were also assessed, where possible. A binary variable was created and each fruit and vegetable was considered to be of poor quality if more than fifty per cent of the items on view were considered unacceptable. Some (fresh) food items require refrigeration (chicken, sausages, both milks and cheese) and one freezing (frozen peas). Others (10 fruit and vegetables, breads and eggs) require cool storage conditions. For the fresh food items, it was noted whether the foods were chilled or not. Sell-by-dates were initially examined, but no out-of-date foods were found in the first 50 shops, and so this indicator was abandoned.

4.4.1.2 Categorisation of shops selling food

Shops selling food were initially categorised into 13 types of store (supermarkets, mini-markets, local stores, butchers, bakeries, freezer-centres, health food stores, delicatessens, greengrocers, off licences, newsagents, petrol station shops and one 'other' category, which included market stalls). Supermarkets were later recoded into three categories: 'large multiple

supermarkets' (e.g. Tesco, Asda, Safeway, Sainsbury's, Morrison's, Co-op), department stores (Marks & Spencer and Fenwick) and 'discount supermarkets' (e.g. Kwiksave, Netto, NISA, Lidl, Aldi). However, it is recognised that there is considerable variation within these groups and, in reality, there is a wide spectrum of store type, so that such a classification results in somewhat heterogeneous groups. For example, Tesco now have several different types of store format, such as superstores (Tesco Extra), city centre/suburban supermarkets (Tesco Metro) and small 'convenience' stores linked to petrol stations (Tesco Express), although there were none of this latter group in Newcastle at the time of our survey. Likewise, Co-op had both large supermarkets and smaller 'convenience' stores ('Co-op Late Shops') (see below for a discussion of classification of 'convenience stores').

Significant difficulty was encountered in classifying the smaller types of local grocery store, primarily due to the variation in size and range of produce in these outlets. Initially, these were classified as 'local stores' and 'mini-markets', based on their size (one checkout for 'local stores' and two or more checkouts for 'mini-markets'). However, this did not provide a good indicator of the range of products sold and resulted in two very similar but heterogeneous groups. In addition, many specialised outlets had diversified to sell a wide range of products. Thus, for example, many shops called 'newsagent' or 'off-licence' were in fact general grocery stores. Some had been renamed as such, for example: 'Newsagent, off-licence and general dealers'.

This problem was tackled by re-classifying local stores, mini-markets, newsagents, off-licences and small supermarkets according to the range of items stocked. Using our list of 33 items, stores that stocked more than one fresh or grocery food item (i.e. all items except crisps, biscuits, chocolate or drinks, including milk (see table 1)) were classified as 'convenience stores'. Those that did not stock these items were classified according to the other main business of the shop (e.g. as a 'Newsagent or post office', 'off-licence' etc.), usually indicated by their original classification. There are two exceptions to this rule: one is petrol station shops, which were all classified as such, irrespective of their food range. The other is a small number of local, independent 'discount stores', selling limited ranges of items, usually in bulk. These were identified from their shop names (e.g. food weighouse, scoop and save, cash and carry etc.).

In practice this re-classification has resulted in most mini-markets and local stores being classified as 'convenience stores', and about half of all newsagents, Post Offices and off-licences being reclassified as 'convenience stores'. In addition, some national chains or franchised operations are categorised as 'convenience stores' rather than supermarkets. These

include 'Spar' shops (of which there were 9 in Newcastle, but none with more than 2 checkouts), 'Co-Op Late Shops' (see above), Price Watch, Life-style and Londis (all national convenience store chains).

4.4.2 Retail survey procedure

The address and post-code of every retail shop was recorded on the data collection sheet and the precise grid-reference recorded using a Global Positioning System (GPS) (Garmin e-Trex personal navigator, Garmin Corp., Kansas, USA, 2000). On entering a shop the research staff identified themselves to the store manager or other staff present, provided them with a letter of introduction and requested permission to conduct the survey within the shop. Sometimes, the issue of permission was referred to an off-site store manager and the survey deferred until a response was received. If permission was refused, the name and location of the store was recorded, but no further information collected. Data were collected on the cost, unit size and quality (where applicable) of the 33 food items within the shopping basket using the retail survey instrument described above(Appendix 1). The smallest/cheapest available price was recorded where the specified standard size (see Table 2) was not available. The number of checkouts or tills, opening hours and access arrangements were also recorded.

The data were largely collected by researchers without the intervention or involvement of the shopkeeper or staff, although clarification of opening hours, address and prices of unlabelled items (particularly fruit and vegetables in smaller, local stores) was sometimes required. Shops that were closed when initially identified were revisited on another day, at another time. Permanent closure was recorded. The data collection sheet was piloted in a random sample of 10 stores and minor modifications were made. Data collection took place between April 2001 and February 2002.

It was observed during checking of the Household Questionnaires that a number of respondents reported doing their main food shopping outside the city boundary. Thus, to avoid losing data from these respondents, the seven shops outside the city boundaries (all large multiple supermarkets), identified by household respondents, were surveyed in May 2002.

4.4.3 Data management and preliminary analysis

The retail data were entered into a customised database in MS Access, checked and cleaned, and then exported to (SPSS V10.0-15.0, SPSS Inc. Chicago, Ill, 2001-2008) for analysis and, later, merging with the other data sets (household and individual questionnaires, geographic and Census data). Eighteen shops were re-surveyed, due to incomplete data. Descriptive

analyses were undertaken to explore the range of foods available by type of store and other parameters, such as price and quality. Details of data integration, spatial and multivariable statistical analysis are given below (Sections 4.7 and 4.8).

4.4.4 Analysis of average costs of food items, weighting and imputation rules

Some items were sold in specific package sizes and a comparable cost per item or cost per kg of the foodstuff was thus calculated. However, not all fruit and vegetables were sold per kg; for example, some were sold per item or in packs of two or more and the facilities to weigh the items were sometimes not available in the store. Thus, where necessary, an average weight was estimated for each fruit and vegetable and all data were converted to price per kg. Average weights for each fruit and vegetable were estimated by weighing 20 of these food items in a supermarket and recording the mean weight (see Table 3).

In order to make meaningful comparisons of 'basket' costs between shops and areas, those shops selling less than the full basket under comparison (e.g. all 10 fresh fruit and vegetables or all 11 'less healthy' items) were excluded and no imputation was undertaken.

Table 2: Average weights and pack sizes for 33 food items

Food Item	Pack types/sizes and weights available in stores	Average item Weight	Standard size/weight used for costing
Fresh Fruit and vegetables			
Apples	each, 2pk, 4pk, 6pk, 7pk, 8pk, per kg, per lb, per g	156g	per kg
Oranges	each, 2pk, 3pk, 4pk, 5pk, 6pk, 7pk, 8pk, 9pk, 10pk, 12pk per kg	225g	per kg
Bananas	each, 4pk, 5pk, 6pk, 7pk, per kg, per lb, per g	188g	per kg
Tomatoes	2pk, 4pk 6pk, 8pk, per kg, per g, per lb	140g	per kg
Cucumber	half, whole, 2pk, per g, per kg	368g	whole
Lettuce	each	140g	whole
Peppers	each, 3pk, 4pk, per kg, per g, per lb	167.5g	per kg
Broccoli	each, per head, per bundle, 2pk, per g, per kg	280g	per kg
Carrots	each, 2pk, 5pk, 6pk, 7pk per kg, per g, per lb	368g	per kg
Onions	each, 2pk, 3pk, 10pk, per lb, per kg, per g	180g	per kg
'Healthier foods'			
Semi-skimmed milk	per litre, ml, pint		per litre
Chicken	per portion, leg, breast, quarter leg, whole chicken; per kg, per g		per kg
	breast fillet	104g	
	thigh fillet	125g	
	thigh with bone	145g	
	leg with bone and skin	322.5g	
	whole chicken	1600g	
Wholemeal bread	small loaf, medium loaf, per g		per 800g loaf
Weetabix	12pk, 24pk, 36pk, 48pk		per 12 biscuit pack
Tuna (in brine)	small tin, per g, per kg		per 185g tin
Pure fruit juice	per pint, litre, ml		per 250 ml
Frozen peas	per lb, g, kg		per kg
Tinned tomatoes	per tin (g)		per 420g tin
Baked beans	per tin (g)		per 420g tin
Pasta	per g, kg		per 500g
Low fat yogurt	each, 4pk, g		per 125g carton
'Less healthy foods'			
Whole milk	per litre, ml, pint		per litre
Sausages	6pk, 8pk, 12pk, 10pk, per lb, kg, g	8pk= 454g (56.75g each)	per kg
White bread	small loaf, medium loaf, per g,		per 800g loaf
Frosties	per pack (g, kg)		per 500g pack
Tinned meat	small tin, per g		per 340g tin
Carbonated drink	per ml, litre, 3pk, 4pk, 6pk, 7pk		per 330 ml can
Crisps	per pack (g), 4pk, 6pk, 9pk, 10pk, 12pk, 24pk		per 35g pack
Biscuits	2pk, 3pk, (per g)		per 250g pack
Kit Kat	4 finger bar, 8 finger bar (per g), 5pk, 6pk, 8pk, 10pk, 12pk, 16pk, 'chunky'		per 4 finger bar
White sugar	per kg, g, lb		per kg
'Neutral foods'			
Eggs	half dozen, 10pk, dozen, 20pk, 18pk, 15pk		per half dozen
Full fat cheddar	per kg, g		per kg

In order to calculate the cost of comparable 'baskets' of foods between stores, the 33 food items were weighted according to typical consumption patterns. This procedure ensured that undue emphasis was not given to items consumed less frequently or in relatively smaller volumes.[149] The weightings were derived from the National Food Survey 2000,[8] which provided robust estimates from a large population sample. Table 3 lists the average amount of each of the 33 items purchased by households in the National Food Survey. Some assumptions have necessarily been made in deriving these weights and footnotes to the table explain these.

Table 3: Average purchase weights (g per person per week) of 33 foods purchased by households in the National Food Survey

Fruit and vegetables		'Healthier foods'		'Less healthy foods'		'Neutral foods'	
Items	**g per person per week**	**Items**	**g per person per week**	**Items**	**g per person per week**	**Items**	**g per person per week**
Apples	175	Chicken[c]	142	Sausages	60	Eggs[j]	(1.7)
Oranges	54	Tuna (in brine)	26	Tinned meat[e]	58	Cheddar cheese	67
Bananas	205	Semi-skimmed milk	973	Whole milk	596		
Tomatoes	90	Wholemeal bread	90	White bread[f]	422		
Cucumber	35	Weetabix[d]	54	Frosties[d]	41		
Lettuce[b]	58	Pure fruit juice	303	Carbonated drink[g]	836		
Peppers[a]	36[a]	Frozen peas	32	Crisps	48		
Broccoli[a]	36[a]	Tinned tomatoes	43	Biscuits[h]	82		
Carrots	106	Baked beans	102	Kit-Kat[i]	34		
Onions	91	Pasta	60	White sugar	105		
Miscellaneous Vegetables[a]	72	Low fat yoghurt	125				

Notes:
Data derived from the National Food Survey 2000[8]
a Miscellaneous vegetables can be used to describe broccoli and peppers (i.e. assuming 36g each)
b Lettuce derived from 'leafy salads, fresh'
c Chicken derived from 'Broiler chicken, and parts uncooked, including frozen'
d Weetabix obtained from 'high fibre breakfast cereals', Frosties from 'sweetened breakfast cereal' categories
e Tinned meat derived from 'other canned meat and meat products', and an estimate (1/2) of 'cooked bacon and ham including 'canned' and 'corned meat'.
f All forms of white bread used (i.e. sliced, unsliced and premium loaves)
g Carbonated drinks based upon 'ready to drink' and 'low-calorie ready to drink' purchases
h Biscuits taken from 'biscuits other than chocolate'
i Kit-Kat derived from 'chocolate coated /filled bars/ sweets'
j Eggs are number eaten per week

4.5 Collation and analysis of area level data

Digitised data on the road network was obtained from the data archive held at Edinburgh University in the form of a set of files relating to road types and areas for the whole of Newcastle upon Tyne. These were converted to ArcInfo format (ArcInfo PC v7.1, ESRI, Redlands, CA). The resolution was such that all significant nodes on the road network (junctions or changes of direction) were recorded in Ordnance Survey 12 digit grid reference format with a nominal accuracy of less than 5 metres. This road network was used in analyses of proximity to food stores (see section 4.7).

A database of socio-economic indicators, derived from the 2001 Census, was created. From this, a Townsend Deprivation Score (TDS) was created for each enumeration district (ED) in the city,[4] standardised to England and Wales. Enumeration districts were then matched to 7 digit unit postcodes, enabling a TDS score to be allocated to homes (and thus individuals) and shops. Seven digit unit postcodes are similar in scale to EDs and standard look-up files, provided by Consignia, were used to match these two areal units. The matching process uses grid references, but since the grid references for postcodes in the database refer to the southwest corner of each postcode, rather than the centroid, 50 metres east and north were added to each grid reference, according to standard procedure, to achieve greater accuracy.[150]

Later TDS for 500m radius buffer zones around individual homes were calculated and the methods for defining these zones and the calculation of TDS are described further below (section 4.7).

4.6 Individual and Household surveys

The Household and Individual surveys were piloted between January 2001 and May 2001 and conducted between June 2001 and December 2001. In this section, the development of the questionnaires, pre-testing and piloting, implementation and analysis are described.

4.6.1 Sample size

The sample size for this study was constrained by the project budget and was, therefore, essentially pragmatic. Our intention was to collect data on approximately 5,000 individuals in 3,000 households, which we considered would provide sufficient spatial resolution for the city of Newcastle, whilst enabling statistical analyses with sufficient power for the intended multi-variable analyses. At the outset, an overall response rate from households of approximately 65% was anticipated and a subsequent response rate from individuals of 85%. These estimates were based on response rates from recent population surveys undertaken in the

north east of England (e.g. the Newcastle Health & Lifestyle Survey[151]) These factors were taken into account in determining the size of sample to be invited to participate and area-based sampling strategies during the fieldwork (see pilot studies below).

4.6.2 Sample population and sampling frame

To achieve a population of adults in the city associated with their households and representative both demographically and geographically, a two stage process was used:

1) Households were first sampled systematically from the Post Office's postcode address file (PAF), a database of all residential addresses in the UK. The PAF was sorted by full seven digit postcode and every n^{th} address was sampled, where n was the sample fraction that was estimated to result in the desired number of responses (see further details below). A Household Questionnaire were then sent to the 'householder', requesting that the household's main food shopper should complete the questionnaire and seek the permission of all other adults (aged over 16 years) in the household to supply their contact details.

2) An Individual Questionnaire was then sent to all adults identified from each responding household.

4.6.3 Development of Household and Individual Questionnaires

Two questionnaires were developed and piloted: the household questionnaire and the individual questionnaire. Most questions were derived from previously validated instruments. Where existing questions were not available, questions were developed *de novo* using established methods[152] and pre-tested among a sample of Newcastle University staff and students (see section 4.6.3.3 below).

4.6.3.1 Household Questionnaire

The household questionnaire was designed to collect information on household composition and socio-economic profile, household shopping patterns and preferences, food preparation, household amenities and domestic facilities. Questions were also included to determine attitudes to shopping and any problems experienced while shopping. Questions were drawn from existing questionnaires, including the Newcastle Health and Lifestyle Survey,[151 153 154] the Family Food and Health study[141] and the 1000 Families from Newcastle Study.[155 156] The final version of the Household Questionnaire is shown in Appendix 2.

4.6.3.2 Individual Questionnaire

The individual questionnaire was designed to determine socio-demographics, dietary intake, nutritional knowledge, attitudes to diet, alcohol consumption, habitual physical activity, smoking, self-reported height and weight, current health and disability. The socio-demographic section covered age, sex, marital status, education, ethnicity and religion, employment status and occupation. Questions were taken from a number of existing questionnaires, including the Newcastle Health and Lifestyle Survey (1991),[151 153 154] the Family Food and Health study,[141] the 2001 Census,[144] the 1000 Families from Newcastle Study,[155 156] the European Prospective Investigation of Cancer[128 132 133] and the Nutritional Knowledge Questionnaire.[157 158] The final version of the individual questionnaire is shown in Appendix 3 and further details are given below.

The European Prospective Investigation of Cancer (EPIC) FFQ was used to assess dietary intake, subject to minor modifications to take into account regional differences in diet, based on information from the Family Food and Health Study.[141] These modifications included removing some foods, such as taramosalata, which was rarely eaten in Newcastle, and adding some foods frequently consumed in Newcastle, such as Yorkshire pudding and Scotch egg.

The FFQ asked respondents to indicate how often in the last year they had eaten a list of 128 foods from 10 food groups, with options for 9 different response categories: never/less than once a month, 1-3 per month, once a week, 2-4 per week, 5-6 per week, once a day, 2-3 per day, 4-5 per day and 6+ per day. Portion size was specified as either a medium serving, or one bowl/slice/spoon etc., as appropriate for each item. In addition, the final sections obtained information on the type and amount of milk consumed, the type of fat used for frying etc., frequency of eating fried foods in and out of the home, salt consumption, special diets and supplements taken.

4.6.3.3 Pre-testing and pilot studies

During the questionnaire development phase, both household and individual questionnaires were pre-tested and acceptability assessed using a focus group. The pre-testing enabled us to modify and improve the design of the questionnaires. Before commencing the main surveys, pilot studies were conducted in order to test the survey methods. Details of the pretesting and piloting, together with some of the instruments used, are reported in Appendices 1-2.

4.6.4 Survey implementation

The procedure and questionnaires for the main study were implemented as follows.

4.6.4.1 Sample selection

The survey was conducted in two phases. Initially, a random sample of 11266 private households in Newcastle was selected in June 2001 using the PAF, as described above. The sampling fraction was calculated using the response rates achieved in pilot study 1 in order to achieve our desired sample size of 5000 individuals. The 608 addresses sampled for the two pilot studies were excluded from the sampling frame.

The response rate to this initial survey was significantly poorer than anticipated (2781 or 24.7%). A further sample of 6535 households was therefore selected, using the same procedure, in September 2001. Thus, the total number of households sampled was 17801. Details of response rates in the two surveys are given in the Results (section 6.1).

4.6.4.2 Survey procedure

Each household was sent a letter addressed to the householder, enclosing an information leaflet about the project, a household questionnaire (see Appendix 2) and a pre-paid return envelope. The 'main food shopper' was asked to complete the questionnaire and return it in the pre-paid envelope. Those who had not replied within two weeks were sent a postcard reminder. Respondents were also asked to indicate the names of all adult members of their household who were willing to take part in the individual survey. Individuals who agreed to be included in Phase 2 of the study were added to the sample list and sent an Individual Questionnaire (see Appendix 3) approximately six weeks after the Household Questionnaire, followed by a postcard reminder after two weeks.

4.6.4.3 Data preparation

Both the Household and Individual Questionnaire schedules were checked and coded before the data were entered by Newcastle University's Data Preparation Service. A small number were spoiled or otherwise insufficiently completed to allow analysis. Occupations were coded using the ONS Standard Occupational Classification for Socio-Economic Groups (2000).[159] Frequencies were generated for all variables and the data then checked and cleaned. Where outlying values or internal inconsistencies were identified, original questionnaires were checked and, if necessary, the database updated accordingly.

4.6.5 Data Management

Once the individual and household questionnaire data had been coded, checked and cleaned, further data manipulation was necessary to create variables suitable for analysis of outcomes and confounding.

4.6.5.1 Derivation of nutrient values from the FFQ

To determine average portion sizes and composite nutrient values for the foods within groups in the FFQ, data from the Family Food and Health study[141] and from McCance and Widdowson's standard food composition tables[160-168] were utilised. Firstly, the foods within each FFQ group were identified from the Family Food and Health database and the average portion size and relative frequency of consumption of each individual food was identified. Next, the nutrient values for each food within the FFQ food group were identified from McCance and Widdowson's food composition tables. The nutrients for each individual food were then multiplied by the average portion size for the item, and then summed to give a nutritional composition for the FFQ group as a whole, weighted according to their average frequency of consumption among Newcastle adults. Once calculated for each food group, the composite nutritional values were multiplied by the number of times per day it was reportedly consumed (i.e. 0, 0.066, 0.14, 0.43, 0.78, 1, 2.5, 4.5 or 6) to give an estimate of the absolute intake of that food group.

For example, in the FFQ all types of beef are grouped together within a single category (i.e. Beef: roast, mince, stew etc) (See Figure 6).

Figure 6: Example from the FFQ asking questions about beef consumption

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
20. MEAT & FISH *(medium serving)*	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Beef: roast, steak, mince, stew casserole, curry or bolognese	1	2	3	4	5	6	7	8	9
Beefburgers	1	2	3	4	5	6	7	8	9

In the Family Food and Health database, the sample of 366 Newcastle adults reported eating beef products on 267 occasions over 3 days. The percentage contribution of each food item to total beef consumption was calculated (e.g. minced beef was eaten on 37 occasions and contributed 13.8% to the total beef consumption). A nutrient composition for each of the beef products was derived from the McCance and Widdowson's food composition database and these were then summed, weighted according to their percentage contribution to the category and portion size, and the composite value multiplied by the frequency of consumption of the beef group in the FFQ. These nutrient values were then used in

calculating two of the healthy eating indices: NSP and FAT. Fruit and vegetable intake was measured in grams, and thus did not rely on nutrient values for the index.

4.6.5.2 Development of healthy eating indices

Three indices of the quality of dietary intake (with reference to current nutritional recommendations),[127] were developed using data from the food frequency questionnaire (FFQ):

- Total fruit and vegetable consumption (in grams) per week (F&V)
- Percentage of dietary energy derived from fat (FAT)
- Non-starch polysaccharide consumption (in grams) per week (NSP)

The fruit and vegetable index summed all relevant items from sections 28 (fruits) and 29 (vegetables) of the FFQ (except soya protein, textured vegetable protein (TVP) and tofu (meat alternatives)), as well as vegetable soup and tomato based sauces from section 26 (Appendix 3). People were asked to estimate their consumption of fruits when in season. Thus, for example, amounts of soft, summer fruits (peaches, plums, strawberries, raspberries etc.) were divided by three prior to inclusion in scores, so as to avoid over estimating 'usual' intake (i.e. averaged over the whole year).[137]

The FAT and NSP indices were estimated by summation of the estimated nutrient intakes of all items in the FFQ, weighted according to typical consumption frequencies and portion sizes, as indicated above.

The indices were used to assess relative consumption, rather than absolute values. The distributions of the indices were first tested for normality. All three were found to be significantly skewed. The indices were therefore transformed by converting each to a Z score (a normalized distribution with a mean of zero and standard deviation of one, calculated by estimating the number of standard deviations of a value from the mean of the original variable). Thus, negative values indicate a value on the original scale below the mean, and a positive value indicates a positive value on the original scale above the mean.

4.6.5.3 Dealing with missing data

Missing data is a common problem in self-completion surveys and a protocol was therefore derived for managing missing data. At the outset, the extent of missing data was assessed for all variables.

The overriding principle was to retain as much data for analysis as possible at each stage. Thus, in univariable analyses, including simple cross-tabulations and correlations, cases with

missing data were excluded for each analysis in a case-wise basis and the base number from which results are calculated is given in the tables, figures and text as appropriate.

Where composite variables were created (see section 4.5.5.4), median values were imputed for missing values of constituent variables in order to enable calculation of the composite indices in most cases. However, if all relevant data for constituent variables were missing, then the composite variable was not computed and the case was coded as 'missing'.

For calculation of the three dietary indices, the following rules were applied:

- For missing data on each of the FFQ variables, median values for the whole population were substituted, with the following exception: cases with more than 10% of missing data (i.e. 13 or more of the 134 food items) were excluded from analysis in order to avoid scores excessively based on imputed values.
- Individuals were also excluded if they reported consuming more than 2000g of fruit and vegetables per day *and* more than 50g of non-starch polysaccharide (NSP) per day, since these were considered implausibly high consumption levels (average value for fruit and vegetables in the National Diet and Nutrition Survey, 2002 were 216g (for men) and 232g (for women), and for NSP were 15.2g (for men) and 12.6g (for women)[7 169]).

As a consequence of these rules, the base (denominator) number for the univariable and multi-variable analyses differs according to data completeness for the variables concerned, with fewer cases available for more complex, multivariable analyses. However, this strategy maximised the data available for each analysis.

4.6.5.4 Development of composite and recoded variables

The individual and household data sets were matched and merged to create one data set containing data on individuals within their households. A number of new variables were created as follows.

Adult equivalence

In order to enable fair comparisons of a number of social variables by household, two variables were created. The reported numbers of adults and children in households were summed to create a variable for the number of persons per household. In addition, a standard formula for 'adult equivalents'[170] in a household was also computed as follows, which counts additional adults beyond the first as 0.7 and each child as 0.5:

Adult equivalents in households = 1 + (0.7 x additional adults) + (0.5 x children)

This index takes into account the marginal impact (on available resources) of each additional household member and was thus used as a denominator for calculation of comparable household income, the socio-economic index (see below) and weekly cost of food shopping for households.

Household composition

Data on the numbers of adults and children in each household were also used to create a composite variable for the household composition, with the following categories: one adult; two adults; three or more adults; one adult with one or more children; two or more adults and one or more children.

Density within households

The number of persons per room was computed for all households and a variable for over-crowding was created using the Census definition (more than 1.5 persons per room).[144] For this purpose, rooms included all bedrooms and living rooms, excluding small kitchens, hall and stair ways and bathrooms, as per the Census definition.[144] Variables were also created for the number of rooms per household and the number of rooms per person or adult equivalent.

Income

Income was recorded in one of eight categories (see Appendix 2) developed and tested in our pilot studies (see Appendix 4 and Appendix 5). The mid-point value of each category was used (and a value of £35000 per annum for the highest, open-ended, category) to assign an estimated income to each household. The number of adult equivalents (see above) was then divided by this to produce an estimated household income per adult equivalent. This is a semi-continuous variable, which was divided into five equal sized groups (fifths) by quintiles for analytical purposes. The fifths are shown in Table 4.

Table 4: Values for fifths of annual household income per adult equivalent

	Estimated annual household income per adult equivalent (£)
1. Lowest fifth	0 – 7499
2.	7500 – 12499
3. Middle fifth	12500 – 17499
4.	17500 – 27499
5. Highest fifth	27500 or more

After exploring the socio-economic position of those who did not respond to the income question using a range of variables (occupational group, household tenure, car ownership, standard of living index (see below) and educational attainment), median substitution was undertaken for this variable (i.e. missing values were recoded to the middle fifth).

Proportion of income spent on food

To determine the proportion of income spent on food, the reported weekly cost of food shopping per adult equivalent was multiplied by 52 and then divided by the reported annual household income per adult equivalent and expressed as a percentage. The median estimated cost of food per adult equivalent per year was £1348 (IQR £1040-1820), with a minimum value of £120/year and a maximum value of £5200/year. The percentage of annual income per adult equivalent spent on food ranged from 1.16% to 416% (median 17.8%, IQR 11.6%-27.7%). Values at the upper and lower extremes of both distributions are unlikely to be true (i.e. unfeasibly large or small). However, as it was impossible to correct or adjust people's responses in a way that is valid, all cases were used in the analyses, accepting that they are indicators of relative spend, and both annual cost of food shopping and annual percentage of income spent on food were recoded into fifths, as shown in Table 5.

Table 5: Fifths of the cost of food shopping per adult equivalent per year and percentage of household annual income per adult equivalent spent on food

	Cost of food shopping per adult equivalent per year (£)	% household annual income per adult equivalent spent on food
1. Lowest fifth	120.00 – 1040.00	1.16 - 10.4
2	1040.01 – 1223.50	10.5 – 14.9
3. Middle fifth	1223.51 – 1529.40	15.0 – 20.8
4	1529.41 – 1835.30	20.9 – 31.2
5. Highest fifth	1835.31 – 5200.00	31.3 – 416.0

Standard of Living Index

A standard of living index (SLI) was created by combining responses to the 18 items of question 26 in the Household Questionnaire (see Appendix 2). Each item was scored one, with a total possible score of 18 for households that owned all items. Fifths of the SLI were computed with the values shown in Table 6.

Table 6: Values of fifths of standard of living index

	Standard of Living Index (SLI) value
1. Lowest fifth	0-12
2.	13
3. Middle fifth	14-15
4.	16
5. Highest fifth	17-18

The seven kitchen items (cooker, dishwasher, fridge, freezer, grill, toaster and microwave) were used to create a sub-score (SLI-Cook). SLI-Cook was recoded into a binary variable: households with a score of 2 or less were classed as having less adequate facilities and those with a score of 3 or more as having adequate facilities, since having cold storage (a fridge) and cooking facilities (a cooker or microwave) was considered a minimum standard to enable regular and safe food preparation.

Socio-Economic Index

A Socio-Economic Index (SEI) was created to reflect broadly each household's access to resources. This was based on the theoretical principles used to construct the TDS,[4] but made use of the wider range of data available within the household survey, thus providing a wide-ranging index of each household's access to material and capital resources and revenue. The items shown in Table 7 were summed with equal weight.

Table 7: Variables used to calculate the socio-economic index (SEI)

Variable	Score range (values)
Fifths of Standard of Living Index	1, 2, 3, 4, 5 (see above)
Cars owned	1(0), 2(1), 3(2), 4(3), 5 (4 or more cars)
Household Tenure	1 (rented accommodation), 3 (others and unknown), 5 (owned or mortgaged)
Fifths of the number of living rooms in the home (excluding small kitchens, bedrooms, bathrooms and hallways)	1(0-3), 2(4), 3(5), 4(6), 5(7 or more rooms)
Fifths of household income	1, 2, 3, 4, 5 (see above)
Member of household receiving state benefits (excluding state pension)	1 (on benefits), 3 (others and unknown), 5 (not on benefits)
Total possible score range	6 - 30

The SEI has an overall mean of 19.0 (SD=5.8). Fifths of the SEI were calculated and assigned as shown in Table 8. The SEI correlates well with other socio-economic variables at area level, such as the TDS for place of residence (Pearson, 2-tailed R=-0.60, P<0.0001) and at individual level, such as individual educational attainment (ANOVA F=160.4, P<0.0001), but provides a socio-economic indicator at household level, derived from the data collected from participating households.

Table 8: Values of fifths of the socio-economic index

	Socio-Economic Index (SEI) value
1. Lowest fifth	6 – 13
2.	13.1 – 18.0
3. Middle fifth	18.1 – 21.0
4.	21.1 - 25
5. Highest fifth	25.1 - 30

Body Mass Index

Self-reported height and weight were used to calculate Body Mass Index (BMI) (weight (kg) / height $(m)^2$). This was converted into international standard categories as follows: Obese (BMI ≥30), Overweight (BMI 25 – 29.9), Ideal Weight (BMI 20 – 24.9), Underweight (BMI <20).[171]

Alcohol consumption

Responses to questions on alcohol consumption (Questions 59 and 60, Individual Questionnaire, Appendix 3) were used to create a variable to indicate categories of consumption as shown in Table 9.[172]

Table 9: Definitions of the categories of alcohol consumption[172]

	Men	Women
Safe alcohol consumption	Less than 22 units per week	Less than 15 units per week
Risky alcohol consumption	22 to 50 units per week	15 to 35 units per week
Hazardous alcohol consumption	More than 50 units per week	More than 35 units per week

Physical activity

Physical activity was measured using two questions in the individual survey (See Questions 55 and 56, Individual Questionnaire, Appendix 3), adapted from questions previously used in the Newcastle Health & Lifestyle Survey.[151 154] The first asked about usual daily activity at work or otherwise. The second asked respondents to record the usual number of hours spent per week undertaking mildly energetic, moderately energetic and vigorous activities. Examples were given of each type of activity. Mild and moderate activities included types of housework and DIY activity, as well as some leisure/sports activities. Vigorous activities included more strenuous leisure activities or sports. These three variables were combined in an overall activity score, giving less weight to mild and moderate activity, as follows:[154]

Activity score = hours mild activity/3 + hours moderate activity/2 + hours vigorous activity

This score has a range of 0– 86, median 4.5 (IQR: 2.3-8.3). It was divided into fifths as shown in Table 10.

Table 10: Values of fifths of the overall physical activity score

	Physical Activity Score
1. Lowest fifth	0 – 1.83
2.	1.84 – 3.5
3. Middle fifth	3.6 – 5.7
4.	5.8 – 10.0
5. Highest fifth	10.1 – 86.0

Nutritional knowledge

Nutritional knowledge was assessed using a short version of the validated Nutritional Knowledge Questionnaire.[157 158] This section contained three questions relating to expert recommendations on healthy eating, four questions relating to the nutritional content of foods and two questions relating to the links between diet and disease (see Appendix 3). Correct answers to the twenty items were scored 1 point (incorrect=zero) and summed to give an overall score for nutritional knowledge (range 0-20, mean 12.56, SD 3.35),[157 158] which was further recoded into fifths as shown in Table 11.

Table 11: Values of fifths of the nutritional knowledge score

	Nutritional Knowledge Score
1. Lowest fifth	0 - 10
2.	11 – 12
3. Middle fifth	13
4.	14 - 15
5. Highest fifth	16 - 20

Eating out

A score for eating outside the home was created by first assigning scores to the frequencies of eating out from question 51 in the individual questionnaire as approximate factions of a week as follows: never or hardly ever = 0.1; once a month = 0.23; once or twice a week = 1.5; most days = 5.5. These scores for the six eating out options were then summed to give an overall score with a possible range of 0.6 to 33.0 (mean = 3.0 (SD = 2.8), median = 2.1 (IQR = 2.8)).

4.7 Integration and analysis of data sets

The Individual Questionnaire, Household Questionnaire and Retail Survey were linked using the Statistical Package for Social Sciences (SPSS) (V11.0-V15.0, SPSS Inc. Chicago, Ill, 2002-7). Individuals and households were matched using unique identification numbers. Retail

data were then added, matched using the retail survey unique identifier for the main food shop nominated by the HQ respondent, enabling analysis of the characteristics of retail outlets in relation to the people who shop in them.

The survey information was linked to the geographical information - the Census (TDS) and road network data - by using the grid reference of the respondent's home or shop as appropriate (see above).

4.7.1 Development of travel distance variables for food shopping and proximity mapping

Distance variables relating households to their main food shop, nearest food shop, nearest shop selling 10 fruit and vegetables and other food baskets were calculated as linear ('as the crow flies') distances between home and shop grid references.

Proximity mapping, which shows the relationship between residential areas and a range of shop types, was undertaken in ArcInfo (ArcInfo PC v7.1, ESRI, Redlands, CA) by measuring linear distance from each shop to all nodes (junctions and changes of direction) on the digitised road network. This procedure was used to produce maps on which all roads are coloured according to their distance from a specified set of shops (e.g. those selling 10 fresh fruit and vegetables). Distance parameters of 250, 500, 750 and 1000 metres were used for illustrative purposes.

4.7.2 Spatial analysis of dietary patterns, retail food access and socio-economic data

To explore the relationships between individual characteristics (e.g. dietary intake) and neighbourhood environmental characteristics (e.g. availability of retailed fruit and vegetables), variables were created for relevant parameters in 500m 'buffer zones' (a 500m radius) around each household. In practice, each radius was measured from the household's unit postcode (+50m North, +50m East). Thus, all households in the same unit postcode have identical values for variables at the 500m buffer level. Data on food availability and cost in 500m buffer zones were derived from all relevant stores whose location (grid reference) fell within the relevant 500m radius. Thus, for example, to explore the relationship between fruit and vegetable consumption and local availability of fresh fruit and vegetables, two parameters were estimated:

- the maximum number of fresh fruit and vegetables (out of 10) available in any single shop within a 500m radius of each household

- the total number of fresh fruit and vegetables (out of 10) available within a 500m radius of each household in any number of shops.

Similar parameters were estimated for other elements of the 33 item shopping basket (for a full list of variables used in integrated analyses, see Table 93, Appendix 6).

Mean TDS was also estimated for all 500m buffer zones around households. To achieve this, Census data at ED level were aggregated for all EDs for which the centroid fell within the 500m radius. TDS was then calculated, standardised to England and Wales, for each aggregated cluster of EDs approximating to the 500m buffer zone, using standard methods.[4]

Analyses of the relationship between the spatial distribution of retail access indicators and dietary patterns were conducted using multivariable statistical methods, which are explained further below. In these analyses the term 'neighbourhood' is used to denote 500m radius buffer zones around households (and the data relating to these areas).

4.8 Statistical analyses

Firstly, to assess the robustness of the data for answering the primary research question, descriptive analyses were undertaken. Next the secondary research questions were addressed in order to provide contextual information to aid interpretation of the main analyses. Finally the main (primary) analysis was undertaken, using multivariable techniques. Throughout, analyses were informed by a hypothesised causal model (Figure 7), derived from that illustrated in Figure 2, Chapter 2, but with the addition of specific variables available in the datasets collected for this study (in blue text). It thus indicates the potential relationships between variables analysed in the multivariable models. Variables shown in Figure 6 that were entered as dependent and independent variables in the single and multilevel models are listed in full in Table 93, Appendix 6.

4.8.1 Descriptive analyses

Descriptive analyses were undertaken using the Statistical Package for Social Sciences (SPSS) (V11.0-V15.0, SPSS Inc. Chicago, Ill, 2002-7). Initial analysis of the Retail, Household and Individual data sets employed descriptive analyses, such as simple frequencies, cross-tabulations and estimation of mean or median values (and standard deviation or inter-quartile ranges) and tests for normality of distributions of continuous variables. Parametric and non-parametric tests were applied as appropriate to test statistical significance and assess correlations, although these have been used sparingly.

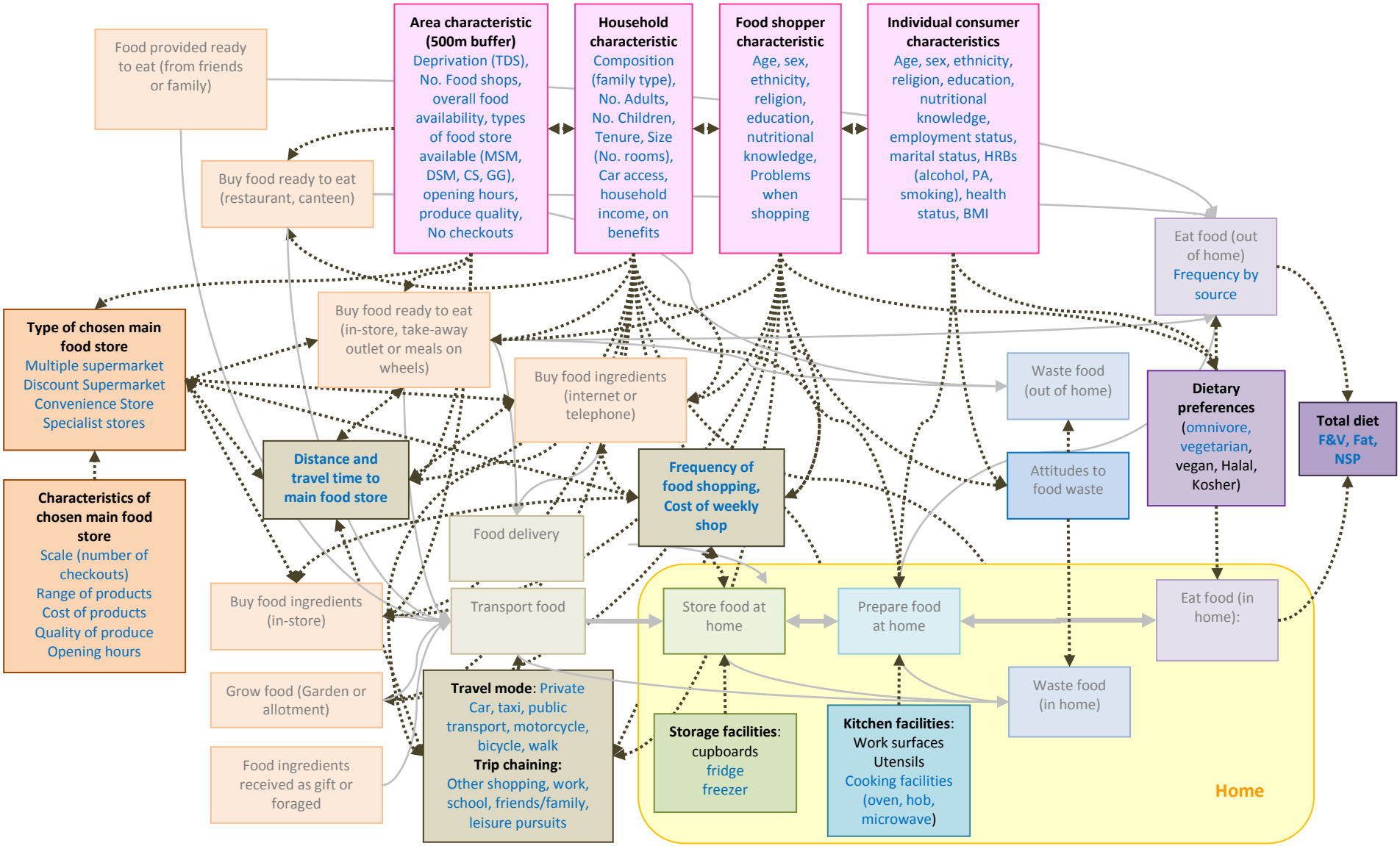
4.8.2 Multivariable analyses

To explore independent associations between key dietary outcomes and plausible causal factors, whilst controlling for potential confounding factors, simple linear (ordinary least squares) regression analyses were first conducted, as appropriate, in (SPSS V10.0-15.0, SPSS Inc. Chicago, Ill, 2001-2008) or SAS (SAS Statistics (v8.2), SAS Institute Inc. Cary, NC),[173] using the forward stepwise method. A significance level of 5% was used as a guide as to whether a variable should be added to and retained in a model. In addition to the main effects, all two-way interactions were explored. Thorough model checking was carried out and the final models were re-run omitting probable outliers. When potential multilevel relationships were identified (i.e. putative causal factors at two or more of individual, household or neighbourhood levels), multilevel regression models were also constructed using MLwiN (v2.02, Centre for Multilevel Modelling, University of Bristol).[174] The three composite dietary indices (F&V, FAT, NSP), were entered as dependent variables in separate multilevel models, based on the hypothesised causal model illustrated in Figure 7, as follows.

Three level random intercepts variance components models were constructed. Any variation remaining in the data, after taking account of possible explanatory variables, was partitioned into individual, household and neighbourhood levels and compared. All continuous independent variables were grand mean centred. Firstly, a null model was fitted, which partitioned the variance in the outcome variable (F&V, FAT or NSP) into that due to differences between individuals within households, that due to differences between households within neighbourhoods, and that due to differences between neighbourhoods. The null model was then extended by first fitting individual level variables and plausible interactions between individual level variables, then household level and finally neighbourhood level variables, along with associated interaction terms.[125] Improvement in the fit of these hierarchical models, due to successive inclusion of the fixed effect variables, was assessed using the deviance statistic. Missing data were deleted listwise. Model fit was assessed using residual diagnostics in MLwiN.[174]

P-values for the fixed effects were calculated using tail probabilities from the Normal distribution. The significance of each of the household and neighbourhood random intercepts was assessed by comparing the change in deviance, with and without the particular random part, to a χ^2 distribution with 1df and halving the resulting tail value.[125]

Figure 7: Data available at individual, household and area levels influencing the behaviours involved in food consumption



Section 2 – Results & Discussion

In this section of the thesis, the results are presented and discussed. The results of each element of the fieldwork are presented in Chapter 5 (retail survey) and Chapter 6 (Household and Individual surveys). In Chapter 7, the results of integrated analyses, drawing on the merged data sets are presented. In presenting the results, the secondary research questions are answered for the most part in Chapters 5 and 6, *en route* to the presentation of findings to answer the primary research question in Chapter 7. The findings are summarised in relation to the research questions at the start of Chapter 8, and then discussed in relation to the methodological strengths and weaknesses of the study, as well as existing knowledge. Finally, the implications of the findings for policy and research are discussed.

5. Results of the retail survey

In this chapter, the findings from the retail survey are presented with the aim of determining whether 'food deserts' exist, and if so in what form.

5.1 Response rate

A total of 622 shops were identified by observation within Newcastle, of which 59 turned out to be permanently closed or had changed their business, 6 did not sell any food and 33 refused to participate in the survey. The majority of shops that refused to take part were butchers; the survey took place during the foot and mouth disease epidemic in the UK. Thirty six food stores, including eight large supermarkets outside Newcastle, were identified by householders as their main food store, and thus were also subsequently surveyed. Thus, 560 shops were surveyed for the availability and cost of 33 food items.

5.2 Type of retail food outlets

The types of store are shown in Table 12. The largest single category was convenience stores (216). There were 20 multiple and 18 discount supermarkets, 47 greengrocers and 58 bakeries, and 106 primarily non-food stores, which sold at least one of the 33 food items surveyed. There were three street market stalls with regular pitches. There were also a number of permanent 'stalls' within a covered market but these have been counted as shops within the appropriate category (e.g. greengrocers).

Table 12: Type of shops surveyed

Type of shop	Number of shops	%
General food stores		
Supermarkets	38	6.8
Multiple supermarkets	20	3.6
Discount supermarkets	18	3.2
Department store	2	0.4
Freezer centre	13	2.3
Convenience store	216	38.6
Local discounter	14	2.5
Specialist food stores		
Bakery	58	10.4
Greengrocer	47	8.4
Butcher	27	4.8
Specialist and Ethnic food stores	16	2.9
Delicatessen	10	1.8
Fishmonger	6	1.1
Health Food store	4	0.7
Street market stall	3	0.5
Primarily non-food stores		
News Agency or Post Office	58	10.4
Petrol Station	24	4.3
Off Licence	13	2.3
Pharmacy	7	1.3
General store	4	0.7
Total	560	100

5.3 Geographic distribution of shops

The geographical distribution of the 560 shops is shown in Figure 8. Shops were fairly evenly distributed in built up areas, although there were some areas less well served than others, particularly in the north and west of the city (although these are less densely populated areas), and a concentration of shops in the city centre.

To give an indication of the distribution of food stores at a smaller spatial scale, Table 13 Shows the distribution of surveyed stores in the 26 parliamentary wards of Newcastle (geographical scale: 3100-5900 households) (see map in Figure 4 for ward boundaries). The number of food stores per 1000 households (mean 4.6, range 1.7-31.3) and general grocery stores (multiple and discount supermarkets, department stores, convenience stores and freezer centres) per 1000 households (mean 2.3, range 0.9-7.4) are shown, as well as the number of

checkouts per 1000 households, as a measure of retail volume. Wards containing main shopping centres or high streets (e.g. West City, containing the city centre, and Byker, containing the Shields Road high street) or containing a large supermarket (e.g. Blakelaw, containing a Tesco Superstore) had larger numbers of checkouts per 1000 households, and per shop.

Figure 8: Geographical distribution of 560 food retail outlets in and around Newcastle upon Tyne

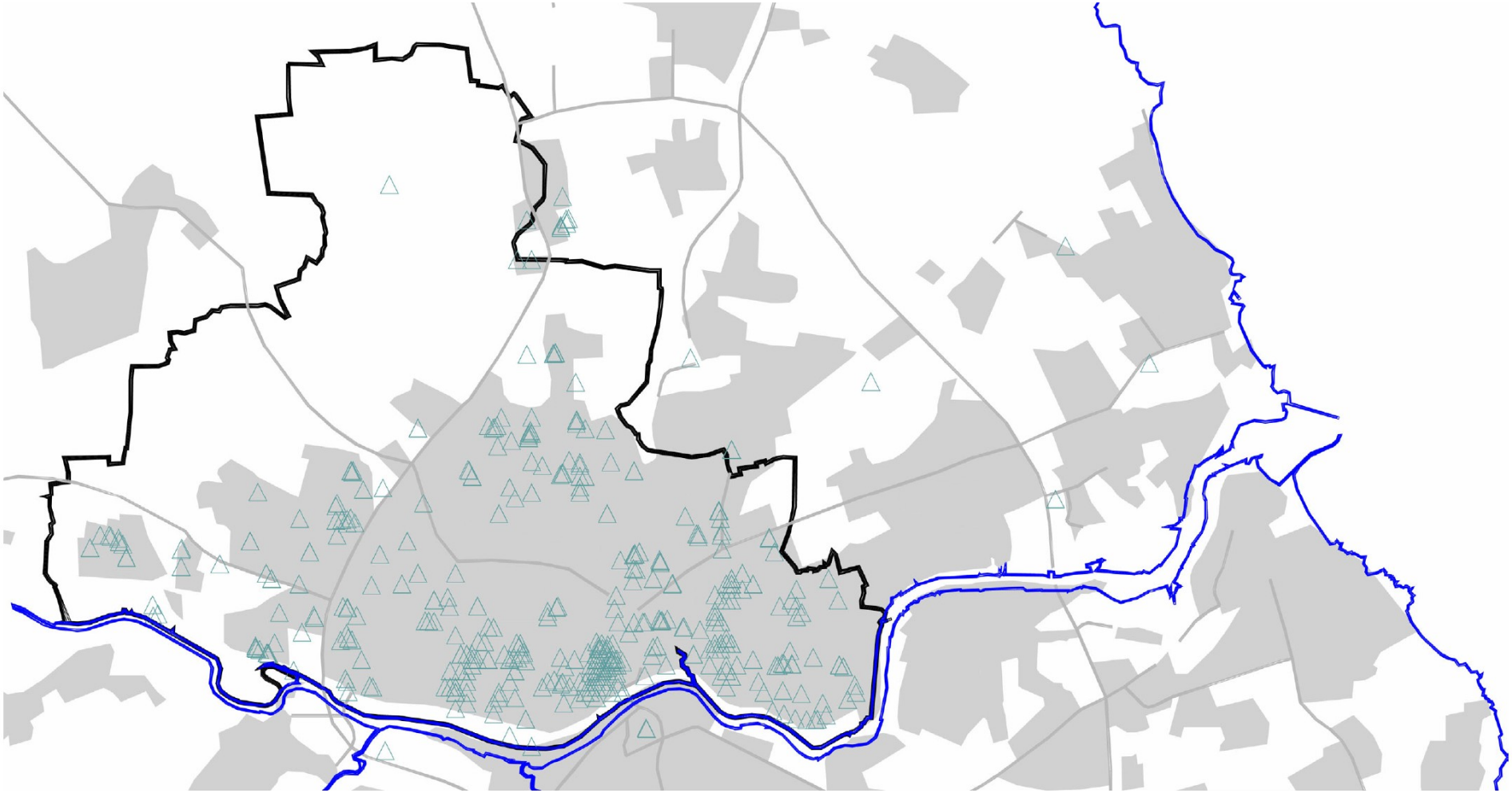


Table 13: Distribution of shops by ward and by category

	Multiple Supermarket	Discount supermarket	Department store	Convenience store	Freezer centre	Local discounter	Bakery	Greengrocer	Butcher	Specialist and Ethnic stores	Delicatessen	Fishmonger	Health Food store	Market stall	News Agency or Post Office	Petrol Station	Off Licence	Pharmacy	General store	All stores	Total number of checkouts	Ward Population	Total stores/1000 Households	Grocery stores/1000 Households	Checkouts/ 1000 households	Checkouts /shop
South Gosforth		1		6			4	2		1	1		1		3		1		1	21	29	4300	4.9	1.6	6.7	1.4
Westerhope		2		6			1	1	1						2	1				14	26	5400	2.6	1.5	4.8	1.9
Castle				4				1	1		1				1					8	7	4700	1.7	0.9	1.5	0.9
Dene	2			7	1			2	2		1				2	2	1			20	42	5900	3.4	1.7	7.1	2.1
Jesmond	1			7			4		1		1				1	1				16	27	4400	3.6	1.8	6.1	1.7
Grange	1	1		6		1	1	1							1	2				14	53	5500	2.5	1.6	9.6	3.8
Lemington				9			1		1						2	1				14	15	4200	3.3	2.1	3.6	1.1
Heaton		1		14				2	1	2					1		1			22	26	4800	4.6	3.1	5.4	1.2
Denton		2		2	1	2	1	1	1						3		1			14	25	4400	3.2	1.6	5.7	1.8
Walkergate				8																8	8	4500	1.8	1.8	1.8	1.0
Newburn	1			9		1	1	1	1						2	2		1		19	29	4100	4.6	2.7	7.1	1.5
Fenham	1			10	1	1	2	1									2			18	23	4600	3.9	2.8	5.0	1.3
Blakelaw	1	1		3			1	1								3				10	71	5000	2.0	1.0	14.2	7.1
Kenton		1		3			1	1			1				2	1	1			11	12	4600	2.4	0.9	2.6	1.1
Wingrove	1			12		1	2	3	1	2					2					24	43	4100	5.9	3.4	10.5	1.8
Sandyford				14						1	1					2	2			20	21	5100	3.9	2.7	4.1	1.1
Fawdon				5			1								1	1				8	11	4500	1.8	1.1	2.4	1.4
Woolsington				3				1	1											5	5	3500	1.4	0.9	1.4	1.0
Benwell				7		1	1				1				2	1				13	13	3600	3.6	2.2	3.6	1.0
Byker	1	3		4	2	2	6	6	5			1			4	1				35	51	4400	8.0	2.7	11.6	1.5
Moorside				7				2							3		1	1		14	20	4300	3.3	1.6	4.7	1.4
Elswick		2		12	1	1	3	3	1	2					1	3		1		30	47	3900	7.7	4.1	12.1	1.6
Scotswood	1			9	2		1	1		1					1					16	25	3100	5.2	3.9	8.1	1.6
Monkchester		1		11	1	1	1								1					16	21	4100	3.9	3.4	5.1	1.3
Walker		1		8	1		1	4							1					16	22	4000	4.0	2.5	5.5	1.4
West City	2	1	2	20	1	2	21	12	8	7	3	5	3	3	18	2	2	4	2	118	231	3800	31.1	7.4	60.8	2.0
All Newcastle	12	17	2	206	11	13	54	46	25	16	10	6	4	3	54	23	12	7	3	524	903	114800	4.6	2.3	7.9	1.7
Out of Newcastle*	8	1		10	2	1	4	1	2						4	1	1		1	36	242					6.7
All shops in survey	**20**	**18**	**2**	**216**	**13**	**14**	**58**	**47**	**27**	**16**	**10**	**6**	**4**	**3**	**58**	**24**	**13**	**7**	**4**	**560**	**1145**					2.0

* shops used as a main food store by respondents to the HHQ

To explore whether there were any patterns with regard to socio-economic characteristics of the areas where stores were located, the distribution of shops by TDS of the ED in which they were located was analysed (Table 14). This showed that, overall, shops were predominantly located in more affluent areas (mean TDS=2.6) than the average for Newcastle (Overall mean TDS for Newcastle EDs is 5.09, with a positive score above this indicating greater than average deprivation for the city). Multiple supermarkets, delicatessens, health food stores, petrol stations, off-licences and general stores tended to be in more affluent areas, and freezer centres, local discounters, specialist and ethnic food stores, greengrocers and fishmongers tended to be in more deprived areas. However, neither the overall pattern nor paired comparisons between multiple supermarkets (the main type of store used by 70% of shoppers) and other types of stores were significant (ANOVA and t-tests). **Table 14: Minimum, maximum and mean (SD) TDS for ED of store location, by type of store**

	Number	Minimum	Maximum	Mean (SD)
Multiple Supermarket	20	-4.37	9.02	1.03 (3.85)
Discount supermarket	18	-4.37	7.85	1.93 (3.94)
Department store	2	2.52	2.52	2.52 (0.00)
Convenience store	216	-4.69	10.55	2.87 (3.48)
Freezer centre	13	-1.26	7.27	3.19(3.15)
Local discounter	14	-3.12	8.63	4.02 (3.49)
Bakery	58	-4.37	9.81	2.63 (3.87)
Greengrocer	47	-3.89	9.81	3.11 (3.61)
Butcher	27	-4.31	9.81	2.49 (3.78)
Specialist and Ethnic food stores	16	-0.56	9.58	4.17 (3.05)
Delicatessen	10	-3.89	7.53	0.97 (3.37)
Fishmonger	6	2.52	7.00	3.27 (1.83)
Health Food store	4	-2.36	2.52	1.30 (2.44)
Market stall	3	2.52	2.52	2.52 (0.00)
News Agency or Post Office	58	-4.31	9.81	2.65 (3.45)
Petrol Station	24	-6.49	8.63	1.42 (3.88)
Off Licence	13	-3.64	7.85	1.12 (3.30)
Pharmacy	7	-2.37	6.68	2.15 (2.70)
General store	4	-2.36	2.52	0.54 (2.41)
All stores	**560**	**-6.49**	**10.55**	**2.63 (3.54)**

5.4 Availability of 33 food items

Table 15 shows the availability of the overall food basket and baskets of 'healthier' and 'less healthy' items, by type of store. This shows that only the multiple and discount supermarkets and department stores reliably sold a full (or near to full) range of the 33 food items (median numbers available: 33, 31 and 32 respectively). Overall, only 22 shops sold the full range of 33 items, of which 14 were multiple supermarkets, 4 discount supermarkets, 1 department store and 3 convenience stores (one Co-op late shop, one Spar and one independent store).

Convenience stores and freezer centres sold about half of the items (medians: 17 and 18 respectively). Convenience stores sold, on average, the majority of the 'less healthy' items (8/10), but a lower proportion of 'healthier' items (8/21), fruit and vegetable items (3/14) or fresh fruit and vegetables (0/10). The pattern for freezer centres was similar.

The availability of items in specialist food stores and predominantly non-food stores was relatively uniform. Few sold more than half of the total basket or any fresh food items. However, greengrocers and market stalls sold most of the fresh fruit and vegetables, as did the multiple supermarkets, discount supermarkets and department stores. Of the primarily non-food stores, petrol station shops sold the widest range of items (median number = 9).

Table 15: Number and percentage of shops selling all 33 food items (minimum, median, maximum of items available) in food baskets by type of store

	No. of stores	All items (33)	'Healthier' basket (21)	'Less Healthy' basket (10)	All F&V (14)	Fresh F&V (10)
Multiple Supermarket	20	70.0 (32,33,33)	95.0 (20,21,21)	75.0 (9,10,10)	100 (14,14,14)	100 (10,10,10)
Discount supermarket	18	22.2 (22,32,33)	27.8 (11,20,21)	50.0 (6,9.5,10)	44.4 (4,13,14)	50.0 (0,10,10)
Department store	2	50.0 (29,31,33)	50.0 (19,20,21)	50.0 (8,9,10)	100 (14,14,14)	100 (10,10,10)
Convenience store	216	1.4 (2,17,33)	1.4 (0,8,21)	13.9 (2,8,10)	2.3 (0,3,14)	2.6 (0,0,10)
Freezer centre	13	0 (5,18,24)	0 (3,8,14)	15.4 (1,7,10)	0 (1,3,10)	0 (0,0,6)
Local discounter	14	0 (4,8,19)	0 (1,4,9)	0 (1,4,9)	0 (0,2,4)	0 (0,0,2)
Bakery	58	0 (2,4,7)	0 (0,1,3)	0 (1,3,4)	0 (0,0,1)	0 (0,0,1)
Greengrocer	47	0 (6,13,23)	0 (6,11,15)	0 (0,1,7)	0 (6,10,13)	87.2 (6,10,10)
Butcher	27	0 (1,3,12)	0 (0,2,11)	0 (0,1,4)	0 (0,0,10)	3.7 (0,0,10)
Specialist and Ethnic food stores	16	0 (0,3,8)	0 (0,2,17)	0 (0,3,8)	6.3 (0,1,14)	6.3 (0,0,10)
Delicatessen	10	0 (1,5,14)	0 (0,3,10)	0 (1,3,5)	0 (0,1,9)	0 (0,0,7)
Fishmonger	6	0 (0,0,1)	0 (0,0,1)	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)
Health Food store	4	0 (4,6,23)	0 (3,4,16)	0 (0,2,5)	0 (1,1,12)	0 (0,0,9)
Market stall	3	0 (7,10,11)	0 (7,10,11)	0 (0,0,0)	0 (7,10,10)	66.7 (7,10,10)
News Agency or Post Office	58	0 (1,4,8)	0 (0,1,3)	0 (1,4,5)	0 (0,0,1)	0 (0,0,0)
Petrol Station	24	0 (4,9,20)	0 (1,2,9)	0 (3,6,9)	0 (0,1,3)	0 (0,0,0)
Off Licence	13	0 (1,4,5)	0 (0,1,1)	0 (1,3,4)	0 (0,0,1)	0 (0,0,0)
Pharmacy	7	0 (1,5,7)	0 (0,3,3)	0 (1,3,4)	0 (0,0,0)	0 (0,0,0)
General store	4	0 (3,3,4)	0 (0,0,0)	0 (3,3,4)	0 (0,0,0)	0 (0,0,0)
All shops	560	3.9 (0,11,33)	5.0 (0,5,21)	10.2 (0,5,10)	6.4 (0,3,14)	14.6 (0,0,10)

* For definitions of baskets, see methods (section 4.5.1.2)

Table 16 shows the overall availability of the 33 food items in all food stores. The most available items were carbonated drinks (84% of stores) and crisps (79%). Kit Kat, white bread and fruit juice were also available at over 50% of stores. Milk was available in about 61% of stores. Of the frozen or chilled goods, chicken and frozen peas were least available. All fruit and vegetables were available in 20-30% of stores, except broccoli (17%) and onions (32%). The most available fruit and vegetables were onions, tomatoes, apples, oranges and bananas.

Table 16: Number of stores (% of total) selling each of the 33 food items

	No of stores selling item (% of total)		No of stores selling item (% of total)
Fresh fruit & vegetables		**'Less healthy' items**	
Apples	158 (28.2)	Whole milk	340 (60.7)
Oranges	148 (26.4)	Sausages	127 (22.7)
Bananas	141 (25.2)	Tinned meat	245 (43.8)
Tomatoes	161 (28.8)	White bread	296 (52.9)
Cucumber	130 (23.2)	Frosties	175 (31.3)
Lettuce	117 (20.9)	Crisps	443 (79.1)
Peppers	117 (20.9)	Biscuits	233 (41.6)
Broccoli	100 (17.9)	Kit Kat	344 (61.4)
Carrots	127 (22.7)	Carbonated drink	472 (84.3)
Onions	182 (32.5)	White sugar	279 (49.8)
'Healthier' items		**'Neutral' items**	
Pure fruit juice	289 (51.6)	Eggs	273 (48.8)
Frozen peas	104 (18.6)	Full fat cheddar cheese	214 (38.2)
Tinned tomatoes	245 (43.8)		
Baked beans	260 (46.4)		
Semi-skimmed milk	340 (60.9)		
Low fat yoghurt	150 (26.8)		
Chicken	88 (15.7)		
Tuna (in brine)	213 (38.0)		
Pasta	208 (37.1)		
Wholemeal bread	210 (37.5)		
Weetabix	212 (37.9)		

To explore this further, two indices were created for each store – the ratio of the percentage availability of the 11 'healthier' pre-packed items to the percentage availability of the 10 'less healthy' pre-packed items, and the ratio of the percentage availability of the 21 'healthier' items (including fresh fruit and vegetables) to the percentage availability of the 10 'less healthy' pre-packed items – and analysed by category of food store (Table 17). A ratio of more than one (cells shaded blue in table) indicates a better percentage availability of 'healthier' than 'less healthy' foods. Multiple supermarkets, discount supermarkets and department stores, as well as health food stores have better availability of 'healthier' pre-packed items, whilst multiple supermarkets, discount supermarkets, department stores, greengrocers and health food stores have better availability of 'healthier' foods overall. The difference in each of the ratios between all store types was statistically significant (Kruskal-Wallis, both $p<0.0001$). The differences in the ratios were also statistically significant when the general 'grocery' stores (multiple supermarkets, discounters, department, convenience and freezer stores) were

compared ($p<0.0001$). However, in a correlation analysis, the ratios were not significantly related to TDS of shop ED ($p>0.05$) (i.e. there was no relationship between the relative healthiness of foods available and neighbourhood socio-economic circumstances).

Table 17: Median (IQR) ratios of availability of healthy to less healthy foods by type of store

		Ratio of healthy (n=11) to less healthy (n=10) pre-packed foods		Ratio of healthier (n=21) to less healthy (n=10) foods	
	No.	Median	IQR	Median	IQR
Multiple Supermarket	20	1.00	(1.00 - 1.08)	1.00	(1.00 - 1.08)
Discount supermarket	18	1.01	(1.00 - 1.11)	1.00	(0.95 - 1.13)
Department store	2	1.01	(1.00 - 1.02)	1.07	(1.00 - 1.13)
Convenience store	216	0.78	(0.57 - 0.91)	0.43	(0.30 - 0.65)
Freezer centre	13	0.91	(0.78 - 1.20)	0.60	(0.41 - 0.72)
Local discounter	14	0.86	(0.45 - 0.91)	0.45	(0.34 - 0.48)
Bakery	58	0.30	(0.30 - 0.61)	0.20	(0.16 - 0.32)
Greengrocer	47	0.70	(0.56 - 1.36)	2.62	(1.90 - 3.10)
Butcher	27	0.91	(0.91 - 1.82)	0.48	(0.48 - 0.95)
Delicatessen	10	0.58	(0.00 - 0.91)	0.40	(0.00 - 0.71)
Health Food store	4	1.82	(1.27 - 2.73)	1.43	(0.95 - 1.52)
News Agency or Post Office	58	0.23	(0.00 - 0.30)	0.12	(0.00 - 0.16)
Petrol Station	24	0.30	(0.24 - 0.52)	0.16	(0.12 - 0.27)
Specialist and Ethnic food stores	16	0.52	(0.00 - 0.91)	0.36	(0.00 - 1.01)
Off Licence	13	0.23	(0.00 - 0.30)	0.12	(0.00 - 0.16)
Pharmacy	7	0.68	(0.00 - 0.91)	0.36	(0.00 - 0.48)
General store	4	0.00	(0.00 - 0.00)	0.00	(0.00 - 0.00)

Ratio of 'healthy' to 'less healthy' foods > 1

The relative availability across the city of the six 'healthier' and 'less healthy' pairs of items included in the retail survey was also assessed (Table 18). Fresh meats were the least available items and milks the most available. White bread was more widely available than wholemeal bread and shops selling wholemeal bread were more likely to be in more affluent areas, although this was only a weak association (t-test, $p=0.032$). The two types of milk were equally available. Weetabix was more widely available than Frosties and carbonated drinks, sausages and tinned meat more widely available than their 'healthier' counterparts. Tinned tuna was more likely to be available in more affluent areas but this was not statistically significant. Availability of the total basket of 33 items ($Rho=0.004$, $P=0.926$, $N=560$), the 10 fresh fruit and vegetable items ($Rho=0.015$, $P=0.72$, $N=560$) and the 10 'less healthy' items ($Rho=-0.002$, $P=0.965$, $N=560$) were not associated with TDS of the store location.

Table 18: Number (%) of shops and mean TDS of shop ED (SD) for shops selling six pairs of healthy and less-healthy items

	No. of shops selling item	(%)	Mean TDS of shop ED (SD)
Neither	187	(33.4)	2.5 (3.5)
Only semi-skimmed milk	33	(5.9)	1.4 (3.6)
Only full fat milk	33	(5.9)	3.1 (3.6)
Both	307	(54.8)	2.8 (3.6)
Neither	332	(59.3)	2.0 (3.3)
Only Weetabix	53	(9.5)	2.5 (3.4)
Only Frosties	16	(2.9)	2.6 (3.9)
Both	159	(28.4)	2.9 (3.8)
Neither	262	(46.8)	2.6 (3.3)
Only wholemeal bread	2	(0.4)	2.5 (0)
Only white bread	88	(15.7)	3.5 (3.5)
Both	208	(37.1)	2.3 (3.8)
Neither	74	(13.2)	3.0 (3.4)
Only fruit juice	14	(2.5)	1.8 (3.1)
Only carbonated drink	197	(35.2)	2.6 (3.5)
Both	275	(49.1)	2.6 (3.6)
Neither	423	(75.5)	2.5 (3.5)
Only chicken	10	(1.8)	3.8 (4.5)
Only sausages	50	(8.9)	2.5 (3.6)
Both	77	(13.8)	1.9 (3.5)
Neither	299	(53.4)	2.5 (3.4)
Only tinned tuna	16	(2.9)	0.5 (2.5)
Only tinned meat	48	(8.6)	2.8 (3.7)
Both	197	(35.2)	2.9 (3.5)

The relationship between availability and size of store, measured by number of checkouts, was also explored. Total number of foods available (out of 33) was positively correlated with number of checkouts (Spearman's Rho=0.237, P<0.0001, N=541). Number of checkouts was also positively correlated with availability of fresh fruit and vegetables (Rho=0.288, P<0.001, N=541) and number of 'less healthy' items available (Rho=0.137, P<0.001, N=541).

5.5 Cost of 33 food items and 'healthier' and 'less healthy' food baskets

Table 19 shows the minimum, maximum and median costs of each of the 33 food items surveyed in shops where they were available (i.e. without imputation for missing data). The most striking finding is the huge variation in price for many of these basic, frequently consumed items across the city. The coefficient of variation is greatest for fruit juice, frozen peas, chicken, sausages and white bread and lowest for Kit Kat, carbonated drinks, crisps, Frosties and Weetabix.

The distributions of price for many items were bi- or multi-modal, suggesting either that there were different pricing strategies in different stores, or that multiple brands (including, for example, own-brand lines) had been costed in different stores (e.g. Tesco 'Finest' versus Tesco Value' products). Most striking amongst these were several fruit and vegetables (oranges, cucumbers, lettuce, frozen peas, peppers, broccoli, carrots, tinned tomatoes and baked beans), dairy produce (milk and yoghurt), meats, breads, crisps, sugar and fruit juice. Foods with a uni-modal distribution included apples, onions, cheese, eggs, Frosties, Kit Kat, biscuits, carbonated drinks and pasta.

To explore this further, the price variability of individual food items by type of store, for the main categories of retail outlet was examined (Table 20). The shading highlights the cheapest (orange) and most expensive (blue) item prices by type of store. This shows that discount stores were cheapest for the largest number of items (17), predominantly pre-packed goods. News agencies were most expensive for five out of eight of the items they sold, but convenience stores had the largest number of highest prices overall (11).

Table 19: Minimum, maximum and median (IQR) cost and coefficient of variation in price of 33 food items surveyed in stores where item was available (with no cost imputation)*

	Cost of items in pence				Coeff. Var. % (IQR/Median)
	Minimum	Maximum	Median	(IQR)	
Fresh fruit and vegetables					
Apples	40	253	108	(77-129)	48.2
Oranges	25	200	98	(67-124)	58.2
Bananas	27	199	108	(86-108)	20.4
Tomatoes	30	306	121	(99-159)	49.6
Cucumber	79	380	163	(133-215)	50.3
Lettuce	143	1064	421	(321-564)	57.7
Peppers	100	567	274	(213-372)	58.0
Broccoli	44	396	174	(118-211)	53.5
Carrots	20	165	79	(55-99)	55.7
Onions	20	358	59	(43-75)	54.2
''Healthier' items					
Pure fruit juice	9	99	22	(17-35)	81.8
Frozen peas	32	432	131	(76-200)	94.7
Tinned tomatoes	7	79	30	(21-35)	46.7
Baked beans	9	91	33	(25-39)	42.4
Semi-skimmed milk	22	138	70	(61-80)	27.1
Low fat yoghurt	7	72	25	(21-29)	32.0
Chicken	99	658	214	(148-334)	86.9
Tuna (in brine)	23	115	69	(49-79)	43.5
Pasta	12	318	55	(45-69)	43.6
Wholemeal bread	14	200	85	(59-94)	41.2
Weetabix	12	169	85	(73-89)	18.8
'Less healthy' items					
Whole milk	22	130	70	(61-79)	25.7
Sausages	97	1450	304	(181-394)	70.1
Tinned meat	39	221	99	(79-119)	40.4
White bread	15	158	58	(32-80)	82.8
Frosties	77	247	185	(159-185)	14.1
Crisps	7	46	29	(27-30)	10.3
Biscuits	10	135	46	(42-58)	34.8
Kit Kat	16	99	30	(28-31)	10.0
Carbonated drink	13	70	49	(43-50)	14.3
White sugar	49	178	79	(69-89)	25.3
'Neutral' items					
Eggs	25	139	60	(50-69)	31.7
Full fat cheddar cheese	99	1350	595	(459-660)	33.8

*for costing methods, see section 4.5.4

Table 20: Median (minimum, maximum) cost in pence of 33 food items by type of store in shops where item was sold (with no missing cost imputation)*

	Multiple supermarket (20)†	Discount supermarket (18)†	Convenience store (216)†	Freezer centre (13)†	Greengrocer (47)†	News Agency (58)†
Fresh fruit & vegetables						
Apples	109 (69, 155)	90 (52, 130)	119 (40, 253)	55 (55, 55)	84 (44, 160)	N/A
Oranges	109 (44, 199)	99 (40, 173)	96 (44, 200)	64 (31, 97)	64 (25, 176)	N/A
Bananas	108 (85, 149)	95 (82, 130)	106 (27, 198)	N/A	99 (37, 133)	N/A
Tomatoes	109 (88, 185)	114 (73, 206)	127 (30, 306)	120 (119, 121)	117 (42, 196)	N/A
Cucumber	160 (79, 269)	188 (106, 380)	163 (82, 321)	245 (245, 245)	176 (82, 378)	N/A
Lettuce	386 (250, 850)	372 (279, 1064)	425 (143, 964)	357 (357, 357)	425 (214, 929)	N/A
Peppers	360 (168, 567)	262 (140, 450)	269 (152, 421)	N/A	249 (100, 500)	N/A
Broccoli	169 (48, 396)	175 (100, 282)	175 (89, 348)	N/A	161 (44, 282)	N/A
Carrots	69 (44, 114)	74 (39, 121)	66 (24, 165)	N/A	88 (49, 130)	N/A
Onions	69 (32, 93)	53 (42, 89)	56 (20, 358)	42 (42, 42)	59 (27, 139)	N/A
'Healthy' items						
Pure fruit juice	11 (9, 30)	14 (9, 29)	22 (11, 62)	35 (12, 99)	16 (15, 57)	40 (20, 69)
Frozen peas	55 (48, 284)	59 (48, 110)	196 (32, 432)	119 (76, 300)	N/A	N/A
Tinned tomatoes	136 (7, 46)	9 (9, 29)	32 (12, 66)	35 (17, 36)	30 (25, 79)	N/A
Baked beans	136 (9, 54)	9 (9, 24)	33 (15, 78)	36 (18, 38)	33 (33, 39)	N/A
Semi-skimmed milk	49 (47, 58)	49 (22, 78)	72 (34, 138)	54 (45, 84)	50 (44, 76)	79 (54, 130)
Low fat yoghurt	21 (8, 72)	17 (7, 29)	26 (12, 50)	24 (10, 55)	40 (40, 40)	31 (28, 32)
Chicken	226 (108, 658)	183 (142, 498)	250 (119, 545)	249 (124, 332)	392 (349, 435)	N/A
Tuna (in brine)	53 (23, 105)	35 (23, 69)	75 (30, 109)	62 (29, 115)	79 (55, 79)	N/A
Pasta	31 (12, 52)	38 (12, 89)	55 (20, 119)	55 (55, 92)	65 (65, 65)	N/A
Wholemeal bread	51 (38, 65)	49 (29, 79)	87 (42, 173)	60 (39, 118)	85 (85, 85)	N/A
Weetabix	73 (23, 94)	73 (12, 82)	85 (22, 140)	60 (60, 60)	89 (89, 89)	N/A

*for costing methods, see section 4.5.4

† actual number of shops where product was available varied by product analysed

Table 20: Median (minimum, maximum) cost in pence of 33 food items by type of store (continued…)

	Multiple supermarket (20)	Discount supermarket (18)	Convenience store (216)	Freezer centre (13)	Greengrocer (47)	News Agency (58)
'Less healthy' items						
Whole milk	49 (47, 58)	49 (22, 78)	72 (35, 119)	54 (45, 84)	66 (44, 80)	76 (54, 130)
Sausages	159 (97, 398)	131 (99, 484)	379 (129, 573)	190 (121, 500)	N/A	N/A
Tinned meat	83 (39, 138)	54 (39, 99)	99 (49, 221)	75 (51, 99)	99 (89, 156)	N/A
White bread	31 (15, 59)	19 (15, 50)	49 (16, 130)	45 (33, 118)	N/A	N/A
Frosties	155 (124, 193)	135 (77, 238)	185 (99, 247)	193 (135, 198)	149 (149, 149)	N/A
Crisps	27 (8, 30)	27 (7, 29)	29 (10, 45)	11 (7, 15)	12 (10, 28)	30 (10, 40)
Biscuits	34 (16, 49)	28 (10, 54)	49 (28, 135)	31 (30, 49)	45 (45, 45)	59 (55, 62)
Kit Kat	28 (19, 30)	28 (16, 30)	30 (16, 99)	25 (20, 99)	20 (20, 20)	30 (20, 39)
Carbonated drink	35 (13, 48)	25 (14, 45)	48 (17, 70)	35 (19, 50)	47 (14, 50)	50 (28, 69)
White sugar	55 (49, 79)	49 (49, 69)	79 (49, 150)	54 (54, 78)	70 (59, 89)	N/A
'Neutral' items						
Eggs	54 (31, 89)	35 (28, 73)	62 (35, 99)	59 (45, 129)	59 (35, 100)	N/A
Full fat cheddar cheese	339 (259, 543)	369 (259, 675)	596 (176, 945)	442 (374, 748)	596 (99, 596)	N/A

*for costing methods, see section 4.5.4

Table 21 shows the price variation by type of store for the main 'baskets' for those stores that stocked all items in the 'basket' analysed. Only some types of store sold the full basket, mainly multiple and discount supermarkets, department stores and convenience stores, although only limited numbers of stores of each type sold the full basket. Some greengrocers and market stalls sold the full range of fresh fruit and vegetables. The overall median cost of the 33 items was £19.06 (IQR £17.03-20.40), whilst the median cost of the 'less healthy' items was £4.46 (IQR £3.63-5.09) and that of the fresh fruit and vegetables was £6.29 (IQR £5.58-8.08). The cheapest overall basket (all 33 items) was found in the 14 multiple supermarkets and the 4 discount supermarkets that stocked all 33 items. The 'healthier' basket was cheapest in the 14 discount supermarkets, with that available at the 19 multiple supermarkets and the 10 convenience stores stocking the full basket of 11 items more expensive. The 'less healthy' basket was cheapest in 9 discount stores by a wide margin and 15 of the multiple supermarkets were next least expensive. The total basket of fruit and vegetables (14 items) was cheapest in 8 discount stores, closely followed by 5 convenience stores, whilst the fresh fruit and vegetables (10 items) were cheapest at 2 of the market stalls and 41 of the greengrocers. Department stores were most expensive for the fruit and vegetable baskets and the 'healthy' basket. Convenience stores were most expensive for the 'less healthy' basket and all 33 items. Overall, price variation was least for the whole basket of 33 items (coefficient of variation 17.7%) and most for the 'healthier' basket (coefficient of variation 43.9%). There were marked differences in the coefficient of variation between store types. The differences in median basket prices between different store types were striking (e.g. £3.91 difference for all 33 items between a discount supermarket and convenience store, a £2.29 difference in the price of 11 healthier items between discount and department stores, and a £2.37 difference in the cost of 10 fresh fruits and vegetables between market stalls and department stores).

Next, the relationship between cost and TDS of shop ED was explored. Overall cost of all 33 items was not associated with TDS of shop ED for those shops selling all 33 items (Spearman's Rho=0.14, P=0.54, N=22); nor with the cost of the 10 'less healthy' items in all stores selling those (Rho=-0.006, P=0.97, N=57). However, TDS was associated with the cost of the 10 fresh fruit and vegetables in those shops selling all 10, which were more expensive in more affluent areas (Rho=-0.42, P=0.002, N=82). Since most stores stocking all items in the full basket were supermarkets, the relationship between cost and TDS by type of store was not analysed. Cost of all 33 items was negatively associated with number of checkouts (as a marker of store size) in the 22 shops selling all 33 items (Spearman's Rho=-

0.247), but this was not significant (P=0.113). Cost was not significantly associated with quality of fresh fruit and vegetables (see below).

Table 21: Min, max and median (IQR) cost (in pence) and coefficient of variation of items in food baskets in stores stocking the full range of foods in each basket (with no imputation for missing values)

	No. Shops	Cost of items in Pence				Coeff. Var (IQR/ Median)
		Minimum	Maximum	Median	(IQR)	
All items (33)						
Multiple Supermarket	14	1444	2130	1841	(1634-1990)	19.3
Discount supermarket	4	1467	2004	1834	(1532-1988)	24.9
Department store	1	2223	2223	2223	(2223-2223)	0
Convenience store	3	1847	2357	2225	(1847-2357)	22.9
All types of store	22	1444	2357	1906	(1703-2040)	17.7
'Healthier' basket (11)						
Multiple Supermarket	19	253	488	363	(288-409)	33.3
Discount supermarket	14	222	435	275	(252-381)	46.9
Department store	1	504	504	504	(504-504)	0
Convenience store	10	330	667	481	(439-624)	38.5
All types of store	44	222	607	369	(276-438)	43.9
'Less Healthy basket (10)						
Multiple Supermarket	15	307	444	359	(322-415)	25.9
Discount supermarket	9	242	433	283	(263-375)	39.6
Department store	1	446	446	446	(446-446)	0
Convenience store	30	373	850	504	(484-542)	11.5
Freezer Centre	2	410	424	417	(410-424)	3.4
All types of store	57	242	850	446	(363-509)	32.7
All F&V (14)						
Multiple Supermarket	20	558	1066	815	(677-950)	33.5
Discount supermarket	8	601	1174	700	(639-920)	40.1
Department store	2	767	985	876	(767-985)	24.9
Convenience store	5	610	774	731	(639-770)	17.9
All types of store	36	558	1174	768	(652-946)	38.3
Fresh F&V (10)						
Multiple Supermarket	20	525	993	753	(620-919)	39.7
Discount supermarket	9	416	1144	633	(582-773)	30.2
Department store	2	682	882	782	(682-882)	25.6
Convenience store	6	495	816	634	(571-715)	22.7
Greengrocer	41	364	1016	589	(484-706)	37.7
Street market stalls	2	531	559	545	(531-559)	5.1
All types of store	82	364	1147	629	(558-808)	39.7

To explore further which factors were independently associated with cost, a forward stepwise linear regression analysis was undertaken with cost as the dependent variable in those shops selling all 33 items. The following factors, thought potentially causal, were tested for association: type of store, TDS for ED of the store location, total weekly number of hours open, number of checkouts and quality of produce Only one variable remained in the final model: number of checkouts. This was negatively associated with cost and accounted for 19% of the variance in cost of all 33 items (B=-8.4, r^2=0.19, p=0.046).

Given the relationship between the scale of food stores and prices, the existence of 'price flexing' within chains of stores, as highlighted by the competition commission,[34] was investigated. To quantify this phenomenon, price variation was analysed in those chains with more than 3 stores (Table 22). Most of the stores included in this analysis sell the full range of produce, so there is little cost imputation in this analysis. Nevertheless, there is very considerable price variation, both between and within types of store. Overall, Asda was cheapest for the total basket and for the 'less healthy' basket, but Co-op and Safeway were cheaper for fresh fruit and vegetables and for the 'healthier' basket. Tesco was most expensive for the 'healthier' basket and the full basket of items. Overall, Asda was the most expensive for fresh fruit and vegetables. Asda and Tesco had the greatest price variation for the full basket of items but the least variation for the 'less healthy' basket. Co-op had the least price variation overall as well as for fresh fruit and vegetables.

Table 22: Price variation within chains with more than 3 stores (with maximum cost imputation for missing values)

	No. checkouts	Full basket (33 items)		Fresh Fruit and vegetables (10 items)		'Healthier' basket (21 items)		'Less healthy' basket (10 items)	
		No. available items	Median cost (pence)	No. available items	Median cost (pence)	No. available items	Median cost (pence)	No. available items	Median cost (pence)
Asda all stores – median cost (IQR) [Coeff.var.]		1746 (1444-1905) [26.4]		926 (562-944) [41.3]		1212 (846-1223) [31.1]		320 (279-322) [13.4]	
Asda NE3	33	33	1444	10	562	21	846	10	322
Asda NE11	49	32	1746	10	926	21	1212	9	279
Asda NE12	38	32	1905	10	944	21	1223	9	319
Co-op all stores – median cost (IQR) [Coeff.var.]		1969 (1838-2044) [10.5]		715 (629-822) [18.3]		1115 (1086-1325) [21.4]		419 (398-459) [14.6]	
Co-op NE1	8	33	1517	10	525	21	914	10	337
Co-op (late) NE3	3	33	1847	10	715	21	1104	10	503
Co-op (late) NE4	2	30	2607	9	1161	20	1626	8	533
Co-op NE5	5	33	1969	10	659	21	1115	10	385
Co-op NE7	3	32	2204	10	866	20	1333	10	422
Co-op NE13	4	33	1870	10	539	21	1035	10	419
Co-op NE15	10	33	1980	10	750	21	1322	10	403
Co-op NE15	5	33	1990	10	807	21	1310	10	444
Co-op NE28	9	33	1812	10	683	21	1112	10	415
Safeway all stores – median cost (IQR) [Coeff.var.]		1832 (1662-1965) [16.5]		707 (600-751) [21.3]		1110 (1002-1236) [21.1]		415 (365-450) [20.5]	
Safeway NE1	14	32	1980	10	736	21	1251	9	451
Safeway NE4	18	33	1635	10	678	21	992	10	359
Safeway NE6	7	32	1918	10	756	21	1188	9	446
Safeway NE7	16	33	1745	10	573	21	1032	10	384
Tesco all stores – median cost (IQR) [Coeff.var.]		2050 (1500-2116) [30.0]		900 (607-967) [40.0]		1358 (923-1440) [38.1]		326 (319-341) [6.7]	
Tesco NE2	11	33	2050	10	900	21	1358	10	326
Tesco NE3	55	33	1500	10	607	21	923	10	341
Tesco NE8	29	32	2116	10	967	21	1440	9	319

5.6 Quality of foods available

There was considerable variation in the quality of fresh fruit and vegetables available in different types of store. Table 23 shows the number and percentage of shops stocking good quality produce, for the types of store expected to sell some fruit and vegetables. Overall, out of 560 shops, 201 (36%) sold fresh fruit and vegetables. Of these, 82 (41%) sold all 10 fresh fruit and vegetable items, and 57 (28%) sold all 10 with acceptable quality. Thus, of those selling all 10 fresh fruits and vegetables, 57 out of 82 (70%) sold all 10 items with acceptable quality. The only store types where all ten fruit and vegetables were available in 100% of stores were the multiple supermarkets (20) and the department stores (2). The only store type

where all ten fruit and vegetables were available in acceptable quality at 100% of stores was department stores. Multiple supermarkets, greengrocers and market stalls were next best for availability and quality and discount stores and convenience stores were considerably less reliable.

Table 23: Quality of 10 fresh fruit and vegetables by type of store

	No. of stores selling good quality product / No. of stores selling product (%)						
	Multiple supermarkets (20)	Department stores (2)	Discount supermarkets (18)	Convenience stores (216)	Greengrocers (47)	Street market stalls (3)	All stores (560)
Apples	20/20 (100)	2/2 (100)	15/15 (100)	48/58 (83)	47/47 (100)	3/3 (100)	143/153 (94)
Oranges	19/20 (95)	2/2 (100)	15/16 (93.8)	40/49 (81.6)	44/46 (95.7)	3/3 (100)	127/144 (88.2)
Bananas	20/20 (100)	2/2 (100)	10/15 (66.7)	35/49 (71.4)	41/46 (89.1)	3/3 (100)	113/139 (81.3)
Tomatoes	20/20 (100)	2/2 (100)	16/17 (94.1)	50/58 (86.2)	46/47 (97.9)	3/3 (100)	146/156 (93.6)
Cucumber	20/20 (100)	2/2 (100)	16/16 (100)	31/31 (100)	42/42 (100)	3/3 (100)	123/124 (99.2)
Lettuce	20/20 (100)	2/2 (100)	15/16 (93.8)	18/21 (85.7)	42/44 (95.5)	3/3 (100)	105/111 (94.6)
Peppers	20/20 (100)	2/2 (100)	14/14 (100)	19/23 (82.6)	40/45 (88.9)	3/3 (100)	103/113 (91.2)
Broccoli	19/20 (95)	2/2 (100)	13/14 (92.9)	10/11 (90.9)	40/45 (88.9)	2/2 (100)	90/98 (91.8)
Carrots	19/20 (95)	2/2 (100)	15/16 (93.8)	24/34 (70.6)	38/44 (86.4)	2/2 (100)	105/123 (85.4)
Onions	19/20 (95)	2/2 (100)	16/17 (94.1)	65/77 (84.4)	44/45 (97.8)	3/3 (100)	158/175 (90.3)
No. (%) selling 10 fruit & veg	20/20 (100)	2/2 (100)	9/18 (50.0)	6/95 (6.3)	41/47 (87.2)	2/3 (66.7)	82/201 (40.8)
No. (%) selling 10 fruit & veg at 100% quality	17/20 (85.0)	2/2 (100)	4/18 (22.2)	5/95 (5.3)	25/47 (53.2)	2/3 (66.7)	57/201 (28.4)

Percentage of fruit and vegetables of high quality was positively correlated with size of store (measured by number of checkouts (Spearman's Rho=0.221, P=0.002, N=541). Percentage of fruit and vegetables of high quality was also associated with number of fresh fruit and vegetables available in shops selling fresh fruit and vegetables (Spearman's Rho=0.231, P<0.0001, N=201), such that, in practice, 100% quality was only achieved in shops selling at least 7 out of 10 fresh fruit and vegetables. Quality was not significantly associated with availability of all 33 items in stores selling any fresh fruit and vegetables (Rho=0.046, P=0.398, N=201).

Quality was negatively associated with cost in all shops (Rho=-0.24, P=0.001, N=560), but not in those stores selling all 10 fresh fruit and vegetables (Rho=0.047, P=0.67, N=82).

Quality was not associated with social deprivation, as measured by the TDS of store location (Spearman, 2-tailed, P>0.05), both in all shops (n=560) and in those selling all 10 fresh fruit and vegetables (n-201).

To explore the factors independently associated with the sale of good quality fruit and vegetables, a forward stepwise linear regression analysis was performed, with good quality (defined as the proportion of fruit and vegetables items on sale recorded as of good quality) as the dependent variable. The following factors were tested for association: type of store, TDS for ED of the store location, total weekly number of hours open, number of checkouts, total number of items sold (out of 33), number of 'healthier' (11) and 'less healthy', (10) items sold and number of fresh fruit and vegetables sold (10). In the final model, only one variable was independently associated with quality of fresh fruit and vegetables: total number of fruit and vegetables available, accounting for 13% of variation in quality (B=3.1, r^2=0.13, P<0.0001).

5.7 Opening hours of shops

There was considerable variation in the median number of hours different types of stores remained open (Table 24). Of the general grocery stores, multiple supermarkets were open the most on average (89 hours/week), followed by convenience stores (84 hours/week). The specialist food stores were open 48-69 hours/week. Most petrol stations were open 24 hours a day (168 hours/week).

Table 24: Minimum, maximum, median (IQR) weekly opening hours by type of store

	Total Hours Open				
	No.	**Median**	**IQR**	**Min**	**Max**
Multiple Supermarket	20	89	(83 - 103)	60	168
Discount supermarket	18	63	(60 - 74)	51	84
Department store	2	56	(54 - 59)	54	59
Convenience store	216	84	(73 - 95)	24	112
Freezer centre	13	59	(48 - 64)	48	93
Local discounter	14	59	(48 - 76)	48	94
Bakery	58	51	(49 - 54)	30	60
Greengrocer	47	54	(51 - 60)	7	84
Butcher	27	53	(48 - 57)	39	67
Specialist and Ethnic food stores	16	62	(51 - 69)	43	78
Fishmonger	6	69	(69 - 69)	69	69
Delicatessen	10	48	(40 - 65)	34	70
Health Food store	4	52	(19 - 58)	9	60
Market stall	3	54	(51 - 60)	51	60
News Agency or Post Office	58	76	(65 - 84)	40	112
Petrol Station	24	168	(104 - 168)	84	168
Off Licence	13	83	(74 - 88)	6	92
Pharmacy	7	60	(58 - 63)	55	64
General store	4	58	(53 - 62)	51	63
All shops	542	71	(54 - 88)	6	168

Opening hours were also related to number of checkouts (Table 25). There was a J-shaped relationship between number of checkouts and opening hours with a trend towards longer opening hours for larger shops with more checkouts and those with only one checkout (e.g. petrol stations, convenience stores, newsagents, off licences etc.). The median value was 74 hours per week for 428 shops with one checkout (IQR: 54-89 hours per week). Seventy four shops with two checkouts were open on average 59 hour per week (IQR: 53-78).

Table 25: Opening hours by number of checkouts

		Total hours open			
No. Checkouts	**No. shops**	**Minimum**	**Maximum**	**Median**	**IQR**
1	428	6	168	74	(54 - 89)
2	74	38	168	59	(53 - 78)
3 to 5	35	51	112	62	(58 - 71)
>5	23	54	168	83	(71 - 89)

Opening hours correlated positively with the total number (out of 33) of foods available (Spearman's Rho=0.46, , n=560, P<0.0001), the number (out of 10) of 'less healthy' items available (Rho=0.62, P<0.0001), the number of 'healthier' items available (Rho=0.44,

P<0.0001), the cost of 10 fresh fruit and vegetables (Rho=0.26, P=0.017) and 10 'less healthy' items (Rho=0.39, P=0.003) in shops where these items were available. Opening hours correlated negatively with the quality of fresh fruit and vegetables (Rho=-0.15, P=0.037) – better quality was to be found in shops open fewer hours (i.e. specifically greengrocers and market stalls).

6. Results of household and individual surveys

In this chapter, the results of the population surveys (individual, followed by household) are presented and I present analyses exploring the patterning of diet by social and environmental factors at household level. I then present findings to establish which types of household choose to buy their food at which types of food store, and the factors associated with such choices.

6.1 Response rates

Four thousand three hundred and six (24%) households responded positively to the initial mailing by sending back completed household questionnaires (Figure 10), but 876 (5%) were returned by the post office or returned blank by participants who refused to take part. Thus, 3661 (85%) households agreed to take part in the next stage of the study, and 6162 individual questionnaires were sent out to consenting adults aged over 16 years. After one reminder, 5145 (83%) individual questionnaires were returned completed (see Figure 9). Of the 5145 completed questionnaires, 5044 contained complete data for age and sex and were successfully matched to one of 3153 households. Thus, most of the descriptive analyses below are based on 5044 individuals from 3153 households.

There was an average of 1.6 adult respondents per household, of which 3153 were first adults, 1540 second adults, 267 third adults 74 fourth adults, 9 fifth adults and one sixth adult. In the Household Questionnaire , the reported number of adults per household ranged from zero to seven. Some respondents forgot to count themselves and a small number of cases were therefore recoded from zero to one. Cross-tabulating the rank order of an adult within a household with the reported size of their household enabled us to estimate the response rate within households. Because one person had to respond from every household, irrespective of size, the response rate for one-person households was 100%. However, response rate was lower for larger households, with a response rate of 90% from individuals within two person households, 78% for three person households, 75% for four person households, 73% for five person households, 47% for six person households and 36% for seven person households.

Households with three or four adults often appeared to include two generations (i.e. had adults with approximately 20-30 years age difference between them), the youngest of which

was often aged 16-20 years. Some households with 4 or more adults were all of the same age and these were predominantly under 30 years (i.e. presumably young adult students or workers sharing accommodation).

Figure 9: Flow chart showing responses rates to Household and Individual Questionnaires

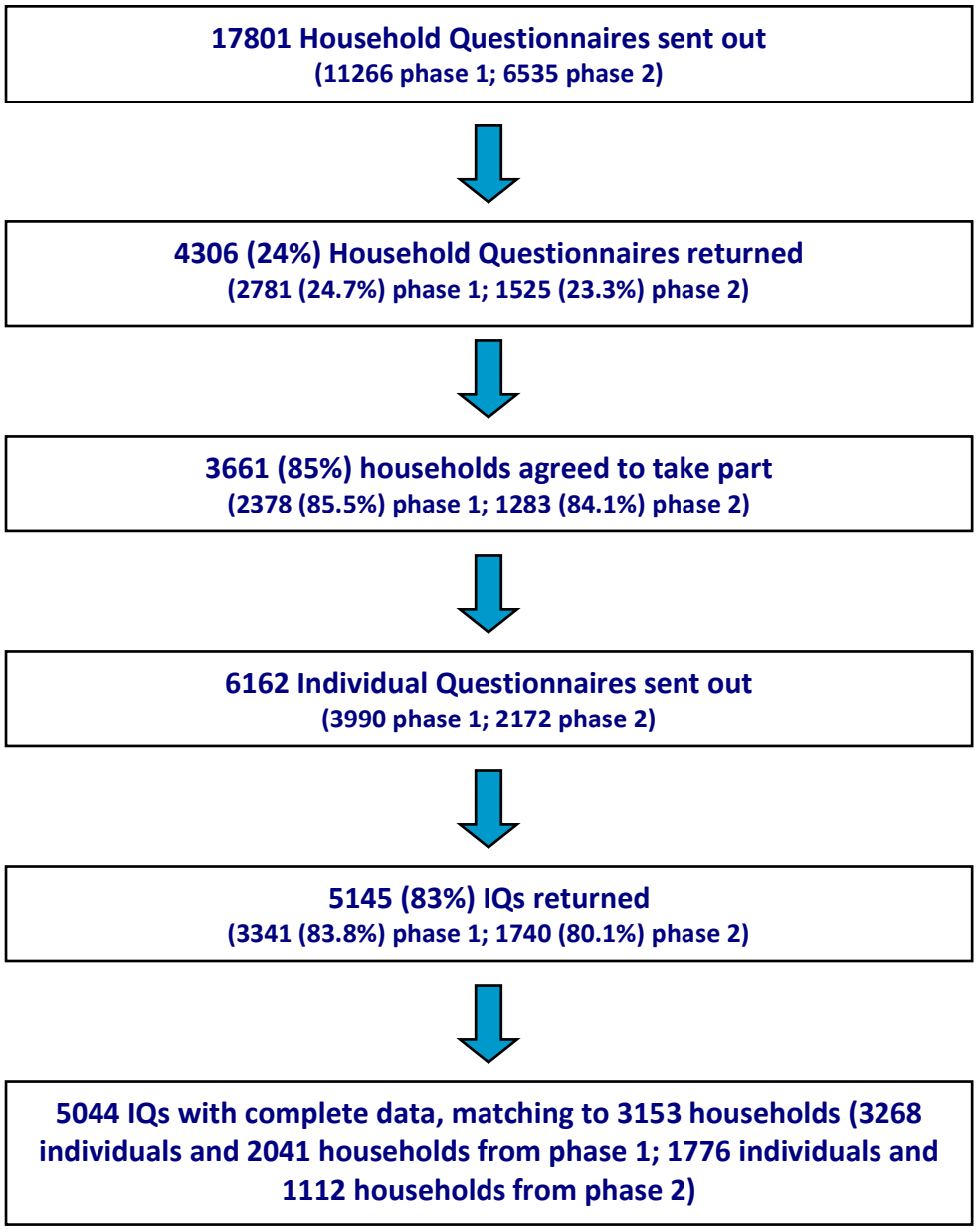


Figure 10 shows the spatial distribution of the 3153 households that are included in the analyses. As can be seen, these are broadly representative of the built up areas of the City (the central "gap" is the Town Moor). There are a few unpopulated areas in the east of the City and west riverside. These correspond to industrial areas and do not appear to indicate poor response. There was also more sparse coverage of the city centre with respondent

households, which may be because there are fewer homes there or because of poorer response rates from those areas.

Figure 10: Map of Newcastle showing distribution of 3153 Households (red crosses)

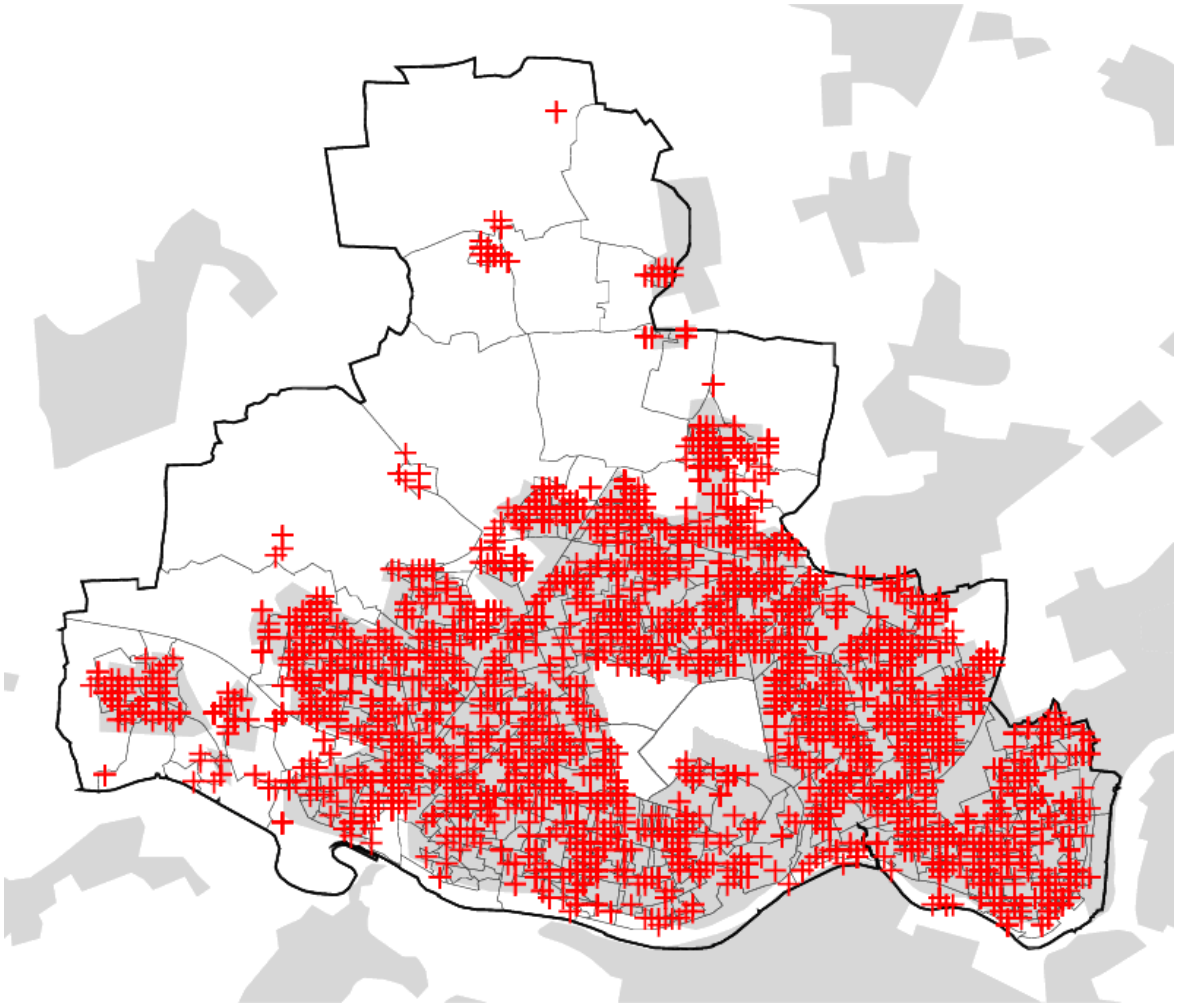


Table 26 shows response rates by postcode district. There was a lower than average response rate to the initial mailing in NE1 (city centre), NE4 (inner west) and NE6 (inner east) areas. Response rate to the Individual Questionnaire was only substantially lower than average in NE1 and NE4 areas. There were too few cases selected from NE20 (because this is only a small area in the north east of the city) to calculate meaningful indices. Although this analysis cannot take account of household size, the ratio of individual responses to initial mailings was lowest in NE1, NE4 and NE6 areas, suggesting a potentially lower than average response rate in these areas. These areas are relatively more deprived, although postcode districts are relatively large and heterogeneous, so caution is needed when interpreting this analysis. There was a mean of 5.2 households per ED (range 0-16), and a mean of 121 households per ward (range 58-212).

Analysis of the TDS for EDs of residence of the sample of 3661 households that agreed to take part showed that it was near to normally distributed, but had a mean of 1.2 (SD 3.8). The mean TDS for all Newcastle EDs was 5.1, suggesting that the sample population is somewhat more affluent than expected, indicating that it is likely that there has been socio-economic bias in our sampling or recruitment.

6.2 Characteristics of household and individual samples

Respondents to the Household Questionnaire were 'main food shoppers' in a randomly selected sample of households in Newcastle. The age and sex distribution of these individuals is shown in Table 27. The age distribution is much the same as the individual respondents (see Table 30), except for a somewhat lower response from those aged 16-24 years. However, the sex distribution is somewhat different, with 69% of main food shoppers being female (compared with 59% of women in the individual sample). Household composition is shown in Table 28. Single adult households accounted for 34% and two adult households for 33% of the total. Thirty two percent of households contained children and just under 5% (151) were one adult with one or more children households.

Some socio-economic characteristics of households are shown in Table 29. Sixty four percent of households owned a car and 68% owned or mortgaged their own home. Standards of living were also relatively high, with almost all homes having a private bathroom (98%) and toilet (99%), central heating (94%) and a washing machine (93%). In terms of access to facilities for food preparation and storage, almost all homes had a refrigerator and freezer, a cooker, grill, microwave and toaster. Access to a telephone (landline 94%) and mobile phone (69%) were high, as was ownership of a video or DVD player (87%) (it was assumed almost all homes would have a television). Less than half of homes had satellite or cable TV, a computer or Internet access.In the 2001 Census data for Newcastle upon Tyne, 55% of households had access to a car or van, 53% owned or mortgaged their own home and 96% had central heating. The data above therefore suggest that the sample was, on average, a little more affluent than the 2001 Census population.[144]

Table 26: Number (%) of Household Questionnaire (HQ) and Individual Questionnaire (IQ) responses (%) by postcode district

Postcode district	HQ sent out	HQ returned	IQ sent out	IQ returned	Ratio of IQ returned to HQs sent out (x100)
NE1	391	81 (20.7)	92	65 (71.0)	16.6
NE2	1498	388 (25.9)	519	427 (82.3)	28.5
NE3	3213	949 (29.5)	1408	1235 (87.7)	38.4
NE4	2417	403 (16.7)	571	456 (79.9)	18.8
NE5	3247	809 (24.9)	1170	958 (81.9)	36.0
NE6	3589	759 (21.0)	1054	862 (81.8)	24.0
NE7	905	275 (30.4)	414	347 (83.8)	38.3
NE13	333	85 (30.4)	114	97 (85.0)	29.1
NE15	2202	557 (25.3)	820	676 (82.4)	37.2
NE20	6	0	0	0	0
All city	17801	4306 (24.2)	6162	5145 (83.5)	28.9

Table 27: Number (%) responding to Household Questionnaire

Age group (years)	Men		Women		Persons	
16-24	36	(3.7)	109	(5.0)	145	(4.6)
25-34	132	(13.5)	365	(16.8)	497	(15.8)
35-44	149	(15.3)	406	(18.6)	555	(17.6)
45-54	170	(17.4)	437	(20.1)	607	(19.3)
55-64	192	(19.7)	352	(16.2)	544	(17.3)
65-74	167	(17.1)	304	(14.0)	471	(14.9)
75+	130	(13.3)	204	(9.4)	334	(10.6)
Total	976	(31.0)	2177	(69.0)	3153	(100.0)

Table 28: Numbers of households (% of total households) by household composition

	Number of children (aged 15 years or less)*						
Number of adults (aged 16 years or more)	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
1	1069 (33.9)	81 (2.6)	56 (1.8)	10 (0.3)	3 (0.1)	1 (0.0)	1220 (38.7)
2	1054 (33.4)	148 (4.7)	224 (7.1)	51 (1.6)	10 (0.3)	3 (0.1)	1490 (47.3)
3	223 (7.1)	53 (1.7)	16 (0.5)	5 (0.2)	1 (0.0)	0	298 (9.5)
4	88 (2.8)	25 (0.8)	7 (0.2)	0	2 (0.1)	0	122 (3.9)
5	11 (0.3)	4 (0.1)	0	0	0	0	15 (0.5)
6	5 (0.2)	0	0	0	0	1 (0.0)	6 (0.2)
7	2 (0.1)	0	0	0	0	0	2 (0.1)
Total	2452 (77.8)	311 (9.9)	303 (9.6)	66 (2.1)	16 (0.5)	5 (0.2)	3153 (100.0)

* Total households with children = 701 (22.2%); total one adult with one or more children households = 151 (4.8%)

Table 29: Number (%) of households by selected socio-economic characteristics

Household facilities			Car ownership		
Private Bathroom	3073	(97.5)	No car	1138	(36.1)
Private indoor toilet	3116	(98.8)	1 car	1370	(43.5)
Central heating	2953	(93.7)	2 cars	552	(17.5)
Washing machine	2942	(93.3)	3 cars	79	(2.5)
			4 cars	11	(0.3)
Fridge	3107	(98.5)	5 or more cars	3	(0.1)
Cooker	2943	(93.3)			
Freezer	2807	(89.0)	**Home ownership**		
Grill	2776	(88.0)	Home owner	2130	(67.6)
Microwave	2714	(86.1)	Rented accommodation	977	(31.0)
Toaster	2584	(82.0)	Rent free accommodation	17	(0.5)
Dishwasher	697	(22.1)			
Telephone	2961	(93.9)			
Mobile phone	2178	(69.1)			
Video or DVD	2731	(86.6)			
Satellite/Cable TV	1228	(38.9)			
Computer	1450	(46.0)			
Internet access	1065	(33.8)			

Table 30 shows the social and demographic characteristics of the Individual Questionnaire sample. A greater number of females than males returned the questionnaire. The mean age of respondents was 49 years old (SD = 18 years), and ranged from 16-97 years. Over 50% of those surveyed were married, the majority (94.5%) described themselves as 'white European'. Seventy percent of the survey population was Christian and over 25% described themselves as having no religion.

The most notable difference between the study sample and the 2001 Census data for Newcastle upon Tyne is that the study has a lower proportion of people aged 16-24 (20.2% in the Census), slightly lower at ages from 25-44 (17.4% in the Census) and slightly higher proportions at all ages from 45-74 years (11.9% in the Census). This means that our sample is, on average, somewhat older than the Census population.[144] The greater likelihood of older household members to respond, in conjunction with a degree of geographical disparity in response rates, is likely to have accounted for the slightly more affluent profile of respondents compared with the Census.

Table 30: Social and demographic characteristics of individuals surveyed

		Men		Women		Persons	
		No.	%	No.	%	No.	%
Total sample		2068	41.0	2976	59.0	5044	100.0
Age	16-24	192	9.3	325	10.9	517	10.2
	25-34	308	14.9	475	16.0	783	15.5
	35-44	339	16.4	495	16.6	834	16.5
	45-54	384	18.6	557	18.7	941	18.7
	55-64	351	17.0	465	15.6	816	16.2
	65-74	295	14.3	402	13.5	697	13.8
	75+	199	9.6	257	8.6	456	9.0
Marital Status	Single	476	23.0	639	21.5	1115	22.1
	Married	1215	58.8	1469	49.4	2684	53.2
	Living as married	154	7.4	213	7.2	367	7.3
	Separated	34	1.6	54	1.8	88	1.7
	Divorced	92	4.4	257	8.6	349	6.9
	Widowed	97	4.7	344	11.6	441	8.7
Ethnicity	White European	1968	95.2	2806	94.3	4774	94.6
	White other	52	2.5	91	3.1	143	2.8
	Black-Caribbean	0	0	2	0.1	2	0.0
	Black-African	4	0.2	2	0.1	6	0.1
	Black-other	3	0.1	3	0.1	6	0.1
	Indian	8	0.4	13	0.4	21	0.4
	Pakistani	4	0.2	2	0.1	6	0.1
	Bangladesh	4	0.2	7	0.2	11	0.2
	Chinese	2	0.1	2	0.1	4	0.1
	Any other ethnic group	8	0.4	12	0.4	20	0.4
	Not known	15	0.7	36	1.2	51	1.0
Religion	None	580	28.0	702	23.6	1282	25.4
	Christian	1396	67.5	2133	71.7	3529	70.0
	Buddhist	9	0.4	5	0.2	14	0.3
	Hindu	3	0.1	4	0.1	7	0.1
	Jewish	9	0.4	10	0.3	19	0.4
	Muslim	15	0.7	21	0.7	36	0.7
	Sikh	5	0.2	8	0.3	13	0.3
	Any other religion	30	1.5	63	2.1	93	1.8
	Not known	21	1.0	30	1.0	51	1.1

Fifty four percent of the population were in some form of paid employment, 29% of those surveyed were retired, 7% were in education and less than 5% were unemployed (Table 31). Respondents were allowed to tick more than one category and some in education were also

employed part-time. There were marked differences in employment pattern by sex, with greater numbers of women working part time and looking after home or family.

Table 31: Employment status by sex

	Men		Women		Persons	
	No.	**%**	**No.**	**%**	**No.**	**%**
Employed full time	937	45.3	923	31.0	1860	36.9
Employed part time	88	4.3	537	18.0	625	12.4
Self employed	134	6.5	82	2.8	216	4.3
Unemployed	127	6.1	107	3.6	234	4.6
Retired	595	28.8	852	28.6	1447	28.7
In full time education	85	4.1	175	5.9	260	5.2
In part time education	26	1.3	84	2.8	110	2.2
Not working because of illness/disability	162	7.8	155	5.2	317	6.3
Not working because looking after home and family	27	1.3	386	13.0	413	8.2
Doing voluntary work	41	2.0	101	3.4	142	2.8

Table 32 shows the socio-economic group of the head of household[175] reported by individual respondents by sex. The largest groups were administrative and secretarial occupations (17%), professional occupations (16%) and associate professional and technical occupations (11%). Again, there were marked sex differences with fewer men in administrative and secretarial, personal service, and sales and consumer service occupations, and more men in managerial, professional, skilled trade and process, plant and machine operative occupations.

Table 32: Socio-economic group of head of household by sex

	Men		Women		Persons	
	No.	%	No.	%	No.	%
Managers and senior officials	224	10.8	161	5.4	385	7.6
Professional occupations	392	19.0	400	13.4	792	15.7
Associate professional and technical occupations	232	11.2	327	11.0	559	11.1
Admin and secretarial occupations	167	8.1	671	22.5	838	16.6
Skilled trade occupations	325	15.7	68	2.3	393	7.8
Personal service occupations	34	1.6	264	8.9	298	5.9
Sales and customer service occupations	67	3.2	264	8.9	331	6.6
Process, plant and machine operatives	166	8.0	41	1.4	207	4.1
Elementary occupations	183	8.8	227	7.6	410	8.1
Not known	278	13.4	553	18.6	831	16.5

The median gross household income category was £193-288/week (£834-1249/month, £10000-14,999/year) for both male and female household respondents and the modal group was £97-192/week (£417-833/month, £5000-9999/year) (Table 33). When household composition is taken into account, the estimated median annual household income per adult equivalent is £7500 (IQR £4412 - £12500).

Table 33: Gross household income by sex

			Male		Female		Persons	
Income per week	**Income per month**	**Annual Income**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Up to £47	**Up to £208**	**Up to £2499**	33	3.6	29	1.4	62	2.1
£48-£96	**£209-£416**	**£2500-£4999**	126	13.9	289	14.2	415	14.1
£97-£192	**£417-£833**	**£5000-£9999**	210	23.2	480	23.7	690	23.5
£193-£288	**£834-£1249**	**£10000-£14999**	143	15.8	360	17.7	503	17.1
£289-£384	**£1250-£1666**	**£15000-£19999**	120	13.2	242	11.9	362	12.3
£385-£481	**£1667-£2083**	**£20000-£24999**	88	9.7	249	12.3	337	11.5
£482-£577	**£2084-£2499**	**£25000-£29999**	78	8.6	155	7.6	233	7.9
Over £578	**Over £2500**	**Over £30000**	109	12.0	225	11.1	334	11.4
Not known	**Not known**	**Not known**	69	7.1	148	6.8	217	6.9

6.3 Patterns of dietary intake and eating

6.3.1 Dietary Intake

Data from the food frequency questionnaire and supplementary questions was analysed to provide information on consumption of food groups and relative macro-nutrient intakes.

6.3.1.1 Descriptive analysis of dietary intake

Details of consumption in the main food groups are described below.

Meat

Chicken was the most frequently consumed meat (78% ate it once a week or more) followed by beef (excluding burgers) (67% >once/week), ham and bacon (56%>once/week). Beef burgers were the least consumed meat product (12% >once/week), followed by other processed meats (corned beef, spam, and luncheon meats) (22% >once/week), savoury pies (27% >once/week) and sausages (32% >once/week).

Fish

Of the fish products, oily fish (mackerel, kippers, tuna, salmon, sardines, herring, etc) were consumed most often (48% >once/week), followed by a white fish not cooked in batter (37% >once/week).

Carbohydrates

White bread was the most popular (78% >once/week), followed by wholemeal (67%>once/week) and brown (59% >once/week) breads. The most popular cereals were the non-sugar-coated plain cereals (e.g. cornflakes, rice krispies) (42% >once/week) followed by bran and whole-wheat types, though these were eaten by only 36% more than once a week.

The most popular starch-based food by a considerable margin was potatoes (not chips or roast), eaten by 90% more than once per week. Chips were eaten more than once per week by 54%. White rice was also relatively popular (50% >once/week), as were Yorkshire puddings (43% >once/week), roast potatoes (40%> once/week), plain pasta (56% >once/week) and pizza (26% >once/week). Least popular forms of carbohydrate were wholemeal pasta, brown rice, tinned pasta, pot noodles and potato salad.

Fruit and vegetables

The most commonly eaten fruits were bananas (72% >once/week), apples (69% >once/week), and oranges (58% >once/week). Strawberries, raspberries and kiwi fruit also appeared relatively popular (49% >once/week), but the survey was conducted during the summer months, so some seasonal adjustment is necessary (see section 4.6.5.2 Development

of healthy eating indices). The least popular were dried fruit (21% >once/week) and grapefruit (17% >once/week).

The most popular vegetables were tomatoes (83% > once/week), carrots (83% >once/week), onions (78% >once/week), green salad vegetables (77% > once/week), peas (76% > once/week), broccoli (63% > once/week) and mushrooms (59% > once/week). Dried lentils, beans etc (21% > once/week), courgettes and marrows (20% > once/week), spinach (15% > once/week), tofu and textured vegetable protein etc (8% > once/week), bean sprouts (13% > once/week), were the least popular vegetables.

Fats, dairy produce, snacks, sauces and sweets

Cheese was eaten more than once per week by 67% and eggs by 66%. The most popular fat spread was polyunsaturated margarine, eaten more than once per week by 56%. Butter was eaten more than once per week by 44% and other types of spreads less often. Milk consumption is discussed in detail below. The most popular snack food was sweet biscuits, eaten more than once per week by 66%, closely followed by salted crisps or other snacks (59% >once/week). Forty one per cent added sugar to tea or coffee more than once per month. Vegetable soups, sauces (including gravy), tomato-based sauces and ketchup, and jams, honey and syrup, were all popular (eaten more than once per week by 40 per cent or more).

Non-alcoholic drinks

Tea (88% >once/week) and coffee (74% >once/week) were the most popular non-alcoholic drinks, closely followed by pure fruit juices (63% >once/week).

Milk consumption

Milk consumption is shown by a range of social and demographic variables in Table 34 and Table 35. Overall, semi-skimmed milk was regularly consumed by 67% of adults, full cream by 15% and skimmed by 13%. Women were more likely than men to drink lower fat milks, as were age groups under 65 years, higher social groups and those with higher educational attainment. Those single and married were less likely to drink full cream milk than those living as married, separated, divorced or widowed. Ethnic minority groups were more likely to drink either full cream or skimmed milk, but less likely to drink semi-skimmed. There was a strong association between higher nutritional knowledge and drinking lower fat milks.

Table 34: Type of milk consumed by demographic and health variables

	Number usually consuming type (%)				
	Full cream	**Semi skimmed**	**Skimmed**	**Other**	**None**
Sex					
Male	378 (18.5)	1365 (66.7)	226 (11.0)	35 (1.7)	42 (2.1)
Female	371 (12.7)	2016 (68.8)	430 (14.7)	49 (1.7)	66 (2.3)
Persons	749 (15.0)	3381 (67.9)	656 (13.2)	84 (1.7)	108 (2.2)
Age groups					
16-24	54 (10.5)	378 (73.7)	63 (12.3)	10 (1.9)	8 (1.6)
25-34	118 (15.3)	520 (67.4)	106 (13.7)	11 (1.4)	16 (2.1)
35-44	112 (13.5)	578 (69.9)	104 (12.6)	11 (1.3)	22 (2.7)
45-54	121 (13.0)	626 (67.3)	138 (14.8)	15 (1.6)	30 (3.2)
55-64	113 (14.0)	550 (68.1)	109 (13.5)	16 (2.0)	20 (2.5)
65-74	116 (16.9)	460 (67.1)	89 (13.0)	12 (1.7)	9 (1.3)
75+	115 (26.0)	269 (60.7)	47 (10.6)	9 (2.0)	3 (0.7)
Marital status					
Single	164 (14.9)	745 (67.5)	150 (13.6)	23 (2.1)	22 (2.0)
Married	354 (13.4)	1855 (70.1)	349 (13.2)	37 (1.4)	53 (2.0)
Living as married	58 (16.0)	234 (64.6)	55 (15.2)	4 (1.1)	11 (3.0)
Separated	17 (19.5)	52 (59.8)	11 (12.6)	3 (3.4)	4 (4.6)
Divorced	56 (16.3)	220 (64.0)	47 (13.7)	9 (2.6)	12 (3.5)
Widowed	100 (23.1)	275 (63.5)	44 (10.2)	8 (1.8)	6 (1.4)
Ethnic group					
White European	695 (14.7)	3233 (68.6)	617 (13.1)	65 (1.4)	102 (2.2)
Other Ethnic groups	45 (20.8)	110 (50.9)	37 (17.1)	18 (8.3)	6 (2.8)
Body mass index					
Underweight	16 (23.5)	42 (61.9)	7 (10.3)	3 (4.4)	0
Ideal weight	181 (16.6)	740 (68.0)	120 (11.0)	20 (1.8)	27 (2.5)
Overweight	329 (15.5)	1429 (67.4)	281 (13.3)	35 (1.7)	46 (2.2)
Obese	192 (12.4)	1070 (69.3)	234 (15.1)	18 (1.2)	31 (2.0)
Self rated health					
Very good	127 (15.5)	534 (65.0)	120 (14.6)	19 (2.3)	22 (2.7)
Good	249 (14.0)	1231 (69.2)	245 (13.8)	22 (1.2)	33 (1.9)
Neither good nor poor	260 (14.7)	1223 (69.0)	227 (12.8)	27 (1.5)	36 (2.0)
Poor or very poor	103 (18.9)	352 (64.6)	57 (10.5)	16 (2.9)	17 (3.1)
Long term illness					
None	524 (15.1)	2367 (68.1)	454 (13.1)	53 (1.5)	80 (2.3)
Long term illness, no limitation	53 (12.1)	305 (69.6)	67 (15.3)	6 (1.4)	7 (1.6)
Long term illness with limitation	161 (15.9)	680 (67.1)	131 (12.9)	21 (2.1)	20 (2.0)

Fried foods

Table 36 and Table 37 show consumption of fried foods both in the home and away from the home, by a range of social and demographic variables. Overall fried food was eaten at home 1-3x/week by 33.5%, >3x/week by 6.6% and never by 15.6%. Fried food was eaten outside the home less often (never 32.5%, <1x/week 52.7%, 1-3x/week 12.6% and >3x/week 2.2%). However, there were marked variations by social and demographic factors. Those in younger and older age groups were most likely to eat fried food at home more than once/week. However, there was a linear age trend for eating fried food out of the home, with younger age groups most likely to.

Table 35: Type of milk consumed by socio-economic and food purchasing and dietary variables

	Number usually consuming type (%)				
	Full cream	**Semi skimmed**	**Skimmed**	**Other**	**None**
Fifths of SEI					
1 – least affluent	151 (23.2)	376 (57.8)	82 (12.6)	19 (2.9)	23 (3.5)
2	124 (18.3)	430 (63.6)	93 (13.8)	9 (1.3)	20 (3.0)
3	79 (14.2)	377 (67.8)	84 (15.1)	7 (1.3)	9 (1.6)
4	88 (11.6)	517 (68.2)	125 (16.5)	15 (2.0)	13 (1.7)
5 – most affluent	32 (6.9)	341 (74.0)	72 (15.6)	6 (1.3)	10 (2.2)
Fifths of TDS					
1 – most deprived	126 (18.8)	419 (62.4)	84 (12.5)	16 (2.4)	27 (4.0)
2	122 (19.0)	390 (60.7)	102 (15.9)	16 (2.5)	12 (1.9)
3	84 (13.8)	416 (68.2)	91 (14.9)	5 (0.8)	14 (2.3)
4	82 (13.6)	412 (68.6)	87 (14.5)	7 (1.2)	13 (2.2)
5 – most affluent	60 (10.4)	404 (70.0)	92 (15.9)	12 (2.1)	9 (1.6)
Educational attainment					
No formal education	15 (16.9)	53 (59.6)	12 (13.5)	7 (7.9)	2 (2.2)
Primary or secondary	350 (17.7)	1313 (66.5)	247 (12.5)	26 (1.3)	38 (1.9)
College or other tertiary	264 (13.4)	1369 (69.5)	262 (13.3)	15 (0.8)	42 (2.1)
University or equivalent	113 (12.7)	604 (67.6)	132 (14.8)	18 (2.0)	26 (2.9)
Still in education	7 (13.5)	42 (80.8)	3 (5.8)	0	0
Fifths of food knowledge score					
1 – lowest knowledge score	314 (26.3)	713 (59.8)	108 (9.1)	29 (2.4)	28 (2.3)
2	174 (15.8)	773 (70.4)	111 (10.1)	15 (1.4)	25 (2.3)
3	85 (12.4)	495 (72.3)	88 (12.8)	5 (0.7)	12 (1.8)
4	120 (9.7)	891 (71.9)	198 (16.0)	11 (0.9)	20 (1.6)
5 – highest knowledge score	56 (7.3)	509 (66.7)	151 (19.8)	24 (3.1)	23 (3.0)
Type of main food shop					
Multiple supermarkets	532 (13.4)	2767 (69.8)	517 (13.0)	63 (1.6)	84 (2.1)
Department stores	17 (15.6)	72 (66.1)	14 (12.8)	2 (1.8)	4 (3.7)
Discount supermarkets	150 (24.1)	359 (57.7)	88 (14.1)	11 (1.8)	14 (2.3)
All other stores	13 (20.6)	31 (49.2)	9 (14.3)	6 (9.5)	4 (6.3)
Not stated	37 (16.8)	151 (68.6)	28 (12.7)	2 (0.9)	2 (0.9)

Single, living as married and separated adults were more likely to eat fried food at home or out more than once/week, as were ethnic minorities, lower socio-economic groups, those with lower educational attainment and those with a lower dietary knowledge score. Eating fried food at home or out was associated with shopping at discount or 'other' types of store. Eating more fried food at home or out was also strongly associated with consumption of higher percentage dietary energy from fat.

Table 36: How often fried food is eaten at home and away from home by selected demographic and health variables

	Number in category (%)							
	At home				Away from home			
	Never	<1/wk	1-3x/wk	>3x/wk	Never	<1/wk	1-3x/wk	>3x/wk
Sex								
Male	239 (11.6)	776 (37.7)	828 (40.2)	218 (10.6)	548 (26.6)	1075 (52.2)	362 (17.6)	74 (3.6)
Female	543 (18.4)	1444 (48.9)	851 (28.8)	115 (3.9)	1082 (36.6)	1565 (53.0)	271 (9.2)	35 (1.2)
Persons	782 (15.6)	2220 (44.3)	1679 (33.5)	333 (6.6)	1630 (32.5)	2640 (52.7)	633 (12.6)	109 (2.2)
Age groups								
16-24	68 (13.3)	186 (36.3)	199 (38.8)	60 (11.7)	92 (17.9)	280 (54.6)	117 (22.8)	24 (4.7)
25-34	122 (15.6)	383 (49.1)	220 (28.2)	55 (7.1)	146 (18.7)	476 (61.0)	146 (18.7)	12 (1.5)
35-44	130 (15.6)	396 (47.6)	247 (29.7)	59 (7.1)	197 (23.7)	504 (60.6)	111 (13.4)	19 (2.3)
45-54	167 (17.8)	422 (45.0)	301 (32.1)	48 (5.1)	305 (32.5)	522 (55.7)	95 (10.1)	16 (1.7)
55-64	107 (13.2)	372 (45.8)	293 (36.0)	41 (5.0)	321 (39.6)	397 (49.0)	73 (9.0)	20 (2.5)
65-74	119 (17.3)	276 (40.1)	251 (36.5)	42 (6.1)	314 (45.6)	310 (45.1)	52 (7.6)	12 (1.7)
75+	69 (15.3)	185 (41.1)	168 (37.3)	28 (6.2)	255 (56.5)	151 (33.5)	39 (8.6)	6 (1.3)
Marital status								
Single	183 (16.5)	440 (39.7)	367 (33.1)	119 (10.7)	270 (24.4)	581 (52.5)	212 (19.2)	44 (4.0)
Married	403 (15.1)	1236 (46.3)	910 (34.1)	123 (4.6)	889 (33.3)	1460 (54.6)	280 (10.5)	44 (1.6)
Living as married	42 (11.5)	165 (45.1)	132 (36.1)	27 (7.4)	84 (23.0)	213 (58.4)	60 (16.4)	8 (2.2)
Separated	24 (27.6)	26 (29.9)	28 (32.2)	9 (10.3)	23 (26.4)	41 (47.1)	22 (25.3)	1 (1.1)
Divorced	50 (14.5)	157 (45.5)	110 (31.9)	28 (8.1)	133 (38.4)	172 (49.7)	34 (9.8)	34 (9.8)
Widowed	80 (18.4)	196 (45.1)	132 (30.3)	27 (6.2)	231 (53.2)	173 (39.9)	25 (5.8)	25 (5.8)
Ethnic group								
White European	750 (15.8)	2101 (44.3)	1602 (33.8)	293 (6.2)	1532 (32.3)	2525 (53.2)	592 (12.5)	95 (2.0)
Other Ethnic groups	25 (11.5)	93 (42.9)	66 (30.4)	33 (15.2)	73 (33.6)	96 (44.2)	36 (16.6)	12 (5.5)
Body mass index								
Underweight	11 (15.9)	23 (33.3)	26 (37.7)	9 (13.0)	24 (34.3)	31 (44.3)	14 (20.0)	1 (1.4)
Ideal weight	174 (15.8)	502 (45.7)	340 (30.9)	83 (7.6)	346 (31.5)	580 (52.8)	145 (13.2)	27 (2.5)
Overweight	352 (16.5)	937 (43.9)	704 (33.0)	139 (6.5)	698 (32.8)	1113 (52.3)	276 (13.0)	42 (2.0)
Obese	219 (14.4)	698 (44.8)	550 (35.3)	91 (5.8)	512 (32.8)	837 (53.7)	177 (11.4)	33 (2.1)
Self rated health								
Very good	135 (16.3)	367 (44.3)	264 (31.9)	62 (7.5)	296 (35.7)	407 (49.1)	105 (12.7)	21 (2.5)
Good	275 (15.3)	867 (48.3)	564 (31.4)	89 (5.0)	534 (29.8)	1022 (57.1)	209 (11.7)	25 (1.4)
Neither good nor poor	272 (15.3)	762 (42.7)	638 (35.8)	111 (6.2)	578 (32.4)	939 (52.7)	226 (12.7)	39 (2.2)
Poor or very poor	90 (16.4)	196 (35.6)	194 (35.3)	70 (12.7)	194 (35.1)	250 (45.3)	87 (15.8)	21 (3.8)
Long term illness								
None	537 (15.3)	1590 (45.4)	1158 (33.0)	221 (6.3)	1006 (28.7)	1943 (55.5)	484 (13.8)	71 (2.0)
Long term illness, no limitation	70 (15.9)	195 (44.3)	153 (34.8)	22 (5.0)	166 (37.8)	228 (51.9)	36 (8.2)	9 (2.1)
Activity limiting long term illness	167 (16.4)	415 (40.7)	350 (34.3)	88 (8.6)	437 (42.8)	447 (43.8)	109 (10.7)	28 (2.7)

Table 37: How often fried food is eaten at home/away by selected socio-economic, dietary and food shopping variables

	Number in category (%)							
	At home				Away from home			
	Never	<1/wk	1-3x/wk	>3x/wk	Never	<1/wk	1-3x/wk	>3x/wk
Educational attainment								
No formal education	18 (19.6)	31 (33.7)	27 (29.3)	6 (17.4)	50 (54.9)	29 (31.9)	12 (13.2)	0
Primary or secondary only	314 (15.8)	790 (39.7)	732 (36.8)	154 (7.7)	821 (41.2)	866 (43.5)	243 (12.2)	62 (3.1)
College or other tertiary	306 (15.4)	950 (47.9)	607 (30.6)	119 (6.0)	567 (28.6)	1134 (57.3)	240 (12.1)	39 (2.0)
University or equivalent	135 (15.0)	430 (47.9)	292 (32.5)	41 (4.6)	183 (20.4)	581 (64.8)	125 (13.9)	8 (0.9)
Still in full time education	9 (17.3)	19 (36.5)	21 (40.4)	3 (5.8)	9 (17.3)	30 (57.7)	13 (25.0)	0
Fifths of SEI								
1 – least affluent	131 (13.8)	323 (34.1)	367 (38.7)	127 (13.4)	353 (37.2)	414 (43.6)	153 (16.1)	29 (3.1)
2	152 (14.4)	435 (41.3)	386 (36.7)	80 (7.6)	348 (33.1)	538 (51.2)	134 12.7)	31 (2.9)
3	169 (16.0)	484 (45.9)	354 (33.6)	47 (4.5)	343 (32.5)	572 (54.2)	118 (11.2)	22 (2.1)
4	166 (16.7)	477 (48.0)	301 (30.3)	49 (4.9)	333 (33.6)	520 (52.4)	121 (12.2)	18 (1.8)
5 – most affluent	164 (17.0)	501 (51.9)	271 (28.1)	30 (3.1)	253 (26.2)	596 (61.8)	107 (11.1)	9 (0.9)
Fifths of TDS								
1. most affluent	162 (15.9)	506 (49.8)	315 (31.0)	33 (3.2)	288 (28.3)	605 (59.5)	112 (11.0)	11 (1.1)
2	179 (17.7)	464 (45.9)	329 (32.6)	38 (3.8)	311 (30.8)	584 (57.9)	98 (9.7)	16 (1.6)
3	157 (15.9)	452 (45.7)	324 (32.8)	56 (5.7)	331 (33.4)	523 (52.8)	118 (11.9)	18 (1.8)
4	149 (14.9)	430 (43.1)	343 (34.4)	76 (7.6)	351 (35.2)	471 (47.1)	150 (15.0)	27 (2.7)
5 least affluent	135 (13.5)	368 (36.8)	368 (36.8)	130 (13.0)	349 (34.9)	458 (45.8)	155 (15.5)	37 (3.7)
Fifths of food knowledge score								
1 – lowest knowledge score	146 (12.1)	409 (33.9)	495 (41.0)	158 (13.1)	437 (36.1)	517 (42.8)	203 (16.8)	52 (4.3)
2	154 (13.9)	488 (44.1)	391 (35.4)	73 (6.6)	361 (32.6)	559 (50.5)	166 (15.0)	21 (1.9)
3	116 (16.8)	324 (47.0)	218 (31.6)	31 (4.5)	214 (31.0)	376 (54.5)	86 (12.5)	14 (2.0)
4	218 (17.5)	623 (50.1)	368 (29.6)	35 (2.8)	398 (32.0)	716 (57.6)	112 (9.0)	16 (1.3)
5 – highest knowledge score	148 (19.3)	376 (49.0)	207 (27.0)	36 (4.7)	220 (28.8)	472 (61.8)	66 (8.6)	6 (0.8)
Fifths of fat consumption (percentage dietary energy from fat)								
1 – lowest % consumption	247 (26.1)	471 (49.8)	197 (20.8)	31 (3.3)	326 (34.6)	537 (57.0)	275 (7.1)	300 (1.3)
2	153 (16.2)	473 (50.0)	283 (29.9)	37 (3.9)	301 (31.8)	540 (57.0)	527 (10.2)	482 (1.0)
3	129 (13.7)	431 (45.7)	355 (37.6)	28 (3.0)	275 (29.1)	527 (55.8)	125 (13.2)	145 (1.9)
4	124 (13.1)	385 (40.6)	347 (37.7)	82 (8.6)	300 (31.7)	482 (50.9)	18 (1.9)	20 (2.1)
5 – highest % consumption	83 (8.8)	339 (35.8)	398 (42.0)	127 (13.4)	303 (31.9)	437 (46.0)	166 (17.5)	43 (4.5)
Type of main food shop								
Multiple supermarkets	655 (16.4)	1808 (45.3)	1298 (32.5)	228 (5.7)	1230 (30.9)	2170 (54.4)	511 (12.8)	75 (1.9)
Department stores	11 (10.0)	61 (55.5)	37 (33.6)	1 (0.9)	51 (46.4)	52 (47.3)	5 (4.5)	2 (1.8)
Discounter supermarkets	82 (13.0)	229 (36.4)	240 (38.2)	78 (12.4)	235 (37.4)	288 (45.8)	85 (13.5)	21 (3.3)
All other stores	9 (14.1)	22 (34.4)	26 (40.6)	7 (10.9)	33 (51.6)	21 (32.8)	8 (12.5)	2 (3.1)
Not stated	25 (11.3)	100 (45.2)	77 (34.8)	19 (8.6)	80 (36.0)	109 (49.1)	24 (10.8)	9 (4.1)

6.3.1.2 Composite dietary health indices

Median reported fruit and vegetable intake was 518.5g/day (Range 0-3172.5g/day) [Mean 576.1g/day, SD 329.3] and the distribution was positively skewed. Median NSP consumption was 26.9g/day (Range 0.2-112.1g/day) [Mean 27.9g/day, SD 9.7] and the distribution was negatively skewed. Median % energy derived from fat was 43.8% (Range 21.0-53.1%) [Mean 43.5%, SD2.8] and the distribution was negatively skewed. Median energy intake was 23576.7J/day (Range 201.5-127221.9J/day) [Mean 25101.5J/day, SD 9592.5J/day]. Details of the three transformed variables (Z-scores) derived from these three indices are shown in Table 38.

Table 38: Values for the main dietary indicator Z-scores*

	Number of cases	Min	Max
Fruit & Vegetable Index (F&V)	5043	-1.24	37.01
Non-Starch Polysaccharide Index (NSP)	5043	-0.93	48.65
Percentage dietary energy from fat Index (FAT)	5043	-3.07	14.94

* All indices are Z-scores, with mean=0 and SD=1.

Table 39, Table 40 and Table 41 show the relationships between these summary Z-scores and a range of social, demographic and household shopping variables.

Fruit and Vegetable Index

Fruit and vegetable consumption was higher among older age groups, women and non-white ethnic groups. However, it was less clearly associated with measures of socio-economic position, such as SEI, education, unemployment, household composition and household TDS. Similarly, in relation to shopping behaviour there were associations with type of main food shop and mode of travel to shops. However, there was a clearer relationship with amount spent on weekly food shopping per adult equivalent, with higher fruit and vegetable consumption among the top 3 fifths of expenditure. In other words, those who spent more, ate more fruit and vegetables.

Non-starch polysaccharide (NSP) Index

A similar picture emerged for NSP consumption, although there was also a relationship with household composition (households with children consume more NSP than other types of households). Younger adults were also more likely to eat more NSP than older adults. NSP consumption was not obviously related to any socio-economic or food shopping variables.

Table 39: Healthy eating indicators* by selected demographic and health variables

	Mean (SD)		
	Fruit and vegetable Index	**NSP Index**	**Fat Index**
Sex			
Male	-0.14 (0.80)	-0.047 (0.77)	-0.015 (1.00)
Female	0.094 (1.10)	0.034 (1.14)	-0.010 (1.00)
Persons	-0.001 (0.99)	0.001 (1.00)	-0.0003 (1.00)
Age			
16-24	-0.16 (0.95)	0.062 (0.77)	0.10 (0.95)
25-34	-0.10 (1.60)	0.077 (1.95)	0.055 (1.13)
35-44	-0.024 (0.80)	0.069 (0.80)	0.075 (1.09)
45-54	0.0047 (0.71)	0.013 (0.68)	-0.046 (1.02)
55-64	0.034 (0.70)	-0.059 (0.57)	-0.052 (0.66)
65-74	0.095 (0.86)	-0.064 (0.83)	-0.045 (1.02)
Over 75	0.17 (1.12)	-0.11 (0.43)	-0.052 (0.66)
Employment status			
Registered unemployed	-0.12 (0.87)	0.086 (0.84)	0.25 (1.06)
In paid employment	-0.052 (1.07)	0.022 (1.18)	-0.016 (1.00)
Other	0.074 (0.90)	-0.034 (0.76)	-0.0078 (0.99)
Ethnic group			
White European	-0.016 (0.95)	-0.012 (0.96)	-0.015 (0.97)
Other ethnic groups	0.27 (1.64)	0.31 (1.68)	0.34 (1.58)
Household composition			
1 adult	0.011 (0.89)	-0.073 (0.60)	-0.10 (0.93)
2 adults	0.013 (0.85)	-0.021 (0.80)	-0.043 (1.04)
3 or more adults	-0.070 (0.79)	0.0092 (0.69)	0.028 (0.98)
1 adult, 1 or more children	0.037 (1.01)	0.012 (0.68)	0.13 (1.00)
2 or more adults, 1 or more children	0.0070 (1.39)	0.11 (1.69)	0.14 (1.00)
Body mass index			
Underweight	-0.098 (1.07)	-0.13 (0.60)	0.17 (0.93)
Ideal weight	-0.064 (0.80)	-0.012 (0.72)	0.065 (0.93)
Overweight	0.0098 (1.12)	0.0072 (1.28)	-0.036 (1.00)
Obese	0.034 (0.90)	0.018 (0.78)	-0.013 (1.06)
Self rated health			
Very good	0.096 (0.82)	0.026 (0.76)	-0.020 (1.05)
Good	0.029 (0.86)	0.019 (0.70)	-0.024 (0.96)
Neither good nor poor	-0.028 (1.23)	0.010 (1.40)	-0.00099 (1.02)
Poor or very poor	-0.16 (0.81)	-0.12 (0.56)	0.095 (1.00)
Long term illness			
None	-0.023 (1.02)	0.11 (1.09)	0.0045 (1.00)
Long term illness, no limitation	0.86 (1.00)	0.17 (1.03)	-0.078 (1.23)
Long term illness, limiting	0.41 (0.92)	-0.032 (0.64)	0.018 (0.91)

* All indices are Z-scores, with mean=0 and SD=1.

Fat Index

Fat consumption was much higher among younger age groups, non-white ethnic groups, those with lower SEI and less affluent TDS and the unemployed. Fat consumption was lowest among those using a car to do their shopping and highest among those travelling from shops by bicycle or taxi. There was a gradient in fat consumption from lowest among those in the

highest fifth for food expenditure per adult equivalent to highest among those with lowest food expenditure.

Table 40: Healthy eating indicators* by selected socio-economic variables

	Mean (SD)		
	Fruit and vegetable Index	**NSP Index**	**Fat Index**
Educational attainment			
Still a student	-0.21 (0.56)	-0.067 (0.46)	0.10 (0.66)
None	-0.55 (1.03)	-0.084 (0.93)	0.016 (0.72)
Primary or secondary	0.00029 (1.20)	0.039 (1.31)	0.025 (0.99)
College	-0.019 (0.87)	0.039 (0.75)	0.0041 (1.02)
University	-0.032 (0.73)	0.020 (0.70)	-0.072 (1.02)
Unemployment (Head of household)			
Unemployed	-0.12 (0.87)	0.086 (0.84)	0.25 (1.06)
Employed	0.0045 (1.00)	-0.0030 (1.01)	-0.012 (1.00)
Car ownership			
No car	0.023 (0.99)	-0.033 (0.76)	0.056 (1.05)
1 car	0.00036 (1.13)	0.017 (1.28)	-0.013 (1.00)
2 cars	-0.039 (0.68)	0.0019 (0.61)	-0.045 (0.94)
3 cars	-0.049 (0.71)	0.070 (0.68)	-0.014 (0.96)
4 or more cars	0.28 (1.14)	0.070 (0.60)	-0.23 (1.29)
Fifths of Socio-Economic Index (SEI)			
1. least affluent	-0.00097 (1.08)	-0.0032 (0.84)	0.12 (1.08)
2.	0.0088 (0.99)	-0.027 (0.82)	0.0073 (0.92)
3.	0.0032 (0.77)	-0.025 (0.82)	0.011 (1.12)
4.	0.019 (1.23)	0.045 (1.47)	-0.031 (0.96)
5. most affluent	-0.048 (0.68)	-0.0037 (0.56)	-0.090 (0.95)
Fifths of TDS for Household			
1. Most affluent	0.047 (0.68)	0.0055 (0.78)	-0.11 (1.00)
2.	0.020 (0.75)	-0.017 (0.56)	-0.037 (0.91)
3.	-0.037 (1.38)	0.020 (1.67)	0.0080 (0.97)
4.	-0.022 (0.91)	-0.0076 (0.75)	0.0085 (1.06)
5. Most deprived	-0.016 (1.09)	0.0041 (0.90)	0.13 (1.05)

* All indices are Z-scores, with mean=0 and SD=1.

Spatial and socio-economic patterning of dietary intake

There were weak correlations between the Fruit and Vegetable Index and TDS of the ED of residence (two-tailed Pearson correlation coefficient, Rho=-0.087, P<0.0001) and the Household SEI (Rho=0.033, P=0.021), indicating slightly higher consumption among those living in more affluent areas.

NSP consumption was also weakly correlated with TDS (Pearson, two-tailed, Rho=-0.051, P<0.0001), and SEI (Pearson, two-tailed, R=0.076, P<0.0001), indicating slightly higher consumption among those living in more affluent areas.

The Fat Index correlated weakly with TDS (Pearson, Rho=0.088, P<0.0001) and SEI (Pearson, Rho=-0.07, P<0.0001), indicating slightly lower consumption among those living in more affluent areas.

Table 41: Healthy eating indicators* by food shopping variables

	Mean (SD)		
	Fruit and vegetable Index	**NSP Index**	**Fat Index**
Standard of Living Index for Cooking			
Adequate facilities	-0.0014 (0.99)	0.0026 (1.01)	0.00076 (0.99)
Less adequate facilities	-0.0049 (1.00)	-0.094 (0.57)	-0.066 (1.41)
Main shop type			
Discounters	-0.045 (1.01)	-0.036 (0.81)	0.10 (1.03)
Multiple supermarkets	-0.0022 (1.00)	0.012 (1.06)	-0.012 (0.99)
Department stores	0.10 (1.17)	-0.092 (0.75)	0.016 (1.31)
Other types of shop	-0.099 (0.82)	-0.17 (0.49)	-0.065 (0.89)
Not known	0.11 (0.85)	-0.0011 (0.73)	-0.087 (0.88)
Mode of travel from main shop			
Car	-0.017 (0.99)	0.0050 (1.08)	-0.024 (0.97)
Taxi	0.15 (1.34)	0.14 (1.21)	0.18 (1.15)
Public Transport	0.039 (0.91)	-0.062 (0.62)	0.0016 (0.87)
Bicycle	0.12 (0.68)	0.057 (0.54)	0.18 (0.71)
Foot	-0.029 (1.03)	-0.0087 (0.88)	0.033 (1.12)
Fifths of cost of weekly food per adult equivalent			
1. Lowest fifth	-0.045 (0.93)	0.019 (0.86)	0.099 (1.01)
2.	-0.087 (0.82)	-0.036 (0.71)	0.011 (0.92)
3.	0.039 (1.44)	0.046 (1.70)	0.0032 (1.12))
4.	0.019 (0.78)	-0.0065 (0.56)	0.022 (0.89)
5. Highest fifth	0.050 (0.80)	-0.013 (0.63)	-0.098 (0.98)

* All indices are Z-scores, with mean=0 and SD=1.

6.3.2 Food eaten outside the home

The Individual Questionnaire included a question on meals eaten outside the home (Table 42). When respondents ate out of the home, they most commonly ate with family and friends or in restaurants, pubs or cafes or take always. However, frequency of daily consumption outside the home was highest for 'work canteen'. Meals on wheels were used by about 13% of adults. It is notable that over 13% of individuals ate chip shop food at least once a week, more than

19% ate food from another kind of take-away and 24% ate at a restaurant, café or pub at least once a week. Further analysis shows that, taking the categories of chip shop, take away and restaurant, café or pub together, on average individuals ate out approximately 2.5 times/week (median 10, IQR 9-11 times per month).

Table 42: Meals eaten outside the home

Source of meal	Frequency of consumption (%)			
	Most days	1-2 times/week	Once/month	Never or hardly ever
Friends or family	344 (6.8)	1143 (22.7)	1840 (36.5)	1357 (26.9)
Restaurant, pub or café	52 (1.0)	1161 (23.0)	2154 (42.7)	1400 (27.8)
Other take-away	88 (1.7)	895 (17.7)	1638 (32.5)	1982 (39.3)
Chip shop	21 (0.4)	676 (13.4)	1469 (29.1)	2531 (52.1)
Work canteen	363 (7.2)	316 (6.3)	167 (3.3)	3663 (72.6)
Meals on wheels	17 (0.3)	9 (0.2)	29 (0.6)	4407 (87.4)

The association between meals eaten outside the home and a range of social and demographic factors was also explored. Age, marital status and SEI were all consistently associated with eating out (Table 43). Eating out was generally more common among younger age groups, the single, separated and those living as married. Eating with family and friends was more common among less affluent households, women and the non-white group, whilst eating out at restaurants, pub and cafes, and take-aways was more common among men and higher socio-economic groups.

One adult with one or more child households and single adults were more likely to eat out with family and friends than other household types. One adult with one or more child households were also more likely to eat out at chip shops and other take-aways and less likely to eat at restaurants than other households. Similar patterns were seen for the unemployed, those claiming state benefits and other indicators of socio-economic position (Table 44). Thus, eating at restaurants, pub and cafes and other take-aways, as well as at work canteens, was associated with affluence, whilst eating at chip shops was associated with socio-economic disadvantage.

There were also relationships between eating out and food shopping variables (Table 45). People shopping at multiple supermarkets, those with a lower percentage of income spent on food and those travelling by car were more likely to eat at restaurants, pub and cafes, other take aways and work canteens. In contrast, those shopping at discount supermarkets were more likely to eat out at chip shops.

There was a strong relationship between eating out and dietary knowledge and, to a lesser extent, with dietary behaviour variables (Table 46). People with higher dietary knowledge were less likely to eat out at family and friends, chip shops and take aways, but more likely to eat at restaurants, pubs and cafes. Those with indicators of a 'healthier' diet were less likely to eat at family and friends (NSP intake was an exception to this), chip shops and other take aways and more likely to eat out at restaurants, pubs and cafes. The relationship between fat consumption or dietary knowledge and eating at a chip shop once a week or more was particularly strong, with those in the higher fat consumption fifths and lowest knowledge score fifths being three times as likely to use this type of outlet regularly.

Table 43: Number (%) eating meals out of home > once/week by selected demographic and health variables

	Friends or family	Restaurant, pub or cafe	Other take away	Chip Shop	Work canteen
Sex					
Men	559 (29.2)	495 (25.5)	493 (26.0)	400 (20.6)	304 (16.4)
Women	928 (33.5)	718 (25.4)	490 (18.1)	297 (10.8)	375 (14.1)
Age groups					
16-24 years	249 (49.0)	135 (26.5)	191 (37.7)	116 (22.8)	158 (31.6)
25-34 years	325 (42.6)	228 (29.8)	268 (34.9)	129 (16.9)	178 (23.7)
35-44 years	265 (32.9)	187 (23.2)	216 (26.8)	127 (15.7)	153 (19.4)
45-54 years	235 (26.4)	206 (22.8)	170 (18.9)	112 (12.5)	140 (15.9)
55-64 years	175 (24.1)	191 (25.1)	83 (11.6)	109 (14.8)	44 (6.4)
65-74 years	129 (21.4)	172 (27.4)	35 (6.2)	79 (13.0)	4 (0.7)
75+ years	109 (28.0)	94 (23.8)	20 (5.8)	25 (6.6)	2 (0.6)
Marital status					
Single	491 (46.1)	325 (30.3)	313 (29.6)	206 (19.3)	248 (23.9)
Married	611 (24.7)	591 (23.2)	482 (19.6)	353 (14.1)	296 (12.3)
Living as married	107 (30.1)	89 (25.0)	111 (31.2)	58 (16.2)	76 (21.7)
Separated	33 (39.8)	26 (31.3)	17 (20.0)	9 (11.3)	18 (22.2)
Divorced	111 (33.8)	82 (25.4)	39 (12.7)	45 (14.2)	36 (11.7)
Widowed	134 (35.3)	100 (26.0)	21 (6.2)	26 (7.2)	5 (1.5)
Ethnic groups					
White European	1404 (31.5)	1156 (25.5)	937 (21.4)	654 (14.6)	640 (14.9)
Other ethnic groups	72 (38.9)	46 (23.8)	39 (22.2)	34 (17.9)	34 (19.5)
Level of obesity (BMI)					
Underweight	26 (41.3)	17 (26.2)	10 (16.4)	10 (15.2)	12 (18.8)
Ideal weight	367 (35.5)	272 (26.0)	249 (24.5)	146 (14.2)	179 (17.8)
Overweight	616 (30.7)	551 (27.2)	392 (19.7)	268 (13.3)	293 (15.2)
Obese	434 (30.1)	336 (22.6)	304 (21.5)	247 (17.1)	175 (12.6)
Self rated health					
Very good	259 (33.4)	227 (28.7)	144 (19.0)	98 (12.6)	125 (16.8)
Good	561 (33.1)	460 (28.6)	328 (19.5)	188 (11.1)	265 (16.0)
Neither good nor poor	504 (30.3)	402 (23.9)	368 (22.7)	285 (17.2)	234 (14.8)
Poor or very poor	151 (30.0)	112 (21.9)	134 (27.1)	116 (22.5)	52 (10.7)
Activity limiting long term illness					
None	1121 (33.7)	892 (26.4)	778 (23.7)	506 (15.2)	598 (18.5)
Long term illness, no limitation	122 (30.3)	113 (27.3)	72 (18.1)	42 (10.4)	39 (10.1)
Long term illness with limitation	231 (25.2)	197 (21.0)	130 (14.7)	145 (15.7)	39 (4.5)

Table 44: Number (%) eating meals out of home > once/week by selected socio-economic variables

	Number (%) eating meals out of home > once/week				
	Friends or family	Restaurant, pub or cafe	Other take away	Chip Shop	Work canteen
Household composition					
Single adult	424 (42.0)	321 (31.6)	137 (14.5)	111 (11.4)	113 (12.2)
2 adults	408 (23.8)	465 (26.3)	294 (17.5)	224 (12.8)	188 (11.4)
3 or more adults	264 (33.2)	199 (24.8)	201 (25.2)	146 (18.2)	147 (18.9)
1 adult, 1 or more child	57 (37.7)	25 (16.2)	41 (26.8)	30 (20.0)	23 (15.5)
2 or more adults & children	334 (32.8)	203 (19.8)	310 (30.3)	186 (18.2)	208 (20.6)
Unemployment					
Registered unemployed	78 (35.9)	47 (21.7)	50 (22.9)	48 (22.1)	7 (3.4)
Paid employment	878 (34.3)	709 (27.4)	721 (28.0)	388 (15.1)	606 (23.9)
Other	531 (27.8)	457 (23.3)	212 (11.7)	261 (13.7)	66 (3.7)
Welfare					
On benefits	561 (28.6)	435 (21.6)	265 (14.0)	307 (15.6)	105 (5.7)
Unknown	33 (24.6)	31 (24.0)	14 (11.6)	20 (14.9)	13 (11.3)
Not on benefits	893 (34.5)	747 (28.5)	704 (27.2)	370 (14.3)	561 (22.1)
Educational attainment					
No formal education	22 (31.4)	13 (18.8)	7 (11.5)	14 (18.4)	2 (3.3)
Primary or secondary only	523 (29.3)	392 (21.4)	329 (18.9)	335 (18.5)	157 (9.2)
College	668 (35.2)	492 (25.5)	427 (22.7)	263 (14.0)	311 (16.9)
University	256 (29.1)	310 (34.8)	205 (23.5)	74 (8.5)	196 (22.8)
Still in FT Ed	18 (35.3)	6 (11.8)	15 (28.8)	11 (22.0)	13 (25.5)
Fifths of SEI					
1. Lowest fifth (most deprived)	345 (34.7)	194 (19.2)	150 (15.8)	189 (18.8)	50 (5.4)
2.	218 (27.5)	170 (21.0)	112 (14.7)	119 (14.9)	93 (12.3)
3.	294 (30.5)	270 (27.4)	172 (18.1)	126 (13.2)	144 (15.4)
4.	364 (33.7)	286 (26.0)	287 (26.6)	154 (14.2)	222 (21.1)
5. Highest fifth (most affluent)	266 (31.2)	293 (34.0)	262 (30.5)	109 (12.8)	170 (20.1)
Fifths of TDS for Home ED					
1. Most affluent fifth	314 (30.1)	341 (31.9)	210 (20.5)	114 (11.1)	142 (14.1)
2.	284 (29.6)	269 (27.4)	195 (20.8)	101 (10.6)	145 (15.8)
3.	320 (33.5)	237 (24.5)	216 (22.9)	139 (14.5)	162 (17.6)
4.	271 (30.7)	196 (21.7)	180 (20.5)	165 (18.4)	128 (14.9)
5. Most deprived fifth	289 (35.2)	157 (19.0)	179 (22.4)	177 (21.2)	96 (12.3)
SLI for cooking					
Less adequate facilities	24 (36.4)	17 (26.6)	9 (15.0)	16 (23.5)	3 (4.9)
Adequate facilities	1463 (31.7)	1196 (25.4)	974 (21.4)	681 (14.7)	676 (15.2)

Table 45: Number (%) eating meals out of home > once/week by selected variables relating to food purchasing

	Friends or family	Restaurant, pub or cafe	Other take away	Chip Shop	Work canteen
Category of main food shop					
Not known	69 (34.8)	58 (27.8)	26 (13.5)	20 (10.3)	17 (9.0)
Discounters	178 (31.7)	96 (16.9)	104 (18.9)	147 (25.4)	54 (10.0)
All other stores	16 (26.2)	8 (13.3)	10 (16.1)	8 (13.6)	6 (10.3)
Department stores	20 (20.2)	35 (34.0)	14 (14.9)	5 (5.1)	10 (10.5)
Multiple supermarkets	1204 (32.0)	1016 (26.5)	829 (22.4)	517 (13.7)	592 (16.3)
Frequency of shopping					
Daily	106 (29.9)	87 (24.3)	84 (23.9)	78 (22.0)	42 (12.3)
2 or 3 times/wk	712 (30.5)	662 (27.7)	466 (20.4)	344 (14.7)	306 (13.6)
Weekly	545 (33.4)	381 (23.0)	361 (22.4)	236 (14.5)	269 (17.1)
Once fortnight	79 (36.7)	50 (23.3)	46 (21.9)	29 (13.6)	41 (20.0)
Other	31 (31.6)	22 (22.0)	18 (18.9)	5 (5.1)	19 (20.0)
Mode of travel from main food shop					
On Foot	204 (33.4)	144 (23.5)	114 (19.2)	95 (15.7)	86 (14.9)
By car	1003 (31.6)	847 (26.2)	719 (22.8)	467 (14.7)	489 (15.8)
By public transport	163 (33.3)	120 (23.9)	82 (17.7)	71 (14.5)	48 (10.6)
By Bike	4 (25.0)	3 (20.0)	3 (20.0)	3 (20.0)	2 (13.3)
By Taxi	58 (28.0)	41 (19.2)	42 (20.6)	36 (16.7)	34 (17.2)
Fifths of cost of weekly food shopping per adult equivalent					
1 lowest fifth	303 (33.9)	191 (21.2)	187 (21.4)	139 (15.5)	148 (17.3)
2	241 (34.6)	149 (21.2)	133 (19.6)	122 (17.5)	87 (13.1)
3	310 (30.0)	238 (23.0)	222 (22.1)	163 (15.8)	158 (16.0)
4	210 (34.0)	161 (25.7)	131 (21.6)	79 (13.0)	109 (18.3)
5 highest fifth	339 (31.0)	386 (33.6)	257 (23.5)	158 (14.2)	143 (13.4)
Fifths of % of income spent on food					
1. Lowest fifth	326 (35.9)	305 (33.7)	216 (24.1)	98 (10.9)	211 (23.9)
2.	214 (28.8)	217 (28.5)	175 (24.0)	87 (11.9)	112 (15.6)
3.	357 (31.6)	291 (25.2)	246 (22.0)	160 (14.0)	159 (14.5)
4.	224 (30.3)	131 (17.4)	144 (19.4)	125 (16.7)	98 (13.6)
5. highest fifth	262 (31.8)	171 (20.1)	148 (18.6)	168 (20.2)	73 (9.3)

Table 46: Number (%) eating meals out of home > once/week by selected variables relating to food consumption

	Friends or family	Restaurant, pub or cafe	Other take away	Chip Shop	Work canteen
Categories of alcohol consumption					
Safe alcohol consumption	1150 (31.0)	911 (24.1)	712 (19.5)	524 (14.1)	531 (14.9)
Risky alcohol consumption	229 (35.2)	216 (32.7)	217 (33.4)	111 (16.9)	122 (19.1)
Hazardous alcohol consumption	15 (30.0)	22 (40.7)	21 (40.4)	16 (30.2)	7 (14.3)
Fifths of fruit and vegetable consumption index					
1. Lowest consumption fifth	311 (33.3)	209 (22.3)	262 (28.4)	184 (19.5)	175 (19.4)
2.	242 (29.1)	222 (26.2)	214 (26.0)	138 (16.6)	121 (15.0)
3. Middle fifth	327 (30.7)	270 (24.9)	224 (21.3)	158 (14.7)	156 (15.0)
4.	293 (31.2)	258 (27.2)	155 (17.0)	115 (12.3)	130 (14.5)
5. Highest consumption fifth	314 (34.5)	254 (26.7)	128 (14.4)	102 (11.2)	97 (11.3)
Fifths of NSP consumption index					
1. Lowest consumption fifth	286 (30.8)	206 (22.1)	198 (21.7)	143 (15.3)	138 (15.5)
2.	172 (26.1)	161 (23.7)	124 (19.0)	82 (12.3)	89 (13.8)
3. Middle fifth	371 (31.0)	336 (27.7)	242 (20.8)	203 (16.9)	155 (13.4)
4.	300 (31.3)	257 (26.5)	186 (19.8)	117 (12.3)	139 (15.2)
5. Highest consumption fifth	358 (38.0)	253 (26.1)	233 (24.9)	152 (16.1)	158 (17.5)
Fifths of fat % energy index					
1. Lowest fat consumption fifth	263 (27.9)	262 (26.9)	157 (16.8)	71 (7.6)	119 (12.9)
2.	291 (30.4)	266 (27.3)	194 (20.7)	99 (10.4)	130 (14.1)
3. Middle fifth	286 (31.8)	227 (25.0)	168 (19.2)	141 (15.6)	125 (14.6)
4.	334 (35.0)	236 (24.5)	219 (23.4)	167 (17.5)	162 (17.6)
5. Highest fat consumption fifth	313 (33.8)	222 (23.5)	245 (26.7)	219 (23.2)	143 (16.1)
Fifth of knowledge score					
1. Lowest fifth	366 (34.3)	252 (23.3)	242 (23.9)	270 (24.7)	134 (13.6)
2.	347 (33.2)	236 (22.4)	237 (23.0)	168 (16.1)	160 (15.8)
3. Middle fifth	207 (32.1)	147 (22.5)	146 (22.8)	87 (13.7)	102 (16.3)
4.	367 (30.5)	347 (28.4)	232 (19.5)	115 (9.7)	171 (14.6)
5. Highest fifth	200 (27.5)	231 (30.4)	126 (17.3)	57 (7.8)	112 (15.8)

6.3.3 Special diets

Overall, 24% of respondents said they were on a special diet of any sort. Eight percent said they were on a diet for a medical condition or allergy, 12% were on a diet to lose weight and 4% were on a special diet for personal or religious beliefs. The number of people on special diets was strongly patterned by age and sex, with women more likely to be on any sort of diet and older adults more likely to be on a diet for a medical condition or allergy. Middle aged adults were more likely to be on a diet to lose weight and younger adults were more likely to be on a diet for personal beliefs. Individuals in ethnic minority groups were more likely to be on a diet to lose weight or for personal beliefs, but were less likely to be on a diet for a medical condition or allergy than white Europeans. Amongst the religious groups, Hindus and Jews were most likely to be on a diet overall, though Hindus and Sikhs were most likely to

report being on a diet for religious reasons/personal beliefs. Jews were most likely to be on a diet for medical reasons or to lose weight. Interestingly, no Hindus, Buddhists or Sikhs reported being on a diet to lose weight, but these analyses are based on relatively small numbers. Single adults were more likely than those in other household types to be on a diet for medical reasons and one adult with one or more child households were twice as likely as individuals in any other type of household to be on a diet to lose weight. People living in more affluent areas were more likely to be on a diet than those living in more deprived areas.

People who reported being overweight (11.0%) or obese (19.6%) were more likely to report being on a diet to lose weight than those of ideal weight (5.1%) or underweight (2.9%). Similarly, those who reported their health as poor or very poor were more likely to report being on a diet for medical reasons (15.3%) than those who reported their health as good (4.8%) or very good (4.9%). Those who reported having an activity-limiting long term illness (23.0%) or those with a long term illness with no limitation of activity (19.3%) were also more likely to report being on a diet for medical reasons than those with no long term illness (3.3%).

Table 47: Number on a special diet (%) by selected demographic and health variables

	On any special diet	For medical condition/allergy	To lose weight	For personal beliefs
Sex				
Male	348 (16.8)	148 (7.2)	116 (5.6)	56 (2.7)
Female	884 (29.7)	269 (9.0)	498 (16.7)	144 (4.8)
Persons	1232 (24.4)	417 (8.3)	614 (12.2)	200 (4.0)
Age group				
16-24	120 (23.2)	18 (3.5)	50 (9.7)	37 (7.2)
25-34	176 (22.5)	32 (4.1)	96 (12.3)	57 (7.3)
35-44	193 (23.1)	38 (4.6)	115 (13.8)	36 (4.3)
45-54	243 (25.8)	80 (8.5)	148 (15.7)	39 (4.1)
55-64	200 (24.5)	75 (9.2)	106 (13.0)	10 (1.2)
65-75	187 (26.8)	108 (15.5)	67 (9.6)	8 (1.1)
75+	113 (24.8)	66 (14.5)	32 (7.0)	13 (2.9)
Marital status				
Single	279 (25.0)	79 (7.1)	123 (11.0)	75 (6.7)
Married	630 (23.5)	215 (8.0)	340 (12.7)	74 (2.8)
Living as married	89 (24.3)	17 (4.6)	43 (11.7)	25 (6.8)
Separated	23 (26.1)	8 (9.1)	15 (17.0)	4 (4.5)
Divorced	87 (24.9)	30 (8.6)	52 (14.9)	15 (4.3)
Widowed	124 (28.1)	68 (15.4)	41 (9.3)	7 (1.6)
Ethnic group				
White European	1148 (24.0)	398 (8.3)	571 (12.0)	182 (3.8)
Other ethnic groups	65 (29.7)	12 (5.5)	33 (15.1)	18 (8.2)
Religion				
None	299 (23.3)	65 (5.1)	142 (11.1)	87 (6.8)
Christian	840 (23.8)	328 (9.3)	433 (12.3)	77 (2.2)
Muslim	16 (44.4)	4 (11.1)	8 (22.2)	4 (11.1)
Jewish	13 (68.4)	7 (38.8)	7 (36.8)	7 (36.8)
Buddhist	7 (50.0)	1 (7.1)	0	4 (28.6)
Hindu	5 (71.4)	0	0	4 (57.1)
Sikh	6 (46.2)	1 (7.7)	0	7 (53.8)
Other religions	30 (32.3)	7 (7.5)	15 (16.1)	6 (6.5)
Not known	16 (31.6)	4 (7.8)	9 (17.6)	4 (7.8)
Household composition				
1 adult	284 (25.6)	127 (11.5)	122 (11.0)	43 (3.9)
2 adults	475 (25.2)	178 (9.4)	219 (11.6)	73 (3.9)
3 or more adults	193 (23.1)	56 (6.7)	104 (12.5)	34 (4.1)
1 adult, 1 or more children	58 (36.5)	10 (6.3)	40 (25.2)	8 (5.0)
2 or more adults, 1 or more children	222 (21.0)	46 (4.4)	129 (12.2)	42 (4.0)
Body mass index				
Underweight	17 (24.3)	8 (11.4)	2 (2.9)	5 (7.1)
Ideal weight	210 (19.0)	79 (7.2)	56 (5.1)	58 (5.3)
Overweight	485 (22.6)	155 (7.2)	235 (11.0)	89 (4.2)
Obese	483 (30.9)	165 (10.5)	306 (19.6)	42 (2.7)
Self rated health				
Very good	164 (19.7)	41 (4.9)	77 (9.2)	34 (4.1)
Good	410 (22.8)	87 (4.8)	229 (12.7)	82 (4.6)
Neither good nor poor	485 (27.0)	195 (10.9)	233 (13.0)	63 (3.5)
Poor or very poor	154 (27.7)	85 (15.3)	71 (12.8)	19 (3.4)
Activity limiting long term illness				
None	713 (20.2)	114 (3.2)	412 (11.7)	161 (4.6)
Long term illness, no limitation	163 (37.0)	97 (22.0)	67 (15.2)	8 (1.8)
Long term illness with limitation	337 (32.8)	200 (19.5)	129 (12.6)	28 (2.7)

Table 48: Number on a special diet (%) Special diets by selected socio-economic variables

	On any diet	For medical condition/ allergy	To lose weight	For personal beliefs
Educational attainment				
No formal education	24 (26.1)	7 (7.6)	10 (10.9)	3 (3.3)
Primary or secondary	473 (23.6)	178 (8.9)	260 (13.0)	26 (1.3)
College	530 (26.6)	164 (8.2)	263 (13.2)	106 (5.3)
University	197 (21.7)	67 (7.4)	78 (8.6)	63 (7.0)
Still a student	8 (15.4)	1 (1.9)	3 (5.8)	2 (3.8)
Socio-Economic Index (SEI)				
1. Lowest fifth	222 (25.9)	89 (10.4)	103 (12.0)	24 (2.8)
2.	280 (27.2)	105 (10.2)	138 (13.4)	42 (4.1)
3.	188 (21.7)	74 (8.5)	79 (9.1)	33 (3.8)
4.	345 (25.3)	99 (7.3)	175 (12.8)	62 (4.6)
5. Highest fifth	197 (21.3)	50 (5.4)	119 (12.8)	39 (4.2)
Fifths of TDS				
1 – most affluent	251 (24.6)	95 (9.3)	123 (12.0)	43 (4.2)
2	226 (22.2)	73 (7.2)	105 (10.3)	32 (3.1)
3	213 (21.4)	70 (7.0)	100 (10.1)	46 (4.6)
4	278 (27.7)	77 (7.7)	150 (15.0)	52 (5.2)
5 – least affluent	264 (26.2)	102 (10.1)	136 (13.5)	27 (2.7)
Weekly food expenditure fifths				
1. Lowest fifth	221 (22.7)	68 (7.0)	107 (11.0)	41 (4.2)
2.	156 (20.8)	51 (6.8)	74 (9.9)	29 (3.9)
3.	257 (23.5)	97 (8.9)	130 (11.9)	41 (3.7)
4.	168 (25.7)	54 (8.3)	87 (13.3)	23 (3.5)
5. Highest fifth	328 (27.5)	109 (9.2)	170 (14.3)	47 (3.9)
Fifths of food knowledge score				
1 – least knowledge	244 (20.0)	78 (6.4)	115 (9.4)	22 (1.8)
2	249 (22.4)	90 (8.1)	108 (9.7)	42 (3.8)
3	189 (27.2)	67 (9.7)	108 (15.6)	24 (3.5)
4	322 (25.8)	106 (8.5)	177 (14.2)	45 (3.6)
5 – most knowledge	228 (29.6)	76 (9.9)	106 (13.8)	67 (8.7)

6.4 Knowledge of diet and nutrition

Higher overall knowledge scores were obtained by women, younger and middle aged people, the more affluent and better educated, white Europeans, those married or living as married, households with two or more adults, those with adequate cooking facilities and those who shop at multiple supermarkets or other types of store (Table 49). Lower scores were obtained by men, those aged 16-24 years and over 74 years, the widowed and those from non-white ethnic minority groups, those with no formal education, those living is less affluent areas, those with lowest SEI, those with less than adequate cooking facilities, the underweight and those who shop at discount stores.

Table 49: Nutritional knowledge score by selected demographic and health variables

	No.	Mean (SD)		No.	Mean (SD)
Sex			**Household composition**		
Male	2068	11.9 (3.3)	1 adult	1108	11.9 (3.6)
Female	2976	12.8 (3.2)	2 adults	1886	12.5 (3.3)
Persons	5044	12.4 (3.3)	≥3 adults	835	12.5 (2.9)
Age			1 adult, ≥1 child	159	11.8 (3.0)
16-24	517	11.6 (2.8)	≥2 adults, ≥1 child	1056	12.8 (3.2)
25-34	783	12.6 (2.9)	**Body mass index**		
35-44	834	13.0 (3.1)	Underweight	70	11.2 (2.6)
45-54	941	13.2 (3.0)	Ideal weight	1104	12.4 (3.2)
55-64	816	12.5 (3.5)	Overweight	2144	12.6 (3.3)
65-74	697	11.7 (3.4)	Obese	1565	12.4 (3.1)
Over 75	456	10.7 (3.7)	**Self rated health**		
Marital status			Very good	834	12.8 (3.5)
Single	1115	12.0 (3.2)	Good	1801	12.9 (2.9)
Married	2684	12.8 (3.1)	Neither good nor poor	1794	12.1 (3.3)
Living as married	367	12.7 (3.0)	Poor or very poor	555	11.3 (3.4)
Separated	88	12.1 (3.6)	**Activity limiting long term illness**		
Divorced	349	12.1 (3.4)	None	3525	12.5 (3.1)
Widowed	441	10.9 (3.7)	Long term illness, no limitation	441	12.7 (3.5)
Ethnic group			Long term illness + limitation	1026	12.3 (3.5)
White European	4774	12.5 (3.2)			
Other ethnic groups	219	10.0 (3.9)			
Other white	143	9.9 (4.1)			
Black groups	14	11.1 (2.6)			
South Asians	38	9.8 (3.2)			
Chinese	4	9.0 (4.8)			

Table 50: Nutritional knowledge score by socio-economic variables

	No.	Mean (SD)
Educational attainment		
None	92	7.7 (4.1)
Primary or secondary	2005	11.4 (3.3)
College	1989	13.0 (2.8)
Still a student	906	13.9 (2.8)
University	52	11.4 (3.0)
Employment status (Head of household)		
Registered unemployed	234	10.7 (3.5)
Paid employment	2664	13.1 (2.8)
Other	2146	11.7 (3.5)
Socio-Economic Index (SEI)		
1. Lowest fifth	856	10.4 (3.5)
2.	1031	11.6 (3.4)
3.	868	12.6 (3.1)
4.	1362	13.2 (2.7)
5. Highest fifth	927	13.7 (2.7)
TDS of Home ED		
1. Most affluent	1021	13.3 (2.9)
2.	1017	13.1 (2.9)
3.	994	12.6 (3.2)
4.	1003	11.9 (3.4)
5. Least affluent	1009	11.0 (3.4)
Standard of Living Index for Cooking		
Adequate facilities	4965	12.4 (3.2)
Less adequate facilities	79	8.9 (4.1)
Main shop type		
Discounters	636	10.8 (3.5)
Multiple supermarkets	4006	12.7 (3.1)
Department stores	111	11.8 (3.7)
Other types of shop	64	12.1 (3.3)
Not known	226	11.6 (3.9)

Dietary knowledge was related to all three healthy eating indices (see Table 51). Greater knowledge was associated with eating more fruit and vegetables and less fat. It was also associated with eating more NSP, although this trend was less clear-cut.

Table 51: Dietary indices by nutritional fifths of dietary knowledge score

	Mean (standard deviation)		
	Fruit and vegetable Index	NSP Index	Fat Index
Quintiles of dietary knowledge score			
1. Lowest fifth	-0.12 (1.03)	-0.10 (0.87)	0.20 (1.01)
2.	-0.080 (0.91)	-0.027 (0.78)	0.060 (1.00)
3. Middle fifth	0.039 (1.57)	0.093 (1.96)	0.024 (1.08)
4.	0.050 (0.72)	0.031 (0.66)	-0.13 (0.96)
5. Highest fifth	0.19 (0.70)	0.071 (0.57)	-0.22 (0.92)

6.5 Health status

The data on health status displayed striking relationships with most social and demographic variables. Two variables are presented in Table 52 and Table 53: long term illness and self reported health. In Table 54 and Table 55 data is presented on body mass index.

6.5.1 Long term illness and self-rated health

Long term illness was more common among men than women and showed a steep gradient with age, from 8.9% having any long term illness at age 16-24 years to 57.7% at ages over 75 years (Table 52). Long term illness was more common among separated, widowed and divorced groups as well as those living in households with one or two adults but no children.

Self rated health displayed similar trends, although it is noticeable that higher than expected proportions reported poor or very poor health among the 16-24 year old age group and amongst single adults with one or more child.

Both long term illness and self reported health showed striking trends with all socio-economic indicators, being more common among the less affluent/more disadvantaged groups (Table 53).

6.5.2 Body mass index

Overall, 43.9% of the sample were overweight (BMI 25-29.9 kgm^{-2}) and 32.1% were obese (BMI >30 kgm^{-2}). Mean BMI was 28.6 (SD 5.3) kgm^{-2}. Body mass index had a 'flatter' distribution among women, with higher proportions in the underweight, ideal weight and obese groups (Table 54). Body mass index increased with age until age 75. The greatest proportion (5.5%) of underweight (BMI <20 kgm^{-2}) individuals were in the 16-24 age group. Overweight and obesity were more common among the white European group than other ethnic groups and were related to other health indicators. Those reporting 'good' health were

more likely to be overweight or ideal weight and less likely to be obese, whilst those reporting poor health or long term illness were more likely to be underweight or obese.

Markers of low socio-economic status were universally associated with being underweight or obese, whilst higher socio-economic position was associated with being an ideal weight or overweight (Table 55). Perhaps the most striking relationship was that between access to cooking facilities and BMI. Those with less adequate facilities were five times as likely to be underweight (7.2%) and less likely to be obese that those with adequate facilities.

Table 52: Number (%) with long term illness and self rated health by selected demographic variables

	Long term illness (LTI)			Self reported health			
	None	With no limitation of activity	Activity limiting LTI	Very good	Good	Neither good nor poor	Poor or very poor
Sex							
Men	1449 (70.1)	201 (9.7)	418 (20.2)	352 (17.2)	761 (37.2)	702 (34.3)	231 (11.3)
Women	2136 (71.8)	220 (7.4)	620 (20.8)	482 (16.4)	1040 (35.4)	1092 (37.2)	324 (11.0)
Persons	3525 (69.9)	441 (8.7)	1026 (20.3)	834 (16.5)	1801 (35.7)	1794 (35.6)	555 (11.0)
Age groups							
16-24 years	471 (91.1)	27 (5.2)	19 (3.7)	75 (14.7)	198 (38.7)	173 (33.9)	65 (12.7)
25-34 years	683 (87.2)	35 (4.5)	65 (8.3)	103 (13.3)	347 (44.8)	251 (32.4)	74 (9.5)
35-44 years	677 (81.2)	57 (6.8)	100 (12.0)	135 (16.2)	313 (37.6)	304 (36.5)	80 (9.6)
45-54 years	707 (75.1)	66 (7.0)	168 (17.9)	154 (16.5)	335 (36.0)	354 (38.0)	88 (9.5)
55-64 years	496 (60.8)	80 (9.8)	240 (29.4)	152 (18.9)	281 (34.9)	268 (33.3)	104 (12.9)
65-74 years	358 (51.4)	104 (14.9)	235 (33.7)	123 (18.0)	211 (30.8)	264 (38.6)	86 (12.6)
75+ years	193 (42.3)	52 (11.4)	211 (46.3)	92 (20.6)	116 (26.0)	180 (40.4)	58 (13.0)
Marital status							
Single	894 (80.2)	77 (6.9)	144 (12.9)	178 (16.2)	411 (37.3)	386 (35.1)	126 (11.4)
Married	1889 (70.4)	234 (8.7)	561 (20.9)	475 (17.9)	976 (36.7)	942 (35.5)	263 (9.9)
Living as married	316 (86.1)	19 (5.2)	32 (8.7)	36 (9.9)	160 (44.2)	128 (35.4)	38 (10.5)
Separated	61 (69.3)	10 (11.4)	17 (19.3)	17 (19.3)	31 (35.2)	31 (35.2)	9 (10.2)
Divorced	212 (60.7)	27 (7.7)	110 (31.5)	48 (14.0)	101 (29.5)	134 (39.2)	59 (17.3)
Widowed	213 (48.3)	54 (12.2)	174 (39.5)	80 (18.4)	122 (28.0)	173 (39.8)	60 (13.8)
Ethnic groups							
White European	3400 (71.2)	401 (8.4)	973 (20.4)	782 (16.6)	1721 (36.5)	1701 (36.0)	515 (10.9)
Other ethnic groups	156 (71.2)	17 (7.8)	46 (21.0)	42 (19.5)	61 (28.4)	82 (38.1)	30 (14.0)
Household composition							
Single adult	682 (61.6)	110 (9.9)	316 (28.5)	192 (17.6)	363 (33.2)	413 (37.8)	124 (11.4)
2 adults	1232 (65.3)	177 (9.4)	477 (25.3)	326 (17.5)	675 (36.3)	634 (34.1)	226 (12.1)
3 or more adults	644 (77.1)	65 (7.8)	126 (15.1)	124 (15.1)	315 (38.3)	304 (36.9)	80 (9.7)
1 adult, 1 or more child	124 (78.0)	9 (5.7)	26 (16.4)	15 (9.4)	47 (29.6)	67 (42.1)	30 (18.9)
2 or more adults & children	903 (85.5)	60 (5.7)	93 (8.8)	177 (16.9)	401 (38.2)	376 (35.8)	95 (9.1)

Table 53: Number (%) with long term illness and self rated health by selected socio-economic variables

	Long term illness (LTI)			Self reported health			
	None	With no limitation of activity	Activity limiting LTI	Very good	Good	Neither good nor poor	Poor or very poor
Unemployment							
Registered unemployed	181 (78.4)	18 (7.8)	32 (13.9)	36 (15.7)	62 (27.1)	91 (39.7)	40 (17.5)
Paid employment	2286 (86.4)	187 (7.1)	174 (6.6)	442 (16.7)	1124 (42.4)	912 (34.4)	172 (6.5)
Other	1058 (50.0)	236 (11.2)	820 (38.8)	356 (16.9)	615 (29.2)	91 (37.6)	343 (16.3)
Welfare							
On benefits	1175 (53.8)	228 (10.4)	781 (35.8)	314 (14.6)	624 (29.0)	848 (39.4)	366 (17.0)
Unknown	81 (50.9)	20 (12.6)	58 (36.5)	27 (17.6)	41 (26.8)	65 (42.5)	20 (13.1)
Not on benefits	2329 (86.2)	173 (6.4)	199 (7.4)	493 (18.4)	1136 (42.4)	881 (32.9)	169 (6.3)
Educational attainment							
No formal education	40 (43.5)	12 (13.0)	40 (43.5)	15 (16.9)	22 (24.7)	29 (32.6)	23 (25.8)
Primary or secondary only	1272 (63.4)	166 (8.3)	567 (28.3)	294 (15.0)	579 (29.5)	813 (41.4)	276 (14.1)
College	1492 (75.0)	170 (8.5)	327 (16.4)	316 (15.9)	777 (39.2)	693 (35.0)	196 (9.9)
University	735 (81.1)	70 (7.7)	101 (11.1)	200 (22.2)	406 (45.2)	237 (26.4)	56 (6.2)
Still in FT education	46 (88.5)	3 (5.8)	3 (5.8)	9 (17.3)	17 (32.7)	22 (42.3)	4 (7.7)
Socio-Economic Index (SEI)							
1. Lowest fifth (most deprived)	445 (52.7)	82 (9.7)	317 (37.6)	104 (12.4)	216 (25.8)	347 (41.5)	169 (20.2)
2.	625 (61.7)	90 (8.9)	298 (29.4)	155 (15.3)	272 (26.9)	428 (42.3)	156 (15.4)
3.	614 (71.6)	68 (7.9)	176 (20.5)	147 (17.1)	316 (36.7)	322 (36.1)	87 (10.1)
4.	1049 (77.5)	126 (9.3)	178 (13.2)	229 (16.9)	581 (42.9)	449 (33.2)	94 (6.9)
5. Highest fifth (most affluent)	792 (85.7)	75 (8.1)	57 (6.2)	199 (21.6)	416 (45.1)	259 (28.1)	49 (5.3)
Fifths of TDS for home ED							
1. Most affluent fifth	75 (74.7)	102 (10.1)	154 (15.2)	197 (19.4)	442 (43.5)	300 (29.5)	78 (7.7)
2.	755 (75.0)	86 (8.5)	165 (16.4)	230 (22.9)	383 (38.1)	336 (33.4)	57 (5.7)
3.	721 (73.0)	84 (8.5)	182 (18.4)	153 (15.5)	383 (38.9)	352 (35.8)	96 (9.8)
4.	672 (67.9)	82 (8.3)	235 (23.8)	136 (13.7)	329 (33.2)	395 (39.8)	132 (13.3)
5. Most deprived fifth	620 (62.2)	87 (8.7)	290 (29.1)	118 (12.0)	264 (26.8)	411 (41.7)	192 (19.5)

Table 54: Number (%) in body mass index categories by selected demographic and health variables

	Underweight (BMI <20)	Ideal weight (BMI 20-24.9)	Overweight (BMI 25-29.9)	Obese (BMI ≥30)
Sex				
Men	22 (1.1)	360 (17.9)	966 (48.0)	663 (33.0)
Women	48 (1.7)	744 (25.9)	1178 (41.0)	902 (31.4)
Persons	70 (1.4)	1104 (21.9)	2144 (42.5)	1565 (31.0)
Age groups				
16-24 years	27 (5.5)	235 (47.6)	166 (33.6)	66 (13.4)
25-34 years	8 (1.1)	235 (31.0)	328 (43.3)	186 (24.6)
35-44 years	6 (0.7)	178 (22.0)	373 (46.2)	251 (31.1)
45-54 years	6 (0.7)	156 (16.9)	422 (45.8)	337 (36.6)
55-64 years	7 (0.9)	108 (13.6)	358 (45.2)	319 (40.3)
65-74 years	8 (1.2)	102 (15.2)	287 (42.6)	276 (41.0)
75+ years	8 (1.8)	90 (20.5)	210 (47.9)	130 (29.7)
Marital status				
Single	35 (3.3)	384 (36.2)	406 (38.3)	235 (22.2)
Married	18 (0.7)	467 (17.8)	1209 (46.1)	927 (35.4)
Living as married	5 (1.4)	92 (25.8)	172 (48.2)	88 (24.6)
Separated	0	18 (21.2)	39 (45.9)	28 (32.9)
Divorced	5 (1.5)	65 (19.3)	137 (40.8)	129 (38.4)
Widowed	7 (1.7)	78 (18.4)	181 (42.7)	158 (37.3)
Ethnic groups				
White European	66 (1.4)	1029 (22.2)	2047 (44.2)	1492 (32.2)
Other ethnic groups	4 (2.0)	65 (31.7)	82 (40.0)	54 (26.3)
Household composition				
Single adult	17 (1.6)	229 (21.6)	463 (43.7)	351 (33.1)
2 adults	18 (1.0)	356 (19.4)	821 (44.6)	644 (35.0)
3 or more adults	15 (1.9)	209 (26.0)	344 (42.7)	237 (29.4)
1 adult, 1 or more child	2 (1.3)	34 (22.2)	69 (45.1)	48 (31.4)
2 or more adults & children	18 (1.8)	276 (26.9)	447 (43.6)	285 (27.8)
Self rated health				
Very good	8 (1.0)	274 (33.9)	386 (47.8)	140 (17.3)
Good	22 (1.2)	435 (24.7)	87 (49.8)	427 (24.2)
Neither good nor poor	28 (1.6)	303 (17.5)	699 (40.4)	699 (40.4)
Poor or very poor	11 (2.1)	79 (14.8)	164 (30.8)	279 (52.3)
Activity limiting long term illness				
None	48 (1.4)	886 (25.9)	1555 (45.4)	936 (27.3)
Long term illness, no limitation	3 (0.7)	72 (16.5)	202 (46.3)	159 (36.5)
Long term illness with limitation	18 (1.8)	142 (14.2)	379 (37.9)	461 (46.1)

Table 55: Number (%) in body mass index categories by selected socio-economic variables

	Underweight (BMI <20)	Ideal weight (BMI 20-24.9)	Overweight (BMI 25-29.9)	Obese (BMI ≥30)
Unemployment				
Registered unemployed	10 (4.4)	63 (28.0)	77 (34.2)	75 (33.3)
Paid employment	20 (0.8)	638 (24.6)	1193 (46.0)	742 (28.6)
Other	40 (1.9)	403 (19.5)	874 (42.3)	748 (36.2)
Welfare				
On benefits	41 (1.9)	390 (18.5)	864 (41.0)	811 (38.5)
Unknown	1 (0.7)	32 (20.9)	71 (46.4)	49 (32.0)
Not on benefits	28 (1.1)	682 (26.0)	1209 (46.1)	705 (26.9)
Educational attainment				
No formal education	2 (2.5)	25 (31.3)	23 (29.8)	30 (37.5)
Primary or secondary only	26 (1.3)	331 (17.1)	818 (42.2)	762 (39.3)
College	26 (1.3)	453 (23.4)	868 (44.9)	587 (30.4)
University	12 (1.4)	274 (31.0)	420 (47.6)	177 (20.0)
Still in full time education	4 (8.2)	21 (42.9)	15 (30.6)	9 (18.4)
Socio-Economic Index (SEI)				
1. Lowest fifth (most deprived)	18 (2.2)	169 (20.9)	320 (39.5)	303 (37.4)
2.	24 (2.4)	219 (21.9)	413 (41.4)	342 (34.3)
3.	8 (1.0)	179 (21.3)	369 (43.8)	286 (34.0)
4.	14 (1.1)	292 (22.0)	626 (47.1)	396 (29.8)
5. Highest fifth (most affluent)	6 (0.7)	245 (27.1)	416 (46.0)	238 (26.3)
Fifths of TDS for home ED				
1. Most affluent fifth	9 (0.9)	231 (23.4)	476 (48.1)	273 (27.6)
2.	11 (1.1)	250 (25.2)	457 (46.1)	274 (27.6)
3.	15 (1.6)	230 (23.8)	445 (46.0)	277 (28.6)
4.	13 (1.3)	191 (19.7)	397 (40.9)	369 (38.0)
5. Most deprived fifth	22 (2.3)	202 (20.9)	369 (38.2)	372 (38.5)
SLI for cooking				
Less adequate facilities	5 (7.2)	22 (31.9)	27 (39.1)	15 (21.7)
Adequate facilities	65 (1.4)	1082 (22.5)	2117 (44.0)	1550 (32.2)

6.6 Other health related behaviours

6.6.1 Alcohol consumption

Data on reported units of alcohol consumed are presented below by demographic and health variables (Table 56) and socio-economic and food shopping variables (Table 57). Overall, 84.4% drank within safe limits, 14.4% drank risky amounts of alcohol and 1.2% hazardous amounts. Median consumption per week by 'safe' drinkers was 4 units (IQR 1-10), by 'risky' drinkers 25 units (IQR 20-30) and by 'hazardous' drinkers 60 units (IQR 52.5-70) (for definitions of risk categories, see Table 9). As expected men drank more than women and there was a peak of risky and hazardous consumption in middle age. Those with poor self-reported health or limiting long term illness reported less risky or hazardous alcohol consumption than those with better health. There was a trend towards higher consumption among the more affluent (higher SEI), those living in more affluent areas (more negative

TDS) and those with a college education. In relation to food shopping, there was no obvious relationship with type of food store.

Table 56: Reported units of alcohol consumed* by selected demographic and health variables

	Number in category (%)			Median units/week (IQR)
	Safe consumption	Risky consumption	Hazardous consumption	
Sex				
Male	1553 (78.3)	389 (19.6)	42 (2.1)	10.0 (4-20)
Female	2426 (88.8)	291 (10.7)	14 (0.5)	4.0 (1-10)
Persons	3979 (84.4)	680 (14.4)	56 (1.2)	6.0 (1-14)
Age				
16-24	412 (83.2)	81 (16.4)	2 (0.4)	7.0 (2-14)
25-34	614 (81.3)	133 (17.6)	8 (1.1)	8.0 (3-15)
35-44	678 (84.6)	113 (14.1)	10 (1.2)	7.0 (2-14)
45-54	709 (79)	172 (19.2)	16 (1.8)	8.0 (2-16)
55-64	643 (84.9)	104 (13.7)	10 (1.3)	6.0 (1-14)
65-74	557 (89.1)	59 (9.4)	9 (1.4)	3.0 (0-10)
Over 75	366 (95.1)	18 (4.7)	1 (0.3)	2.0 (0-7)
Ethnic group				
White European	3780 (84)	665 (14.8)	53 (1.2)	6.0 (2-14)
Other ethnic groups	157 (90.2)	14 (8)	3 (1.7)	2.0 (0-7)
Household composition				
1 adult	836 (84.4)	142 (14.3)	13 (1.3)	4.0 (1-14)
2 adults	1507 (84.9)	243 (13.7)	25 (1.4)	6.0 (1-14)
3 or more adults	640 (80.9)	143 (18.1)	8 (1)	8.0 (2-16)
1 adult, 1 or more children	133 (89.9)	14 (9.5)	1 (0.7)	5.0 (1-10)
2 or more adults, 1 or more children	863 (85.4)	138 (13.7)	9 (0.9)	6.0 (2-14)
Body mass index				
Underweight	63 (96.9)	2 (3.1)	0	2.0 (0-9.25)
Ideal weight	900 (86.9)	129 (12.5)	7 (0.7)	6.0 (2.0-12.0)
Overweight	1690 (82.8)	326 (16.0)	25 (1.2)	7.0 (2.0-15.0)
Obese	1225 (84.0)	210 (14.4)	24 (1.6)	6.0 (1.0-14.0)
Self rated health				
Very good	693 (88.4)	86 (11.0)	5 (0.6)	6.0 (2.0-12.0)
Good	1432 (83.0)	271 (15.7)	23 (1.3)	7.0 (2.0-15.0)
Neither good nor poor	1375 (82.7)	265 (15.9)	22 (1.3)	6.0 (1.0-14.0)
Poor or very poor	437 (88.1)	54 (10.9)	5 (1.0)	3.0 (0-10.0)
Long term illness				
None	2766 (82.3)	550 (16.4)	44 (1.3)	7.0 (2.0-15.0)
Long term illness, no limitation	361 (87.8)	44 (10.7)	6 (1.5)	6.0 (1.0-14.0)
Long term illness with limitation	829 (90.1)	85 (9.2)	6 (0.7)	3.0 (0-9.75)

* see methods section 4.4.4.7

Table 57: Reported units of alcohol consumed* by selected socio-economic and food shopping variables

	Number in category (%)			Median units/week (IQR)
	Safe consumption	Risky consumption	Hazardous consumption	
Educational attainment				
Still a student	43 (86)	7 (14)	0	2.5 (0-10)
None	57 (95)	3 (5)	0	1.0 (0-6)
Primary or secondary	1584 (87.5)	204 (11.3)	23 (1.3)	5.0 (1-12)
College	1575 (81.9)	325 (16.9)	24 (1.2)	7.0 (2-14)
University	720 (82.8)	141 (16.2)	9 (1)	8.0 (3-15)
Employment status (Head of household)				
Registered unemployed	166 (79.0)	40 (19.0)	4 (1.9)	6.0 (1.0-16.0)
In paid employment	2109 (81.5)	445 (17.2)	33 (1.3)	8.0 (3.0-16.0)
Other	1704 (88.8)	195 (10.2)	19 (1.0)	4.0 (0-10.0)
Socio-Economic Index (SEI)				
1. Lowest fifth	653 (89.1)	73 (10.0)	7 (1.0)	4.0 (0-10)
2.	808 (86.1)	124 (13.2)	6 (0.6)	4.0 (1-12)
3.	706 (85.6)	104 (12.6)	15 (1.8)	6.0 (1-13)
4.	1088 (83.1)	205 (15.7)	16 (1.2)	7.0 (2-15)
5. Highest fifth	724 (79.6)	174 (19.1)	12 (1.3)	9.0 (4-16)
TDS fifths				
1. – most affluent fifth	827 (83.8)	153 (15.5)	7 (0.7)	7.0 (2-14)
2.	823 (85.8)	125 (13.0)	11 (1.1)	6.0 (2-14)
3.	780 (83.0)	149 (15.9)	11 (1.2)	7.0 (2-14)
4.	760 (82.5)	141 (15.3)	20 (2.2)	6.0 (1-14)
5. – most deprived fifth	789 (86.9)	112 (12.3)	7 (0.8)	5.0 (1-12)
Standard of Living Index for Cooking				
Adequate facilities	3930 (84.3)	676 (14.5)	55 (1.2)	6.0 (2-14)
Less adequate facilities	49 (90.7)	4 (7.4)	1 (1.9)	1.0 (0-7)
Main shop type				
Discounters	477 (85.2)	73 (13)	10 (1.8)	5.0 (0-12)
Multiple supermarkets	3183 (83.9)	568 (15)	42 (1.1)	6.0 (2-14)
Department stores	89 (87.3)	11 (10.8)	2 (2)	3.0 (0-14)
Other types of shop	53 (85.5)	8 (12.9)	1 (1.6)	3.5 (0-10)
Not known	177 (89.4)	20 (10.1)	1 (0.5)	5.0 (1-12)

* For definitions of categories, see section Table 9

6.6.2 Physical activity

Variables for light, moderate and strenuous physical activity had skewed distributions with a substantial proportion of zero values (i.e. inactive respondents). Mildly energetic activity was *not* undertaken by 679 (13.5%). The median value for mildly energetic activity was 5 hours/week, with an inter-quartile range of 2-10 hours/week. Moderately energetic activity was *not* undertaken by 1901 (37.7%), with a median value of 2 (IQR: 0-4) hours/week.

Vigorous activity was *not* undertaken by 3758 (74.5%) with a median of 0 (IQR: 0-1) hours/week.

In Table 58 and Table 59, data are presented on usual daily physical activity and the combined 'activity score' (see methods section 4.5.4.7). Overall, women were more likely to be active at work than men, though men were more likely to do 'heavy' work (Table 58). Women also had a higher overall activity score than men. Overall, both work and leisure time activity decreased with age, although activity score increased to ages 55-74, before falling again in those over 75 years. Single adults with one or more child reported higher activity scores than members of other types of households. The obese and overweight were more likely to report usually sitting at work, but also 'heavy' work. Activity score was highest for those of ideal weight. Those with poor or very poor self rated health or activity limiting long term illness, underweight BMI, no education, non-white ethnicity or over 75 years reported the lowest activity scores.

Sedentary work was more common among more affluent groups (Table 59). However, the more affluent had higher activity scores, suggesting greater levels of leisure time activity. Activity score was also higher among those who owned more cars as well as those who used a car for shopping, suggesting that leisure time activity, as opposed to active travel, contributed more to overall activity. Those who used multiple supermarkets and department stores had the highest activity scores and those who shopped at 'other' stores (i.e. mostly convenience stores) had the lowest activity scores. Higher activity score was associated with a higher dietary knowledge score.

Table 58: Usual daily physical activity levels by selected demographic and health variables

	Number in group (%)				Median physical activity score (IQR)
	Usually sitting	Standing or walking	Light loads, stairs or hills	Heavy work or loads	
Sex					
Male	581 (28.9)	848 (42.2)	359 (17.9)	220 (11.0)	4.0 (2.0-7.7)
Female	757 (26.1)	1412 (48.7)	643 (22.2)	85 (2.9)	4.6 (2.5-8.8)
Persons	1338 (27.3)	2260 (46.1)	1002 (20.4)	305 (6.2)	4.3 (2.3-8.3)
Age					
16-24	117 (22.9)	232 (45.5)	119 (23.3)	42 (8.2)	5.3 (3.3-9.7)
25-34	274 (35.7)	300 (39.1)	135 (17.6)	58 (7.6)	4.6 (2.7-7.8)
35-44	272 (33.1)	330 (40.1)	150 (18.2)	70 (8.5)	4.5 (2.5-7.8)
45-54	288 (31.1)	403 (43.5)	163 (17.6)	73 (7.9)	4.2 (2.3-8.0)
55-64	178 (22.4)	381 (48.0)	184 (23.2)	50 (6.3)	4.5 (2.0-8.8)
65-74	105 (15.9)	406 (61.5)	144 (21.8)	5 (0.8)	5.0 (2.2-9.3)
Over 75	104 (24.4)	208 (48.8)	107 (25.1)	7 (1.6)	3.0 (1.0-6.7)
Ethnic group					
White European	1285 (27.6)	2127 (45.8)	946 (20.3)	291 (6.3)	4.7 (2.3-8.5)
Other ethnic groups	46 (21.9)	107 (51.0)	45 (21.4)	12 (5.7)	3.0 (1.3-6.8)
Household composition					
1 adult	302 (28.5)	498 (47.0)	224 (21.2)	35 (3.3)	4.0 (2.0-7.0)
2 adults	470 (25.7)	890 (48.6)	378 (20.6)	93 (5.1)	4.7 (2.3-8.3)
3 or more adults	237 (28.9)	357 (43.6)	150 (18.3)	75 (9.2)	4.8 (2.5-8.67)
1 adult, 1 or more children	30 (19.5)	70 (45.5)	43 (27.9)	11 (7.1)	6.3 (3.2 (11.2)
2 or more adults, 1 or more children	299 (28.7)	445 (42.7)	207 (19.9)	91 (8.7)	4.5 (2.5-9.0)
Educational attainment					
Still a student	12 (23.5)	22 (43.1)	17 (33.3)	0	5.0 (3.0-7.6)
None	27 (32.1)	38 (45.2)	11 (13.1)	8 (9.5)	2.0 (0-4.0)
Primary or secondary	472 (24.6)	910 (47.4)	394 (20.5)	144 (7.5)	4.0 (1.7-8.0)
College	500 (25.6)	859 (44.0)	456 (23.3)	138 (7.1)	5.0 (2.8-9.2)
University	327 (36.5)	431 (48.0)	124 (13.8)	15 (1.7)	4.7 (2.5-7.7)
Body mass index					
Underweight	14 (20.9)	31 (46.3)	21 (31.3)	1 (1.5)	3.8 (2.0-7.7)
Ideal weight	248 (23.0)	517 (48.0)	251 (23.3)	60 (5.6)	5.0 (2.7-9.2)
Overweight	542 (25.7)	101 (48.0)	421 (20.0)	132 (6.3)	48 (2.5-8.7)
Obese	485 (32.2)	648 (43.0)	273 (18.1)	101 (6.7)	4.0 (2.0-7.7)
Long term illness					
None	888 (25.3)	1613 (25.3)	751 (21.4)	252 (7.2)	4.7 (2.0-8.7)
Long term illness, no limitation	76 (18.7)	202 (49.6)	99 (24.3)	30 (7.4)	5.0 (3.0-10.0)
Long term illness with limitation	374 (37.6)	445 (44.8)	152 (15.3)	23 (2.3)	3.3 (1.0-7.0)
Self rated health					
Very good	137 (16.9)	397 (48.9)	223 (27.0)	55 (6.8)	5.5 (3.0-10.0)
Good	448 (25.2)	847 (47.6)	374 (21.0)	112 (6.3)	5.0 (3.0-9.0)
Neither good nor poor	499 (28.5)	809 (46.1)	336 (19.2)	109 (6.2)	4.0 (2.0-7.7)
Poor or very poor	247 (46.2)	196 (36.6)	65 (12.1)	27 (5.0)	2.8 (1.00-6.00)

Table 59: Usual daily physical activity by selected socio-economic, dietary and food shopping variables

	Number in group (%)				Median physical activity score (IQR)
	Usually sitting	Standing or walking	Light loads, stairs or hills	Heavy work or loads	
Car ownership					
None	334 (23.5)	665 (46.8)	348 (24.5)	73 (5.1)	4.0 (1.7-8.2)
1 car	624 (28.1)	1025 (46.2)	444 (20.0)	124 (5.6)	4.8 (2.3-8.7)
2 cars	322 (30.6)	473 (44.9)	174 (16.5)	84 (8.0)	4.7 (2.8-8.0)
3 cars	50 (26.9)	87 (46.8)	29 (15.6)	20 (10.8)	4.7 (2.5-7.7)
4 or more cars	8 (27.6)	10 (34.5)	7 (24.1)	4 (13.8)	5.5 (3.0-9.3)
Unemployment (Head of household)					
Registered unemployed	46 (20.8)	105 (47.5)	52 (23.5)	18 (8.1)	4.2 (2.0-8.5)
Paid employment	873 (33.1)	1042 (39.5)	469 (17.8)	252 (9.6)	4.5 (2.5-7.7)
Other	419 (20.5)	1113 (54.3)	481 (23.5)	35 (1.7)	4.7 (2.0-9.2)
Socio-Economic Index (SEI)					
1. Lowest fifth	197 (24.7)	379 (47.4)	185 (23.2)	38 (4.8)	3.5 (1.3-8.0)
2.	239 (24.0)	470 (47.2)	233 (23.4)	53 (5.3)	4.2 (2.0-8.0)
3.	215 (25.3)	423 (48.6)	166 (19.5)	56 (6.6)	4.5 (2.5-8.5)
4.	384 (28.6)	563 (41.9)	284 (21.1)	112 (8.3)	5.0 (2.5-8.8)
5. Highest fifth	303 (33.0)	435 (47.4)	134 (14.6)	46 (5.0)	4.7(2.8-7.8)
Fifths of TDS for home ED					
1 – most affluent	264 (26.3)	508 (50.6)	189 (18.8)	43 (4.3)	5.0 (2.8-8.7)
2	287 (28.6)	459 (45.8)	204 (20.3)	53 (5.3)	4.7 (2.5-8.3)
3	289 (29.8)	434 (44.7)	181 (18.7)	66 (6.8)	4.3 (2.3-8.0)
4	263 (27.3)	430 (44.6)	194 (20.1)	77 (8.0)	4.2 (2.0-8.5)
5 – least affluent	235 (24.4)	429 (44.5)	234 (24.3)	66 (6.8)	4.0 (2.0-8.2)
Cost of weekly food per adult equivalent					
1. Lowest fifth	217 (23.3)	447 (47.9)	209 (22.4)	60 (6.4)	4.5 (2.3-8.5)
2.	197 (27.1)	317 (43.5)	166 (22.8)	48 (6.6)	4.3 (2.0-8.5)
3.	288 (26.8)	511 (47.6)	214 (19.9)	61 (5.7)	4.7 (2.3-8.7)
4.	189 (29.3)	298 (46.3)	114 (17.7)	43 (6.7)	4.3 (2.5-7.7)
5. Highest fifth	354 (30.)	514 (44.2)	222 (19.1)	73 (6.3)	4.7 (2.3-8.3)
Dietary knowledge score					
1. Lowest fifth	292 (25.4)	543 (47.2)	214 (18.6)	102 (8.9)	3.5 (1.3-6.7)
2.	291 (26.9)	459 (42.5)	251 (23.2)	80 (7.4)	4.7 (2.3-8.7)
3.	182 (26.6)	314 (45.8)	146 (21.3)	43 (6.3)	4.7 (2.3-8.3)
4.	357(29.0)	577 (46.9)	235 (19.1)	61 (5.0)	5.0 (2.7-9.0)
5. Highest fifth	216 (28.5)	367 (48.4)	156 (20.6)	19 (2.5)	5.2 (3.1-8.5)
Category of main shop					
Multiple supermarket	1119 (28.5)	1810 (46.2)	748 (19.1)	244 (6.2)	5.0 (2.7-8.7)
Discount supermarket	127 (20.8)	268 (43.9)	169 (27.7)	46 (7.5)	4.2 (1.5-8.7)
Department store	24 (22.6)	53 (50.0)	26 (24.5)	3 (2.8)	5.1 (2.8-8.5)
Not known	53 (25.6)	98 (47.3)	49 (23.7)	7 (3.4)	3.8 (1.3-8.0)
All other	15 (25.0)	30 (5.0)	10 (16.7)	5 (8.3)	3.5 (1.7-6.7)
Mode of travel from main food shop					
Foot	140 (21.7)	311 (48.2)	165 (25.6)	29 (4.5)	4.7 (2.2-9.7)
Car	985 (29.9)	1496 (45.5)	602 (18.3)	208 (6.3)	5.0 (2.7-8.7)
Public transport	99 (18.8)	254 (48.1)	139 (26.3)	36 (6.8)	3.8 (2.0-8.0)
Bike	3 (21.4)	4 (28.6)	4 (28.6)	3 (21.4)	4.3 (1.0-7.6)
Taxi	64 (27.8)	101 (43.9)	44 (19.1)	21 (9.1)	5.0 (2.0-10.0)

6.6.3 Smoking

Table 60 shows that 23% of those surveyed were smokers, 29% were ex-smokers and 48% had never smoked. There was no difference in prevalence of current regular smoking between males and females, but there was a difference between the proportions of men and women who were ex-smokers and who had never smoked. There were trends with age, such that middle aged adults were most likely to smoke regularly and younger adults more likely to smoke occasionally. The largest proportions of ex-smokers were among the oldest age groups. Smoking was strongly patterned socio-economically, with the highest rates among those in the lowest fifth for SEI, the unemployed and the least educated (Table 61). Single adults with one or more child smoked more than other adults in the survey. There were also patterns with food expenditure, with those spending least on food most likely to smoke. Those with poorest dietary knowledge were also more likely to smoke.

Table 60: Smoking prevalence by selected demographic and health variables

	Number in group (%)			
	Smoke daily	**Smoke occasionally**	**Ex-smokers**	**Never smoked**
Sex				
Male	391 (19.1)	97 (4.7)	685 (33.5)	874 (42.7)
Female	570 (19.3)	97 (3.3)	752 (25.5)	1532 (51.9)
Persons	961 (19.2)	194 (3.9)	1437 (28.8)	2406 (48.1)
Age				
16-24	90 (17.4)	39 (7.6)	44 (8.5)	343 (66.5)
25-34	181 (23.3)	63 (8.1)	120 (15.4)	413 (53.2)
35-44	167 (20.1)	26 (3.1)	167 (20.1)	472 (56.7)
45-54	209 (22.3)	25 (2.7)	274 (29.2)	430 (45.8)
55-64	180 (22.2)	18 (2.2)	292 (36.0)	320 (39.5)
65-74	98 (14.3)	15 (2.2)	323 (47.2)	249 (36.4)
Over 75	36 (8.2)	8 (1.8)	217 (49.3)	179 (40.7)
Ethnic group				
White European	905 (19.1)	183 (3.9)	1372 (29.0)	2274 (48.0)
Other ethnic groups	43 (20.0)	11 (5.1)	51 (23.7)	110 (51.2)
Household composition				
1 adult	254 (23.3)	37 (3.4)	342 (31.4)	456 (41.9)
2 adults	322 (17.2)	62 (3.3)	644 (34.5)	839 (44.9)
3 or more adults	151 (18.2)	45 (5.4)	188 (22.7)	446 (53.7)
1 adult, 1 or more children	50 (31.4)	7 (4.4)	38 (23.9)	64 (40.3)
2 or more adults, 1 or more children	184 (17.5)	43 (4.1)	225 (21.4)	601 (57.1)
Educational attainment				
Still a student	2 (3.8)	3 (5.8)	5 (9.6)	42 (80.8)
None	21 (23.6)	2 (2.2)	31 (34.8)	35 (39.3)
Primary or secondary	493 (24.9)	66 (3.3)	656 (33.2)	762 (38.5)
College	355 (17.9)	87 (4.4)	536 (27.1)	1001 (50.6)
University	90 (10.0)	36 (4.0)	209 (23.2)	566 (62.8)
Body mass index				
Underweight	20 (29.0)	4 (5.8)	14 (20.3)	31 (44.9)
Ideal weight	243 (22.2)	54 (4.9)	223 (20.3)	577 (52.6)
Overweight	404 (19.0)	82 (3.9)	625 (29.4)	1014 (47.7)
Obese	265 (17.1)	48 (3.1)	542 (34.9)	698 (44.9)
Self rated health				
Very good	105 (12.6)	27 (3.2)	207 (24.9)	492 (59.2)
Good	263 (14.6)	81 (4.5)	514 (28.6)	938 (52.2)
Neither good nor poor	418 (23.4)	65 (3.6)	531 (29.7)	776 (43.4)
Poor or very poor	165 (29.9)	20 (3.6)	177 (32.1)	189 (34.3)
Long term illness				
None	659 (18.8)	148 (4.2)	854 (24.4)	1841 (52.6)
Long term illness, no limitation	62 (14.3)	14 (3.2)	167 (38.4)	192 (44.1)
Long term illness with limitation	227 (22.4)	31 (3.1)	403 (39.7)	354 (34.9)

Table 61: Smoking prevalence by socio-economic and dietary variables

	Number in group (%)			
	Smoke daily	**Smoke occasionally**	**Ex-smokers**	**Never smoked**
Unemployment (Head of household)				
Registered unemployed	98 (42.2)	14 (6.0)	38 (16.4)	82 (35.3)
Paid employment	496 (18.7)	123 (4.6)	610 (23.0)	1428 (53.7)
Other	367 (17.4)	57 (2.7)	789 (37.4)	896 (42.5)
Socio-Economic Index (SEI)				
1. Lowest fifth	291 (34.7)	29 (3.5)	250 (29.8)	269 (32.1)
2.	235 (23.2)	45 (4.4)	322 (31.7)	413 (40.7)
3.	160 (18.5)	33 (3.8)	267 (30.9)	403 (46.7)
4.	197 (14.5)	53 (3.9)	377 (27.8)	729 (53.8)
5. Highest fifth	78 (8.4)	34 (3.7)	221 (23.9)	592 (64.0)
Fifths of TDS for home ED				
1 – most affluent	101 (9.9)	34 (3.3)	279 (27.4)	604 (59.3)
2	124 (12.3)	37 (3.7)	287 (28.5)	559 (55.5)
3	177 (17.9)	37 (3.7)	296 (30.0)	478 (48.4)
4	221 (22.3)	43 (4.3)	319 (32.3)	406 (41.1)
5 – least affluent	338 (33.9)	43 (4.3)	256 (25.7)	359 (36.0)
Cost of weekly food per adult equivalent				
1. Lowest fifth	245 (25.4)	45 (4.7)	236 (24.4)	440 (45.5)
2.	161 (21.7)	35 (4.7)	192 (25.9)	353 (47.6)
3.	196 (18.1)	36 (3.3)	327 (30.1)	526 (48.5)
4.	110 (17.0)	27 (4.2)	166 (25.7)	344 (53.2)
5. Highest fifth	175 (14.8)	38 (3.2)	388 (32.8)	583 (49.2)
Dietary knowledge score				
1. Lowest fifth	328 (27.4)	47 (3.9)	353 (29.5)	467 (39.1)
2.	246 (22.3)	38 (3.4)	293 (26.6)	525 (47.6)
3.	134 (19.3)	31 (4.5)	198 (28.6)	330 (47.6)
4.	183 (14.7)	60 (4.8)	369 (29.7)	631 (50.8)
5. Highest fifth	70 (9.2)	18 (2.4)	224 (29.3)	453 (59.2)

6.7 Patterns of household food purchasing

A wide range of results illustrates the ways in which different people undertook their regular food shopping.

6.7.1 Frequency of shopping

shows that most households went shopping one to three times a week. However, frequency of shopping is patterned socio-demographically. Middle to older aged groups were more likely to shop daily or 2-3 times per week than younger shoppers. Daily shopping was also more common among the poorest groups and those with least education. This pattern was reflected in the standard of living for cooking facilities, with those having less adequate facilities very much more likely to shop daily. Those doing their main food shopping at

discount supermarkets, department stores or convenience stores were more likely to shop more than 3 times per week, as were those who carried their shopping on foot, bicycle or public transport. There were no major differences in the above indices between male and female main food shoppers (data not shown).

Table 62: Frequency of shopping by socio-economic characteristics of households and main food shopper

	Frequency of food shopping: Number (%)				
	Daily	**2-3/week**	**Once weekly**	**Once a fortnight**	**Less often**
All Households	250 (8.0)	1573 (50.5)	1077 (34.6)	143 (4.6)	71 (2.3)
Age group of main food shopper					
16-24 years	3 (2.1)	51 (35.2)	66 (45.5)	20 (13.8)	5 (3.4)
25-34 years	21 (4.2)	191 (38.6)	211 (42.6)	48 (9.7)	24 (4.8)
35-44 years	37 (6.7)	279 (50.5)	195 (35.3)	24 (4.3)	18 (3.3)
45-54 years	66 (10.9)	290 (48.1)	217 (36.0)	25 (4.1)	5 (0.8)
55-64 years	62 (11.5)	277 (51.5)	178 (33.1)	10 (1.9)	11 (2.0)
65-74 years	44 (9.6)	284 (62.1)	115 (25.2)	9 (2.0)	5 (1.1)
75+ years	17 (5.3)	201 (62.2)	95 (29.4)	7 (2.2)	3 (0.9)
Educational attainment of main food shopper					
No formal education	14 (24.1)	24 (41.4)	17 (29.3)	0	3 (5.2)
Primary or secondary only	122 (9.7)	652 (51.7)	420 (33.3)	46 (3.6)	21 (1.7)
College	84 (6.9)	605 (49.4)	432 (35.3)	70 (5.7)	34 (2.8)
University	30 (5.4)	284 (50.7)	206 (36.8)	27 (4.8)	13 (2.3)
Household SEI					
1. Lowest fifth (most deprived)	90 (13.6)	333 (50.4)	186 (28.1)	42 (6.4)	10 (1.5)
2.	73 (10.9)	359 (53.5)	205 (30.6)	20 (3.0)	14 (2.1)
3.	29 (5.2)	286 (51.2)	200 (35.8)	26 (4.7)	18 (3.2)
4.	35 (4.6)	359 (47.2)	310 (40.8)	37 (4.9)	19 (2.5)
5. Highest fifth (most affluent)	23 (5.0)	236 (51.0)	176 (38.0)	18 (3.9)	10 (2.2)
TDS for Home ED					
5. highest fifth (most deprived)	87 (12.9)	325 (48.0)	211 (31.2)	39 (5.8)	15 (2.2)
4.	70 (10.9)	298 (46.3)	223 (34.7)	29 (4.5)	23 (3.6)
3.	38 (6.2)	324 (52.8)	207 (33.7)	34 (5.5)	11 (1.8)
2.	35 (5.9)	316 (52.9)	206 (34.5)	28 (4.7)	12 (2.0)
1. Lowest fifth (most affluent)	20 (3.4)	310 (53.2)	230 (39.5)	13 (2.2)	10 (1.7)
Standard of living Index for Cooking					
Less adequate facilities	15 (24.6)	23 (37.7)	17 (27.9)	4 (6.6)	2 (3.3)
Adequate facilities	235 (7.7)	1550 (50.8)	1060 (34.7)	139 (4.6)	69 (2.3)
Main food store type					
Convenience store	9 (19.1)	29 (61.7)	8 (17.0)	0	1 (2.1)
Discount supermarket	59 (13.8)	220 (51.5)	118 (27.6)	21 (4.9)	9 (2.1)
Department store	10 (12.7)	57 (72.2)	10 (12.7)	1 (1.3)	1 (1.3)
Multiple supermarket	156 (6.4)	1192 (49.2)	901 (37.2)	115 (4.7)	59 (2.4)
Not stated	16 (11.7)	74 (54.0)	40 (29.2)	6 (4.4)	1 (0.7)
Mode of travel from shops					
Taxi	9 (5.8)	57 (36.8)	62 (40.0)	16 (10.3)	11 (7.1)
Car	69 (3.6)	892 (46.4)	817 (42.5)	97 (5.0)	46 (2.4)
Public transport	47 (11.8)	261 (65.3)	78 (19.5)	10 (2.5)	4 (1.0)
Bicycle	3 (25.0)	6 (50.0)	3 (25.0)	0	0
On foot	106 (21.9)	276 (57.1)	83 (17.2)	14 (2.9)	4 (0.8)

6.7.2 Who uses which shops?

Householders were asked to indicate which shops they used on a regular basis and to nominate their main food shop. The most frequently used shops are shown in . Respondents were asked to tick as many shops as were applicable. The larger multiple supermarkets represent the most frequently used types of shop, with nearly half those surveyed shopping at Safeway. In contrast, only 2% of households used Internet shopping. Large numbers of people used department stores such as Marks & Spencer and discount stores, such as Kwiksave. Over 20% also said they used markets stalls on a regular basis.

Table 63: Number (%) of households regularly using a range of stores to buy food in Newcastle

Multiple supermarkets			**Department stores**		
Safeway	1532	(48.6)	Marks and Spencer	1075	(34.1)
Tesco	1367	(43.4)	Fenwick	581	(18.4)
Asda	1310	(41.5)			
Co-op [1]	780	(24.7)	**Other types of store**		
Morrison	333	(10.6)	Small local shops [1]	797	(25.3)
Sainsbury	123	(3.9)	Out of this World [2]	147	(4.7)
Iceland (Frozen goods)	596	(18.9)	Spar [1]	97	(3.1)
Internet shopping (Tesco, Iceland)	67	(2.1)	Happy shopper [1]	27	(0.9)
			Market stalls	706	(22.4)
Discount supermarkets			Mobile vans	22	(0.7)
Kwiksave	1012	(32.1)	Home deliveries	41	(1.3)
Netto	417	(13.2)			
ALDI	215	(6.8)			
LIDL	64	(2.0)			
NISA	83	(2.6)			

1 For a discussion of the categorisation of smaller stores into 'convenience' stores etc, see the methods section for the retail survey
2 Out of this World is a large whole food and 'Fair trade' grocery store in Gosforth (NE3).

Table 64 shows the main food store nominated by main household shopper. These were dominated by the large multiple supermarkets, used by over 77% of householders. Discount supermarkets were used by 13.7% and other stores by much smaller numbers.

Table 64: Main food shop (number of stores in and around Newcastle*) nominated by each household's main food shopper by food store category

	No. of households	%		No. of households	%
Multiple supermarkets	**2440**	**77.4**	**Discount supermarkets**	**435**	**13.8**
Tesco (3)	753	23.9	Kwiksave (11)	284	9.0
Asda (6)	677	21.5	Netto (6)	114	3.6
Safeway (12)	633	20.1	ALDI (4)	30	1.0
Co-op (11)	214	6.8	LIDL (2)	4	0.1
Morrison's (2)	106	3.4	NISA (1)	3	0.1
Sainsbury (2)	13	0.4			
Iceland (Frozen goods) (3)	22	0.7	**Department Stores**	**82**	**2.6**
			Marks and Spencer (2)	62	2.0
Internet shopping (Tesco, Iceland, Sainsbury)	15	0.5	Fenwick (1)	20	0.6
			Market stalls	**10**	**0.3**
			Other types of store (20)	**47**	**1.5**
			No single main shop stated	**149**	**4.7**
			Total	**3153**	**100.0**

* Note: the number of stores mentioned by shoppers does NOT tally with the number surveyed (see and Sections 4.6.2 and 6.1), as not all shops surveyed were used as a 'main shop'. In addition, some people used a 'main shop' outside our retail survey area (e.g. Sainsbury's, Durham).

Table 65 shows the main social and demographic characteristics of those using the different types of store as their main food store. There are strong socio-economic trends, with more affluent and better educated groups more likely to use multiple supermarkets and less affluent groups more likely to use discount supermarkets and other types of stores. One adult with children and single adult households were more likely to use discount supermarkets and less likely to use multiple supermarkets, as were older age groups. Younger people were more likely to use multiple supermarkets and there was no difference in the main food shop used between male and female main food shoppers. Department stores were used by a relatively small group of shoppers, who tended to be older, retired, widowed, have relatively high incomes but smaller homes and no car, and therefore had a relatively low SEI. Other characteristics of people using different types of shop, such as car ownership and mode of travel to shops are reported below.

To explore the relationship between the socio-economic characteristics of areas where people lived and in which main food shops were located, the correlation between home and main shop TDS was examined. People in poorer areas tended to use shops also in poorer areas (Pearson coefficient=0.26, $p<0.001$).

Table 65: Number (%) of households using different types of main store by social and demographic characteristics of households and main food shopper

	Multiple supermarkets	Department stores	Discount supermarkets	Other stores	Not stated
Sex of main food shopper					
Male	740 (75.8)	18 (1.8)	153 (15.7)	16 (1.6)	49 (5.0)
Female	1700 (78.1)	64 (2.9)	282 (13.0)	31 (1.4)	99 (4.5)
Persons	2440 (77.4)	82 (2.6)	435 (13.8)	47 (1.5)	148 (4.7)
Age group of main food shopper					
16-24 years	123 (84.5)	0	15 (10.3)	2 (1.4)	5 (3.4)
25-34 years	425 (85.5)	3 (0.6)	47 (9.5)	8 (1.6)	14 (2.8)
35-44 years	460 (82.9)	6 (1.1)	59 (10.6)	5 (0.9)	25 (4.5)
45-54 years	483 (79.6)	14 (2.3)	85 (14.0)	8 (1.3)	17 (2.8)
55-64 years	399 (73.3)	13 (2.4)	93 (17.1)	12 (2.2)	27 (5.0)
65-74 years	323 (68.6)	21 (4.5)	83 (17.6)	7 (1.5)	37 (7.9)
75+ years	227 (68.2)	25 (7.5)	53 (15.9)	5 (1.5)	23 (6.9)
Marital status of main food shopper					
Married	1228 (82.6)	23 (1.5)	161 (10.8)	10 (0.7)	65 (4.4)
Living as married	188 (83.6)	2 (0.9)	24 (10.7)	2 (0.9)	9 (4.0)
Single	478 (77.6)	18 (2.9)	83 (13.5)	8 (1.3)	29 (4.7)
Separated	56 (68.3	2 (2.4)	11 (13.4)	6 (7.3)	7 (8.5)
Widowed	270 (65.9)	30 (7.3)	72 (17.6)	12 (2.9)	26 (6.3)
Divorced	220 (66.3)	7 (2.1)	84 (25.3)	9 (2.7)	12 (3.6)
Educational attainment of main food shopper					
No formal education	32 (52.2)	2 (3.3)	19 (31.1)	0	8 (13.1)
Primary or secondary only	888 (69.3)	39 (3.0)	276 (21.5)	24 (1.9)	55 (4.3)
College	1018 (82.2)	32 (2.6)	113 (9.1)	14 (1.1)	62 (5.0)
University	495 (88.4)	9 (1.6)	24 (4.3)	9 (1.6)	23 (4.1)
Household composition					
1 adult	757 (70.9)	51 (4.8)	176 (16.5)	24 (2.2)	60 (5.6)
1 adult + ≥1 child	108 (71.5)	1 (0.7)	37 (24.5)	2 (1.3)	3 (2.0)
2 adults	836 (79.3)	24 (2.3)	129 (12.2)	14 (1.3)	51 (4.8)
≥3 adults	269 (81.8)	1 (0.3)	42 (12.8)	4 (1.2)	13 (4.0)
2 adults + ≥1 child	470 (85.5)	5 (0.9)	51 (9.3)	3 (0.5)	21 (3.8)
Household SEI					
1. Lowest fifth (most deprived)	384 (57.3)	18 (2.7)	212 (31.6)	23 (3.4)	33 (4.9)
2.	491 (71.6)	24 (3.5)	121 (17.6)	12 (1.7)	38 (5.5)
3.	456 (80.6)	19 (3.4)	56 (9.9)	4 (0.7)	31 (5.5)
4.	678 (88.6)	13 (1.7)	38 (5.0)	6 (0.8)	30 (3.9)
5. Highest fifth (most affluent)	431 (92.7)	8 (1.7)	8 (1.7)	2 (0.4)	16 (3.4)
TDS for Home ED					
5. Highest fifth (most deprived)	418 (60.4)	22 (3.2)	199 (28.8)	16 (2.3)	37 (5.3)
4.	478 (73.9)	9 (1.4)	111 (17.2)	15 (2.3)	34 (5.3)
3.	504 (81.4)	17 (2.7)	67 (10.8)	5 (0.8)	26 (4.2)
2.	519 (85.4)	19 (3.1)	39 (6.4)	6 (1.0)	25 (4.1)
1. Lowest fifth (most affluent)	521 (88.9)	15 (2.6)	19 (3.2)	5 (0.9)	26 (4.4)

To explore which factors were independently associated with the choice of type of main food store, separate stepwise logistic regression analyses were undertaken for each of the two main types of food store (multiple supermarket and discount supermarket). Two models were

constructed for each type of store: the first including only household socio-economic factors and factors relating to retail geography; and the second including also characteristics of the main food shopper. The results are summarised in Table 66 and Table 67.

Choice of a multiple supermarket was associated in model 1 (Table 66) with a lower TDS of home ED (living in a more affluent area), travelling by car or taxi, being in a household where the head of household is employed, owning one or more cars, having a higher standard of living index, being white European, not living in a single person household, in receipt of health-related benefits, having a higher distance to main food shop and not doing other shopping whilst food shopping (r^2=0.33).

When characteristics of the main food shopper were added (model 2), five variables were excluded from the model (being single, cars owned, standard of living index, distance to main shop and travel by taxi) and four other variables were included: not being retired, not in receipt of a state pension, younger age and shorter self-reported travel time to main food shop (r^2=0.35).

Choice of a discount supermarket was associated in model 1 (Table 67) with shorter distance to main food shop, lower household income, higher TDS of home ED (living in a more deprived area), greater distance from the city centre, longer self-reported travel time to main food shop, not travelling by car, not receiving health related benefits, being from an ethnic minority group, being in a single person household, living in a more crowded home, not working and not in full time education.

When main food shopper characteristics were added (model 2), three variables were excluded (distance to main shop, being single and not being in education) and three other variables were included: higher BMI, being in receipt of a state pension and being retired (r^2=0.40).

Overall, these results are in accord with the univariable analyses in , indicating that multiple supermarkets are chosen by a more affluent group of household than discount supermarkets. Use of multiple supermarkets is associated with car use and short self-reported travel times, whilst use of discount supermarkets is associated with travel by other means and longer journey times.

Table 66: Logistic regression analyses: factors independently associated with choice of main food shop: multiple supermarket

Shop type (dependent variable)	Model No.	r^2	Variable	Categories	B	Significance. (P value)
Multiple Supermarket	1	0.33	TDS of home ED		-0.08	0.0002
			Travel by Car		1.1	0.0008
			Receipt of health-related benefits		0.7	0.0007
			Employment status	Working		0.002
				Not working	1.0	0.0005
				Registered unemployed	0.8	0.008
			Does other shopping while food shopping	Usually		0.003
				Sometimes	-0.8	0.001
				Never	-0.2	0.3
			Marital status: single		-0.5	0.01
			Member of ethnic minority group		-0.7	0.02
			Distance from home to main shop		0.00009	0.02
			Number of cars owned		0.3	0.04
			Standard of Living Index		0.06	0.05
			Travel by Taxi		0.8	0.05
Multiple Supermarket	2	0.35	TDS of home ED		-0.09	0.0001
			Employment status	Working		0.0002
				Not working	1.3	0.00004
				Registered unemployed	0.8	0.03
			Travel by Car		1.3	0.0004
			Receipt of health-related benefits		0.6	0.004
			Does other shopping while food shopping	Usually		0.005
				Sometimes	-0.8	0.002
				Never	-0.3	0.2
			Member of ethnic minority group		-0.8	0.02
			Retired		-0.6	0.03
			In receipt of state pension		-0.5	0.03
			Age		-0.02	0.04
			Travel time to main shop	5-15 mins		0.04
				15-30 mins	-0.4	0.05
				>30 mins	-0.05	0.9

Table 67: Logistic regression analyses: factors independently associated with choice of main food shop: discount supermarket

Shop type (dependent variable)	Model No.	r^2	Variable	Categories	B	Significance (P value)
Discount Supermarket	1	0.37	Distance from home to main shop		-0.0004	<0.00001
			Annual Household Income		-0.00006	0.00003
			TDS of home ED		0.1	0.00003
			Distance from home to city centre		0.0002	0.0001
			Travel time to main shop	5-15 mins		0.003
				15-30 mins	0.6	0.007
				>30 mins	0.07	0.8
			Receipt of health-related benefits		-0.6	0.007
			Member of ethnic minority group		0.8	0.01
			Marital status: single		0.6	0.02
			Travel by Car		-0.9	0.02
			Crowding (persons per room)		1.3	0.02
			Employment status	Working		0.03
				Not working	-0.8	0.009
				Registered unemployed	-0.5	0.1
			In full time education		-1.9	0.03
Discount Supermarket	2	0.40	TDS of home ED		0.1	0.0001
			Annual Household Income		-0.0001	0.0002
			BMI		0.05	0.002
			Distance from home to city centre		0.0001	0.002
			Employment status	Working		0.002
				Not working	-1.2	0.0008
				Registered unemployed	-0.5	0.2
			Travel time to main shop	5-15 mins		0.005
				15-30 mins	0.6	0.006
				>30 mins	0.2	0.6
			Receipt of health-related benefits		-0.6	0.01
			Member of ethnic minority group		0.9	0.01
			Travel by Car		-0.9	0.02
			Crowding (persons per room)		1.4	0.02
			In receipt of state pension		0.6	0.03
			Retired		0.5	0.2

6.7.3 Reasons for choice of main food store

Table 68 shows that the most important reason for choice of shop was 'near to home' (33%), followed by 'easy to get to' (22%), 'convenience' (21%), cost (21%), 'range of food' (20%) and 'quality of food' (15%). However, this ranking differed by chosen type of main food shop. For users of multiple supermarkets, 'near to home' was the most important reason, followed by 'range of foods', 'convenience' 'easy to get to' and 'quality of foods'. For those using discount supermarkets by far the most important reasons were 'cost of food' and 'near to home', followed by 'easy to get to', 'convenience' and 'special offers'. For users of Department stores 'quality of food' was the most important reason for 78%, followed by 'easy

to get to' and 'range of foods'. For those using other types of stores (mainly local and specialist shops), 'near to home' was the most important reason, followed by 'cost', 'convenience', 'friendly staff' and 'easy to get to'.

Table 68: Reasons for choice of main shop

	Type of Main food store – number (%)					
	Multiple supermarket	Discount supermarket	Department store	Other stores	Main shop not stated	All stores
Near to home	780 (32.0)	179 (41.1)	2 (2.4)	19 (40.4)	45 (30.4)	1025 (32.5)
Easy to get to	514 (21.1)	119 (27.4)	19 (23.2)	9 (19.1)	26 (17.6)	687 (21.8)
Convenience	527 (21.6)	88 (20.2)	11 (13.4)	10 (21.3)	38 (25.7)	674 (21.4)
Cost	414 (17.0)	205 (47.1)	1 (1.2)	12 (25.5)	41 (27.7)	673 (21.3)
Range of food	534 (21.9)	28 (6.4)	16 (19.5)	8 (17.0)	28 (18.9)	614 (19.5)
Quality of food	467 (19.1)	37 (8.5)	64 (78.0)	8 (17.0)	36 (24.7)	612 (19.4)
Special offers	310 (12.7)	69 (15.9)	1 (1.2)	3 (6.4)	23 (15.5)	406 (12.9)
Friendly staff	219 (9.0)	55 (12.6)	7 (8.5)	9 (19.1)	25 (16.9)	315 (10.0)
Pleasant environment	199 (8.2)	16 (3.7)	7 (8.5)	5 (10.6)	20 (13.5)	247 (7.8)
Late opening hours	189 (7.7)	15 (3.4)	1 (1.2)	4 (8.5)	11 (7.4)	220 (7.0)
Range of healthy food	101 (4.1)	8 (1.8)	4 (4.9)	8 (17.0)	13 (8.8)	134 (4.2)
Loyalty points	88 (3.6)	1 (0.2)	0	0	5 (3.4)	94 (3.0)

The relationship between reasons for choice of shop and a range of socio-economic and demographic variables was also examined (data not shown). There were no obvious associations between socio-economic or demographic factors and a shop being 'near to home'. However, being 'easy to get to' was more important for older people, especially the over 75s, and for 16-24 year olds, those with no car and those with a lower SEI. 'Convenience' was important for those with no car and, somewhat surprisingly, for those with two or more cars. 'Cost' was associated with all socio-economic variables, being more important for those with lower income and lower SEI, and displayed a gradient with age, being more important for younger age groups. The 'range of foods' was important for those with a higher SEI, one or more cars, those with higher education and those in the top fifth for weekly household food expenditure per adult equivalent. Quality of food was most important for those aged over 65 or under 25 years and those in the top fifth for weekly food expenditure. 'Special offers' were also more important for the 16-24 year age group, but were more likely to be reported as a reason for choice of main food store by those with no car, lower SEI and no formal education. 'Friendly staff' were most important for the retired and older age groups, as well as those with no car, lower SEI and no formal education. The only

reason for choice of main food store that was more important for men was 'pleasant environment'. 'Late opening hours' were more important to young people, especially those aged under 25 years and those in full time education.

6.7.4 Travel to and from main food store

6.7.4.1 Travel mode

Table 69 shows modes of travel to and from main food shop by the main food shopper. Out of 2996 households, 2784 (92.9%) used the same form of transport to get to and from their main food store (shaded cells in table). The most used mode of transport both ways was car (64%), followed by foot (16%) and bus (11%). Other modes were used less often and 212 (7%) of shoppers used different modes to return from the shop, typically arriving on foot and returning by bus or taxi.

Table 69: Number (% of total households) using different modes of travel to and from main food shop

		Journeys FROM main food store by:						
		Car	**Bus**	**Metro**	**Taxi**	**Bicycle**	**Foot**	**All Modes**
Journeys TO main food store by:	**Car**	1909 (63.7)	1 (0.0)		2 (0.1)		1 (0.0)	1913 (63.9)
	Bus	11 (0.3)	320 (10.7)	1 (0.0)	60 (2.0)		7 (0.2)	399 (13.3)
	Metro	1 (0.0)	3 (0.1)	28 (0.9)	11 (0.3)			43 (1.4)
	Taxi				34 (1.1)			34 (1.1)
	Bicycle					12 (0.4)		12 (0.4)
	Foot	13 (0.4)	52 (1.7)	1 (0.0)	48 (1.6)		481 (16.1)	595 (19.9)
	All Modes	1934 (64.6)	376 (12.6)	30 (1.0)	155 (5.2)	12 (0.4)	489 (16.4)	2996 (100.0)

Different modes of travel were used by different social groups and those using different types of main food store. To explore this further, travel *from* shops (i.e. when shoppers have to carry their shopping) was analysed in relation to type of shop (Table 70) and a range of other demographic (Table 71) and socio-economic variables (Table 72). Those using discount supermarkets and 'other' types of store (mostly local shops) were more likely to travel by foot or public transport than those using multiple supermarkets. Those using local stores were

least likely to use a car and those using multiple supermarkets most likely. Taxis were most used by those shopping at discount supermarkets and department stores (Table 70).

Table 70: Number (%) travelling home from the main types of food store used by travel mode

Category of main food shop	Mode of travel from main food shop – number (%)					
	Car	Public transport	Taxi	Bicycle	Foot	All travel modes
Multiple supermarkets	1722 (72.8)	248 (10.5)	111 (4.7)	8 (0.3)	277 (11.7)	2366
Discount supermarkets	129 (31.5)	88 (21.5)	33 (8.1)	3 (0.7)	156 (38.1)	409
Department stores	20 (25.0)	48 (60.0)	5 (6.3)	0	7 (8.8)	80
All other stores	7 (15.6)	10 (22.2)	1 (2.2)	1 (2.2)	26 (57.8)	45
No store stated	57 (54.3)	16 (15.2)	8 (7.6)	0	24 (22.9)	105
All types of shop	1935 (64.4)	410 (13.6)	158 (5.3)	12 (0.4)	490 (16.3)	3005

There were strong socio-economic patterns (Table 72) indicating that those with access to greater resources were more likely to use a car to travel from the shops and less likely to use public transport or walk. Similar patterns were found for non-white ethnic groups, those with lower levels of educational attainment, and single adults and one adult with children households (Table 71). Middle aged adults were most likely to use a car and least likely to travel on foot. Men were less likely than women to travel by car or taxi and more likely to travel on foot or bike.

Table 71: Number (%) travelling home from main food store by demographic characteristics of main food shopper and by travel mode

	Mode of travel from main food shop – number (%)						
	Car	**Bus**	**Metro**	**Taxi**	**Bicycle**	**Foot**	**All modes**
Sex of main food shopper							
Men	570 (58.4)	109 (11.2)	13 (1.3)	28 (2.9)	10 (1.0)	204 (20.9)	976
Women	1365 (62.7)	270 (12.4)	18 (0.8)	130 (6.0)	2 (0.1)	286 (13.1)	2177
Age groups							
16-24 years	82 (56.6)	10 (6.9)	4 (2.8)	13 (9.0)	1 (0.7)	29 (20.0)	145
25-34 years	338 (68.0)	30 (6.0)	1 (0.2)	29 (5.8)	3 (0.6)	77 (15.5)	497
35-44 years	400 (72.1)	40 (7.2)	3 (0.5)	27 (4.9)	2 (0.4)	64 (11.5)	555
45-54 years	404 (66.6)	51 (8.4)	7 (1.2)	35 (5.8)	2 (0.3)	83 (13.7)	607
55-64 years	330 (60.7)	71 (13.1)	5 (0.9)	16 (2.9)	3 (0.6)	99 (18.2)	544
65-74 years	247 (52.4)	95 (20.2)	6 (1.3)	17 (3.6)	1 (0.2)	75 (15.9)	471
75+ years	134 (40.1)	82 (24.6)	5 (1.5)	21 (6.3)	0	63 (18.9)	334
Ethnic groups							
White European	1871 (62.7)	343 (11.5)	30 (1.0)	141 (4.7)	11 (0.4)	453 (15.2)	2982
Other ethnic groups	52 (37.7)	28 (20.3)	1 (0.7)	14 (0.1)	1 (0.7)	31 (22.5)	138
Marital status							
Single	284 (46.1)	85 (13.8)	11 (1.8)	33 (5.4)	6 (1.0)	171 (27.8)	616
Married	1154 (77.6)	102 (6.9)	6 (0.4)	48 (3.2)	3 (0.2)	115 (7.7)	1487
Living as married	160 (71.1)	9 (4.0)	3 (1.3)	14 (6.2)	0	28 (12.4)	225
Separated	41 (50.0)	11 (13.4)	0	6 (7.3)	0	16 (19.5)	82
Divorced	139 (41.9)	60 (18.1)	3 (0.9)	26 (7.8)	3 (0.9)	85 (25.6)	332
Widowed	157 (38.2)	112 (27.3)	8 (1.9)	31 (7.5)	0	75 (18.2)	411
Household composition							
Single adult	428 (40.0)	223 (20.9)	18 (1.7)	59 (5.5)	7 (0.7)	269 (25.2)	1069
1 adult, 1 or more child	78 (52.3)	16 (10.6)	1 (0.7)	20 (13.2)	0	30 (19.9)	151
2 adults	733 (69.5)	100 (9.5)	6 (0.6)	43 (4.1)	4 (0.4)	112 (10.6)	1054
3 or more adults	245 (74.5)	20 (6.1)	4 (1.2)	12 (3.6)	0	41 (12.5)	329
2 or more adults & children	450 (81.8)	20 (3.6)	2 (0.4)	24 (4.4)	1 (0.2)	38 (6.9)	550

Table 72: Number (%) travelling home from main food store by household socio-economic characteristics and by mode of travel

	Mode of travel from main food shop – number (%)						
	Car	**Bus**	**Metro**	**Taxi**	**Bicycle**	**Foot**	**All modes**
Educational attainment							
No formal education	18 (31.1)	18 (29.5)	0	6 (9.8)	0	14 (23.0)	61
Primary or secondary only	661 (51.5)	230 (17.9)	15 (1.2)	78 (6.1)	4 (0.2)	223 (17.4)	1283
College	832 (67.2)	108 (8.7)	10 (0.8)	62 (5.0)	5 (0.4)	169 (13.0)	1239
University	415 (74.1)	22 (3.9)	6 (1.1)	12 (2.1)	3 (0.5)	83 (14.8)	560
Socio-Economic Index (SEI)							
1. Lowest fifth (most deprived)	142 (23.0)	182 (29.4)	9 (1.5)	73 (11.8)	5 (0.8)	207 (33.5)	618
2.	311 (48.0)	125 (19.3)	14 (2.2)	41 (6.3)	2 (0.3)	155 (23.9)	648
3.	392 (71.3)	55 (10.0)	4 (0.7)	23 (4.2)		76 (13.8)	550
4.	662 (89.9)	14 (1.9)	3 (0.4)	17 (2.3)	4 (0.5)	36 (4.9)	736
5. Highest fifth (most affluent)	428 (94.5)	3 (0.7)	1 (0.2)	4 (0.9)	1 (0.2)	16 (3.5)	453
TDS for Home ED							
5. Highest fifth (most deprived)	238 (36.8)	163 (25.2)	5 (0.8)	71 (11.0)	6 (0.9)	164 (25.3)	647
4.	339 (55.9)	96 (15.8)	6 (1.0)	32 (5.3)	2 (0.3)	131 (21.6)	606
3.	405 (68.1)	58 (9.7)	4 (0.7)	19 (3.2)		109 (18.3)	595
2.	449 (76.5)	41 (7.0)	11 (1.9)	17 (2.9)	4 (0.7)	65 (11.1)	587
1. Lowest fifth (most affluent)	504 (88.4)	21 (3.7)	5 (0.9)	19 (3.3)		21 (3.7)	570
Access to a car							
No car	149 (14.3)	342 (32.7)	26 (2.5)	141 (13.5)	8 (0.8)	379 (36.3)	1045
Car	1786 (91.1)	37 (1.9)	5 (0.3)	17 (0.9)	4 (0.2)	111 (5.7)	1960

6.7.4.2 Travel time and car ownership

Reported travel time to main food shop is shown in Table 73. The modal travel time was 5-15 minutes, irrespective of travel mode. However, for those travelling to department stores journeys were overall likely to take longer (15-60 minutes) than those using other types of store. This is likely to be because the two department stores are in the city centre and those using them are more likely to use public transport or taxis (see Table 70 and Table 74).

Table 73: Number (%) reporting different travel times to main food shop by type of main food store

	Travel time to main food shop – number (%)					
Category of main food shop	**< 5 minutes**	**5-15 minutes**	**All journeys >15 minutes**	**15-30 minutes**	**30-60 minutes**	**> 60 minutes**
Multiple supermarkets	558 (22.9)	1454 (59.6)	386 (16.1)	308 (12.6)	55 (2.3)	23 (0.9)
Discount supermarkets	70 (16.1)	281 (64.6)	79 (18.4)	64 (14.7)	11 (2.5)	4 (0.9)
Department stores	2 (2.4)	37 (45.1)	42 (51.9)	37 (45.1)	5 (6.1)	0
All other stores	12 (25.5)	24 (51.1)	10 (21.7)	10 (21.3)	0	0
Not stated	26 (17.6)	72 (48.6)	36 (26.9)	27 (18.2)	6 (4.1)	3 (2.0)
All stores	668 (21.2)	1868 (59.3)	553 (17.9)	446 (14.1)	77 (2.4)	30 (1.0)

Table 74 explores further the relationship between car ownership and types of main food store. Car ownership was more likely among those shopping at multiple supermarkets. Those not owning a car were much more likely to use a discount supermarket than those owning a car and more likely to use a department store than other local shops. Multiple supermarket users were more likely to own a larger number of cars than users of other types of stores.

Table 74: Number (%) with different levels of car ownership by type of main food store

	Multiple supermarkets	**Department stores**	**Discount supermarkets**	**Other stores**	**Not stated**
Car ownership					
None	691 (60.8)	60 (5.3)	286 (25.2)	34 (3.0)	66 (5.8)
1 or more	1749 (86.8)	22 (1.1)	149 (7.4)	13 (0.6)	82 (4.1)
1	1166 (85.1)	16 (1.2)	123 (9.0)	8 (0.6)	57 (4.2)
2	497 (90.0)	6 (1.1)	23 (4.2)	4 (0.7)	22 (4.0)
3	72 (91.1)	0	3 (3.8)	1 (1.3)	3 (3.8)
4 or more	14 (100.0)	0	0	0	0

6.7.4.3 Trip chaining

One of the reasons for travelling a greater distance than expected is 'trip chaining' (i.e. adding food shopping to an additional trip for another purpose, or vice versa).[73] Trip chaining activities are shown by age group of main food shopper, household composition and type of main food shop in Table 75. Overall, 30% of households trip chained sometimes or usually when food shopping. The most common trip chaining activities were non-food shopping, work and visiting family and friends. Overall, regular trip chaining was more common among younger age groups, parents and single adults and those shopping at stores other than multiple supermarkets. Trip chaining via work was uncommon among the retired population, adults

without children and one adult with one or more children households, and among those shopping at discount supermarkets. Trip chaining via non-food shopping was most common among young to middle aged groups, parents with children and those shopping at department stores. Trip chaining via friends or family was more common among younger age groups, one adult with children households and those shopping at discount and multiple supermarkets.

Table 75: Number (%) of households trip-chaining usually or sometimes by trip chain venue and by age group of main food shopper, household composition and main shop type

	Visiting family/ friends	Via school	Via non-food shopping	Via gym	Via work	Via other activity	Via any location / activity
Age groups							
All ages	**1093 (34.7)**	**331** (10.5)	**1641** (52.0)	**336** (10.7)	**1269 (40.2)**	**794** (25.2)	**960 (30.4)**
16-24	62 (42.8)	13 (9.0)	85 (58.6)	32 (22.1)	88 (60.7)	36 (24.8)	56 (38.6)
25-34	225 (45.3)	78 (15.7)	277 (55.7)	97 (19.5)	300 (60.4)	128 (25.8)	204 (41.0)
35-44	200 (36.0)	156 (28.1)	335 (60.4)	92 (16.6)	310 (55.9)	127 (22.9)	200 (36.0)
45-54	213 (35.1)	53 (8.7)	325 (53.5)	53 (8.7)	365 (60.1)	162 (26.7)	208 (34.3)
55-64	185 (34.0)	18 (3.3)	282 (51.8)	38 (7.0)	166 (30.5)	151 (27.8)	149 (27.4)
65-74	139 (29.5)	10 (2.1)	205 (43.5)	21 (4.5)	19 (4.0)	113 (24.0)	94 (20.0)
75+	69 (20.7)	3 (0.9)	132 (39.5)	3 (0.9)	21 (6.3)	77 (23.1)	49 (14.7)
Household composition							
1 adult	374 (35.0)	11 (1.0)	492 (46.0)	105 (9.8)	364 (34.1)	270 (25.3)	332 (31.1)
2 adults	335 (31.8)	27 (2.6)	531 (50.4)	115 (10.9)	396 (37.6)	272 (25.8)	285 (27.0)
3 or more adults	109 (33.1)	13 (4.0)	189 (57.4)	29 (8.8)	171 (52.0)	86 (26.1)	94 (28.6)
1 adult, 1 or more children	71 (47.0)	72 (47.7)	87 (57.6)	23 (15.2)	60 (39.7)	30 (19.9)	73 (48.3)
2 or more adults, 1 or more children	204 (37.1)	208 (37.8)	342 (62.2)	64 (11.6)	278 (50.5)	136 (24.7)	176 (32.0)
Main shop type							
Multiple supermarkets	837 (34.3)	261 (10.7)	1291 (52.9)	289 (11.8)	1071 (43.9)	608 (24.9)	706 (28.9)
Discounters	172 (39.5)	49 (11.3)	184 (42.3)	21 (4.8)	107 (24.6)	104 (23.9)	151 (34.7)
Department stores	19 (23.2)	3 (3.7)	65 (79.3)	6 (7.3)	28 (34.1)	24 (29.3)	29 (35.4)
Other types of shop	14 (29.8)	5 (10.6)	25 (53.2)	4 (8.5)	18 (38.3)	14 (29.8)	21 (44.7)
Not known	51 (34.5)	13 (8.8)	76 (51.4)	16 (10.8)	45 (30.4)	44 (29.7)	53 (35.8)

6.7.5 Reported problems associated with shopping

The main reported problem associated with food shopping was carrying shopping home, although only for 18% of respondents (Table 76). The majority (65%) stated that they did not experience any problems when food shopping.

Table 76: Number (%) of households reporting problems encountered when food shopping

	Number	%
Carrying shopping home	562	(17.8)
Lack of time	292	(9.3)
Mobility problems	192	(6.1)
Distance	184	(5.8)
Shops not easily accessible by public transport	142	(4.5)
Lack of transport	136	(4.3)
Opening hours	72	(2.3)
Lack of childcare facilities	77	(2.4)
I don't experience any problems	2040	(64.7)

To explore the characteristics of those reporting difficulty in carrying their shopping home, this variable was cross tabulated with a range of other social and demographic variables (Table 77). The youngest and older age groups were more likely to report difficulties, as were women and those from ethnic minority groups. There was no association between difficulty carrying shopping home and having children of any age (data not shown). Those single, widowed or divorced reported difficulty carrying shopping more often than those married. Single adults and one adult with children households were more likely than other types of household to report difficulties. There were strong socio-economic trends, with the least affluent group ten times as likely to report difficulty as the most affluent. Those with no car were more than six times as likely to report difficulty as those with one car, and there was a further trend with ownership of more cars. This association was also reflected in the mode of travel home from the main food shop, with those not using a car more than 10 times more likely to report difficulties carrying shopping. There were strong gradients with self-rated health and long-term illness, both in the expected direction. The relationship between difficulty carrying shopping home and type of shop used was complex. The least difficulty was experienced by those using multiple supermarkets (14.5%) and the most by those using department stores (43.9%). Multiple supermarket shopping is strongly associated with car use, but the

department stores are in the city centre, where parking is expensive and inconvenient for food shopping. Department stores are also more likely to be used by older adults.

Table 77: Characteristics of those who have difficulty carrying shopping home

	Has difficulty carrying shopping home (%)		Has difficulty carrying shopping home (%)
Sex		**Car ownership**	
Male	122 (12.5)	None	457 (40.2)
Female	440 (20.2)	1	88 (6.4)
Persons	562 (17.8)	2	15 (2.7)
Age		3	2 (2.5)
16-24 years	37 (25.5)	4 or more	0 (0)
25-34 years	79 (15.9)	**Type of main food shop**	
35-44 years	71 (12.8)	Multiple	354 (14.5)
45-54 years	99 (16.3)	Discounter	122 (28.0)
55-64 years	89 (16.4)	Department store	36 (43.9)
65-74 years	87 (18.5)	Other store	13 (27.7)
75+ years	100 (29.9)	**Mode of travel from shops**	
Marital status		Car	81 (4.2)
Married	168 (11.3)	Taxi	75 (47.5)
Living as married	38 (16.9)	Metro	15 (48.4)
Single	129 (20.9)	Bus	194 (51.2)
Widowed	123 (29.9)	Bicycle	6 (50.0)
Divorced	93 (28.0)	Foot	154 (31.4)
Retired		**Educational attainment**	
Retired	218 (21.6)	No formal education	18 (29.5)
Not retired	344 (16.1)	Primary or secondary	257 (20.0)
Household composition		College or other tertiary	225 (18.2)
Single adults	262 (24.5)	University of equivalent	58 (10.4)
Two adults	152 (14.4)	In full time education	4 (40.0)
Three or more adults	47 (14.3)	**Ethnicity**	
One adult with one or more child	44 (29.1)	White	519 (17.4)
Two or more adults with one or more child	57 (10.4)	Non-white	36 (26.1)
Socio-Economic Index (SEI)		**Self-rated health**	
1. Lowest fifth (most deprived)	215 (32.1)	Very good	62 (11.8)
2.	183 (26.6)	Good	158 (14.0)
3.	104 (18.4)	Neither good nor poor	249 (22.0)
4.	46 (6.0)	Poor	57 (23.0)
5. Highest fifth (most affluent)	14 (3.0)	Very poor	26 (31.0)
TDS for Home ED		**Long term illness**	
1. Most deprived fifth	182 (26.3)	None	316 (14.9)
2.	140 (21.6)	Long term illness, no limitation	46 (15.7)
3.	112 (18.1)	Long term illness + limitation	193 (27.6)
4.	83 (13.6)		
5. Most affluent fifth	45 (7.7)		

6.7.6 Cost of weekly food shopping

At household level, the average reported (median) amount spent on food per week (excluding alcohol) was £40.00 (Inter-Quartile Range (IQR) = £30.00-60.00). The Median (IQR)

amount of additional expenditure associated with undertaking weekly shopping (e.g. travel costs, child care) was £2.00 (£0-4.00). Table 78 shows the amount spent by households per week on food by household composition. The amount spent each week was, as expected, related to the number of members of the household, with larger households (e.g. 3 or more adults) spending more (median £70, IQR £50-85) than single person households (median £25, IQR £20-35). When the number of people was taken into account, the amounts spent were similar in different types of household and the median weekly spend per person was £22.5 (IQR £16.7-30) and £25.9 (IQR £20-35) per adult equivalent. However, one adult with one or more child households spent somewhat less per person than families with two parents, even when 'adult equivalence'[170] was taken into account. The median percentage of annual household income per adult equivalent spent on food was 17.8% (IQR 11.6-27.7) and this was similar for most types of household. The noticeable exception was single adults with one or more child households, where the proportion of annual household income per adult equivalent was 27.7% (IQR 18.7-41.6).

Table 78: Amount spent on weekly food shopping by household composition

Household composition	Number of households	Median (IQR) amount per household (£)	Median (IQR) amount per person (£)	Median (IQR) amount per adult equivalent* (£)	Median % of annual household income spent on food (IQR)
1 adult	987	25 (20-35)	25 (20-35)	25 (20-35)	17.3 (10.4-27.7)
2 adults	982	45 (35-60)	22.5 (17.5-30)	26.5 (20.6-35.2)	16.3 (10.4-26.4)
3 or more adults	312	70 (50-85)	20 (16.7-26.7)	25.8 (20.8-33.3)	18.4 (12.1-29.1)
1 adult, 1 or more children	146	40 (30-50)	15 (12.5-20)	22.5 (17.1-30)	27.7 (18.7-41.6)
2 or more adults, 1 or more children	511	70 (55-90)	17 (13.8-22.5)	25.9 (19.4-31.8)	17.8 (13.2-25.0)
All households	3109	40 (30-60)	22.5 (16.7-30)	25.9 (20-35)	17.8 (11.6-27.7)

* Adult equivalence is calculated as [1 + (0.7 X every additional adult) + (0.5 X every child) in the household]

The median amount spent on weekly food shopping (excluding alcohol) per adult equivalent in households was also explored by a range of socio-demographic indicators (Table 79 and Table 80). There was little difference between men and women (or between male and female main food shoppers – data not shown). The youngest two age groups spent least on food, followed by the oldest age group. There was a strong socio-economic trend with those in the lowest fifth for SEI spending a median of £23.50 (IQR £17.70-30.00), compared with a median of £31.30 (IQR £24.20-38.70) in the highest fifth. Similar patterns were seen in relation to education, unemployment and income, although current students spent a surprisingly large amount per adult equivalent (median £27.80/week, IQR £20.70-33.30).

Similar trends were seen in the percentage of annual income spent on food, with women, older people, the poorly educated, the separated, widowed or divorced, non-white ethnic minority groups, the unemployed and those in poorer social groups spending a greater proportion of their income on food (Table 79 and Table 80). The strongest of these trends was in relation to household income, where those in the highest fifth spent only 9.2% of their income on food, compared with 34.7% spent by the least affluent fifth.

Table 79: Usual cost of weekly food shopping and percentage of annual income spent on food per adult equivalent, by individual socio-economic variables

	No.	Median cost/week in £ (IQR)	% of annual household income spent on food (IQR)
Sex			
Male	2043	26.5 (20.6-35.0)	17.3 (11.6-27.7)
Female	2928	25.9 (20.0-34.5)	17.8 (11.9-27.7)
Persons	4971	25.9 (20.4-35.0)	17.8 (11.6-27.7)
Age			
16-24	509	24.1 (17.7-32.3)	18.5 (11.9-29.1)
25-34	778	23.5 (18.5-30.0)	12.5 (8.3-20.8)
35-44	829	26.5 (20.6-34.1)	16.6 (11.9-24.3)
45-54	930	29.4 (22.2-35.3)	16.6 (11.9-26.5)
55-64	805	29.4 (20.8-35.3)	18.9 (12.5-27.7)
65-74	682	26.5 (20.6-35.0)	23.8 (16.0-34.7)
Over 75	438	25.0 (20.0-30.0)	20.8 (13.9-34.7)
Educational attainment			
Still a student	52	27.8 (20.7-33.3)	19.1 (12.7-32.8)
None	89	25.0 (17.7-30.5)	34.7 (20.8-50.3)
Primary or secondary	1972	25.0 (20.0-33.3)	22.3 (14.9-34.7)
College	1960	25.9 (20.5-35.0)	16.6 (11.4-25.0)
University	898	27.6 (20.6-35.3)	11.9 (8.9-18.5)
Ethnicity			
White	4705	26.5 (20.6-35.0)	17.3 (11.6-27.7)
Non-white	217	20.6 (15.0-29.2)	20.8 (13.9-39.5)
Marital status			
Single	1092	25.0 (19.4-32.3)	17.3 (10.4-27.7)
Married	2648	27.3 (22.2-35.3)	17.8 (11.9-26.7)
Living as married	367	23.5 (17.7-29.4)	12.5 (8.9-20.8)
Separated	88	25.0 (20.0-35.0)	20.8 (11.4-27.7)
Divorced	347	25.0 (20.0-30.0)	20.8 (13.9-37.4)
Widowed	429	25.0 (20.0-35.0)	20.8 (15.6-34.7)
Retired			
Yes	1409	26.0 (20.6-35.0)	20.8 (13.9-34.7)
No	3562	25.9 (20.0-35.0)	16.6 (11.1-26.0)

Table 80: Usual cost of weekly food shopping and percentage of annual income spent on food per adult equivalent, by household socio-economic variables

	No.	Median cost/week in £ (IQR)	Median % of annual household income spent on food (IQR)
Household income per adult equivalent			
1. Lowest fifth	726	23.5 (18.2-30.0)	34.7 (27.0-55.5)
2	493	23.5 (18.5-29.4)	24.3 (18.7-31.2)
3.	596	26.5 (20.0-33.3)	17.8 (13.9-22.6)
4.	522	27.6 (20.6-35.3)	13.2 (10.4-16.6)
5. Highest fifth	599	30.0 (23.5-40.9)	9.2 (6.9-11.9)
Socio-Economic Index (SEI)			
1. Lowest fifth	670	22.0 (17.2-29.4)	27.7 (20.8-41.6)
2.	687	25.0 (20.0-30.0)	22.3 (14.6-34.7)
3.	566	25.4 (20.0-35.0)	16.6 (10.4-25.0)
4.	765	29.4 (22.4-35.3)	13.9 (9.2-20.8)
5. Highest fifth	465	31.5 (25.0-39.5)	13.2 (9.5-16.4)
Employment status (Head of household)			
Registered unemployed	152	20.0 (16.7-27.8)	34.7 (20.8-62.4)
Employed	1560	27.3 (20.6-35.3)	13.9 (9.2-20.8)
Other	1397	25.0 (20.0-32.4)	22.9 (15.1-34.7)
TDS			
1. Most deprived fifth	586	23.5 (17.7-30.0)	25.0 (14.9-35.4)
2.	609	25.0 (20.0-30.1)	20.8 (12.5-34.7)
3.	619	26.2 (20.0-34.5)	16.2 (10.4-25.0)
4.	647	28.2 (20.6-35.5)	14.9 (10.4-22.7)
5. Most affluent fifth	692	29.4 (23.5-37.0)	14.9 (10.4-20.8)
Household member on benefits (excluding state pension)			
Yes	672	23.5 (18.2-30.0)	27.7 (18.7-41.6)
Unknown	46	27.3 (24.6-37.8)	22.0 (13.9-34.7)
No	2435	27.0 (20.6-35.3)	15.1 (10.4-24.3)
Car ownership			
No car	1138	25.0 (19.0-30.0)	24.3 (15.2-34.7)
1 car	1370	26.5 (20.6-35.3)	16.6 (10.4-25.0)
2 cars	552	29.4 (23.5-35.4)	14.2 (9.6-18.9)
3 cars	79	27.5 (22.4-35.4)	14.9 (10.03-19.2)
4 or more cars	14	29.6 (20.4-37.7)	11.9 (10.77-20.4)

Amount spent on food was also patterned by dietary and health variables (Table 81), with higher spending among those consuming more fruit and vegetables, more NSP and less fat.

Table 81: Usual cost of weekly household shopping and percentage of annual income spent on food per adult equivalent, by dietary and health variables

	No.	Median cost/week in £ (IQR)	Median % of annual household income spent on food (IQR)
Fifths of fruit and vegetable consumption index			
1. Lowest fifth	1007	25.0 (20.0-32.5)	17.8 (11.9-29.1)
2.	888	25.0 (20.0-32.6)	17.3 (11.6-27.7)
3.	1130	26.5 (20.6-34.5)	16.6 (11.6-26.7)
4.	1010	26.5 (20.6-35.3)	17.8 (11.6-27.0)
5. Highest fifth	1008	27.3 (20.6-35.3)	20.5 (11.9-28.3)
Fifths of NSP consumption index			
1. Lowest fifth	1008	25.0 (20.0-33.3)	17.8 (11.6-27.7)
2.	704	25.8 (20.6-35.3)	17.3 (11.9-27.7)
3.	1304	25.9 (20.6-33.3)	17.8 (11.9-27.7)
4.	1015	26.5 (20.6-35.0)	17.3 (11.6-27.7)
5. Highest fifth	1012	25.9 (20.0-35.3)	18.3 (11.6-27.7)
Fifths of Fat consumption index			
1. Lowest fifth	1010	27.3 (20.6-35.3)	16.6 (11.4-25.0)
2.	1016	26.5 (20.6-35.0)	16.6 (11.1-25.0)
3.	997	25.0 (20.0-33.3)	18.7 (12.3-27.7)
4.	1011	26.5 (20.6-35.3)	17.8 (11.9-27.7)
5. Highest fifth	1009	25.0 (19.4-32.4)	19.4 (11.9-29.6)
Fifths of dietary knowledge score			
1. Lowest fifth	1221	24.2 (18.0-30.0)	23.6 (14.2-34.7)
2.	1112	25.0 (20.0-34.3)	18.0 (11.9-27.7)
3.	694	26.5 (20.6-35.0)	17.2 (11.9-25.4)
4.	1248	29.2 (22.2-35.3)	16.3 (11.4-25.0)
5. Highest fifth	769	29.4 (22.2-35.3)	14.9 (10.4-20.8)
Body Mass index			
Underweight	70	21.5 (16.7-30.0)	17.0 (11.9-31.2)
Ideal weight	1104	25.0 (20.0-32.4)	16.2 (10.4-25.0)
Overweight	2144	25.9 (20.6-35.0)	16.6 (11.6-27.7)
Obese	1565	27.0 (20.6-35.3)	20.8 (13.4-29.7)
Self-reported Health			
Very good	834	26.0 (20.5-35.0)	16.2 (10.4-245.0)
Good	1801	26.5 (20.6-35.3)	15.1 (10.4-23.8)
Neither good nor poor	1794	25.0 (20.0-33.5)	20.8 (12.5-27.7)
Poor or very poor	555	25.9 (20.6-34.6)	24.3 (15.8-34.7)
Long-term illness			
None	2121	25.8 (20.0-35.0)	16.2 (10.4-25.0)
LTI without limitation	293	27.3 (20.4-35.0)	20.8 (12.3-28.1)
Activity-limiting LTI	700	25.8 (20.0-34.5)	22.2 (14.9-34.7)

Amount spent was also higher among the obese and those with activity-limiting long-term illness. Those with greater dietary knowledge spent more on food than those with poor knowledge. Trends in percentage of income spent on food were patterned in a similar way, although there was no obvious relationship with NSP consumption (Table 81).

These socio-economic patterns in food spend were reflected in the types of shops used for main food shopping (Table 82). Those who shopped at discount supermarkets spent on average £22.90/week (IQR £17.20-29.40), whilst those who shopped at multiple supermarkets

spent £26.50/week (IQR £20.50-35.00) and those who shopped at department stores spent £30.00/week (IQR £25.00-40.00).

Table 82: Usual cost of weekly household shopping and percentage of annual income spent on food per adult equivalent, by variables relating to retailing and food preparation

	No.	Median cost/week in £ (IQR)	% of annual household income spent on food
Main shop type			
Discounters	335	22.9 (17.2-29.4)	25.0 (16.3-41.6)
Multiple supermarkets	2111	26.5 (20.5-35.0)	16.6 (10.6-26.7)
Department stores	65	30.0 (25.0-40.0)	17.3 (11.8-27.7)
Other stores	39	23.5 (20.0-30.0)	18.2 (13.9-34.7)
Not known	105	26.7 (20.0-35.3)	20.8 (12.5-27.7)
Frequency of shopping			
Daily	249	28.0 (20.8-35.2)	25.0 (16.6-34.7)
2-3 times/week	1559	26.5 (20.4-35.0)	18.7 (11.9-27.7)
Weekly	1070	25.0 (20.0-33.3)	16.2 (10.4-25.0)
Once/fortnight	142	20.6 (15.0-29.4)	12.5 (7.4-27.0)
Less often	70	20.3 (15.0-30.0)	9.8 (6.9-18.9)
Usual mode of travel from main food shop			
Car	1915	27.8 (22.2-35.3)	16.2 (10.4-24.3)
Taxi	155	25.0 (20.0-35.3)	25.9 (16.6-41.6)
Public Transport	402	23.5 (17.7-30.0)	24.3 (13.9-34.7)
Foot	484	23.2 (17.7-30.0)	20.8 (12.5-31.2)
Bike	12	29.7 (18.4-30.0)	17.3 (12.0-38.1)
SLI for cooking			
Less adequate facilities	61	25.0 (17.65-30.0)	27.7 (20.8-54.1)
Adequate facilities	3048	25.9 (20.0-35.0)	17.3 (11.6-27.7)

As expected the percentage of income spent on food was greater for those who shopped at discount and local stores and lowest for those who shopped at multiple supermarkets (Table 82). There was a strong gradient with frequency of shopping, such that those shopping daily spent the highest percentage of income on food, as did those who brought their shopping home by taxi, public transport or on foot, and those with less adequate cooking facilities. Trends were also seen with frequency of shopping and mode of transport used. Those who shopped daily spent the most on food (£28.00/week), whilst those who shopped less than once a fortnight on average spent only £20.30/week. This is likely to be because those shopping daily are more likely to use local, convenience stores (where prices are higher) than larger multiple or discount supermarkets (see Table 62). Those travelling from shops on foot or public transport spent least, whilst those using a car or bicycle spent the most.

7. Analysis of integrated data sets

One of the principal strengths of this study is its ability to bring together data from more than one source in order to explore the complex relationship between retail access to food, the population and its socio-economic characteristics, and what people eat. In this chapter, analyses are presented that explore the relationship between individuals, households and access to food retailing, enabling assessment of whether geographical differences in food retail access adversely affect particular population groups. These analyses are followed by multilevel regression analyses that allow assessment of whether food retail access at a household's usual main food store, or in the neighbourhood surrounding the home, are independently associated with the quality of individual diets (as measured by fruit and vegetable, NSP and fat intake), thus responding to the primary research question.

7.1 Travel distance

Table 83 shows the linear distance between households and their usual main food store. Overall, the median travel distance to main food shop was 1865 metres (IQR: 885-3701). The shortest distance was zero (for a small number of households that lived in the same ED as their main food shop) and the longest distance was 23716 metres (for one household that regularly shopped at Sainsbury's, Durham).

Average distances to main food store were greater for users of department stores than multiple supermarkets and least for discount supermarkets and other local stores (Table 83). Both department stores are in the city centre, which probably accounts for the higher travel distance to these shops. Most supermarkets are in suburban areas, on main circular or arterial roads, whereas discount supermarkets are more usually found in suburban shopping centres.

Of the multiple supermarkets, a small number stood out with greater travel distances, including Morrisons and Sainsbury's (multiple) supermarkets (both out of Newcastle, in Whitley Bay and Durham). Those owning a car travelled further (2220 metres) than those without (1360 metres), though only those who returned from shops on foot travelled substantially shorter distances (median 510 metres) than those using other modes (medians 1562 to 2528 metres). Travel distance by metro was relatively higher (2442 metres) than by bus (2093 metres). This may be because relatively few major stores are close to a metro station (i.e. only Tesco Kingston Park, Safeway Byker, and the city centre stores) and these stores are at a greater distance from most residential areas.

Travel distances were also analysed in relation to 'trip-chain' activity. Those who added food shopping to another journey, or vice versa, travelled a median of 2012 (IQR 935-3835) metres and those who did not, travelled a median of 1790 (IQR 856-3614) metres to their main food store. Doing 'other' shopping when food shopping resulted in the longest journeys: those doing other shopping 'usually' travelled a median of 2042 (IQR 921-3993) metres and those doing other shopping 'occasionally' travelled a median of 2110 (IQR 1000-3765) metres, whereas those not adding 'other' shopping to their food shopping travelled a median of 1679 (IQR 795-3523) metres. This is likely to be because most 'other' shopping (e.g. clothes) takes place in the city centre or a major out-of-town mall (i.e. the Metrocentre in Gateshead).

Those with higher SEI travelled further on average than those with lower SEI (Table 83). This was reflected in a weak, though significant correlation between linear distance to main food shop and TDS of ED of residence (Spearman's Rho=-0.068, P<0.0001) or household SEI (Spearman's Rho=0.1, p<0.0001), suggesting that people living in poorer areas travel less far and people from more affluent households travel further to their main food store.

In order to explore further the relationship between mode of travel and socio-economic position and distance to main food shop, a stratified analysis of travel distance by mode of travel and SEI was undertaken. Although this did not show any significant trends, the poorest group were found to walk furthest to the shops (589 metres, IQR: 300-854) compared with 412 metres (IQR: 200-577) for the highest socio-economic fifth.

The relationship between socio-economic position, car ownership and distance travelled was also explored. For non-car owners, there was a gradient in median distance travelled, from 1225 metres for the most deprived fifth of TDS for home ED to 2338 metres for the most affluent TDS fifth. There was also a trend in distance by TDS for car owners.

Table 83: Median (IQR) [minimum, maximum] distance from home to main food store in metres by type of shop and socio-economic factors

		Distance from home to main food shop in metres		
	Number of households	Median	Inter-quartile range	Minimum - Maximum
Main shop type				
Shop categories				
Multiple supermarkets	**2440**	**2081**	**(1020-3846)**	**(39-19105)**
Asda	677	2569	(1330-4053)	(65-15517)
Co-op	214	1389	(570-3431)	(39-10377)
Morrison	106	7712	(6661-8627)	(1981-19105)
Safeway	633	1356	(781-2205)	(71-14439)
Sainsbury	13	9726	(8781-10420)	(7537-11629)
Tesco	753	2555	(1138-3808)	(100-9244)
Discounts supermarkets	**435**	**1077**	**(539-1965)**	**(0-18873)**
Aldi	30	1298	(803-2870)	(207-14969)
Kwiksave	284	879	(412-1707)	(0-8584)
Lidl	4	1167	(332-4501)	(100-5566)
Netto	114	1393	(806-2491)	(158-18873)
Department stores	**82**	**3418**	**(2302-4653)**	**(100-10066)**
Fenwick	20	3142	(1417-4313)	(00-7111)
Marks & Spencer	62	3486	(2700-4827)	(224-10066)
All other stores	**47**	**1060**	**(539-1965)**	**(0-18873)**
Iceland	22	1500	(671-3606)	(200-8782)
Travel mode from shops				
Foot	490	510	(300-852)	(0-13815)
Car	1935	2528	(1315-4030)	(95-23716)
Bus	379	2093	(1300-3720)	(25-15308)
Metro	31	2442	(1351-2992)	(510-5746)
Bike	12	1759	(1509-3204)	(412-7537)
Taxi	158	1562	(947-2885)	(100-7078)
Cars per household				
No car or unknown	1138	1360	(640-2884)	(0-15308)
One or more cars	2015	2220	(1118-3905)	(0-23716)
1 car	1370	2129	(1063-3887)	(0-23716)
2 cars	552	2470	(1196-3956)	(76-14969)
3 cars	79	2460	(1366-3964)	(100-12248)
4 or more cars	14	3389	(1432-6127)	(316-19105)
Socio-Economic Index (SEI)				
1. Lowest fifth (most deprived)	670	1325	(633-2850)	(0-18873)
2.	687	1669	(803-3542)	(71-14650)
3.	566	2119	(1116-4140)	(0-19105)
4.	765	2190	(1105-3824)	(95-15308)
5. Highest fifth (most affluent)	465	2419	(1054-3758)	(95-23716)
All households	**2988**	**1856**	**(885-3701)**	**(0-23716)**

Since most shoppers (70%) used a car to do their main food shopping, the distances they were prepared to travel are perhaps not surprising. It is clear that many people did not shop at their nearest food store, preferring to travel beyond this to an alternative store for various reasons

(e.g. see section 6.7.2). Median distance to nearest food store was 361 (IQR: 207-586) metres and the median difference between distance to main food store and nearest food store was 1590 (IQR: 522-3306) metres. Distance to nearest shop was positively associated with household SEI (Spearman's Rho=0.104, p<0.0001, N=560) and negatively associated with TDS (Spearman's Rho, p<0.0001, N=560) indicating that less affluent households in general live nearer to a shop selling food than more affluent households.

7.2 Relative access to food and food shops in Newcastle

By linking data on where people live, their access to public and private transport, where they shop and the characteristics of those shops, relative access to different types of shop, a range of foods and their cost and quality were assessed.

7.2.1 Proximity mapping

Figure 11 shows the entire road network in and around Newcastle. Those roads within 250 metres (red), 500m (purple), 750m (blue), 1000m (green) or >1000m (black) of any shop selling any food (i.e. all 560 shops) are highlighted. Background grey shading indicates residential areas and the heavy black line traces the city boundary. The figure shows that there are very few residential areas of the city that are not within walking distance (i.e. 250m for the elderly, disabled or those with babies and small children; 500m for others[145-148]) of a food shop of one sort or another.

Figure 11: Geographical proximity to shops selling food in Newcastle upon Tyne

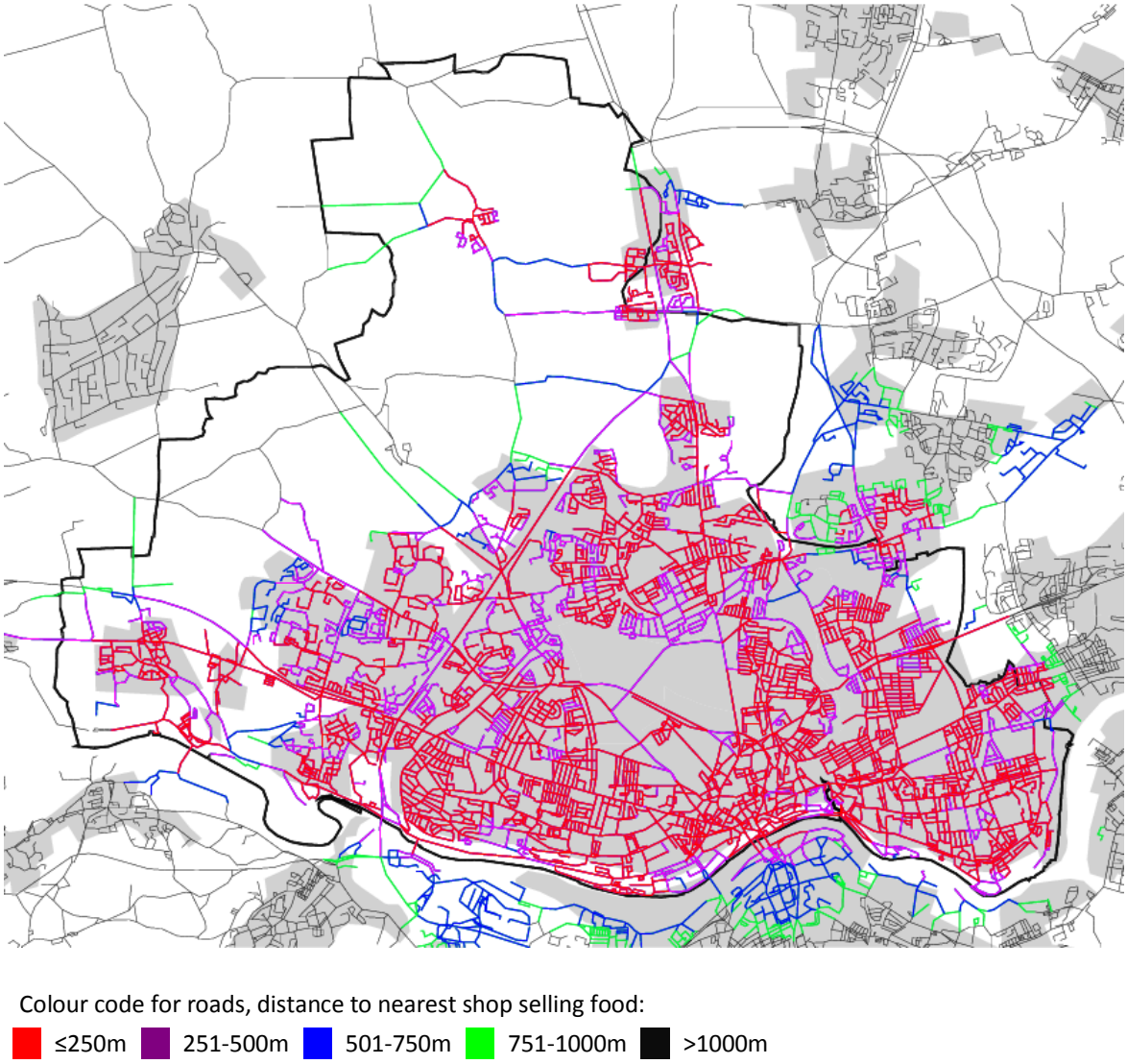
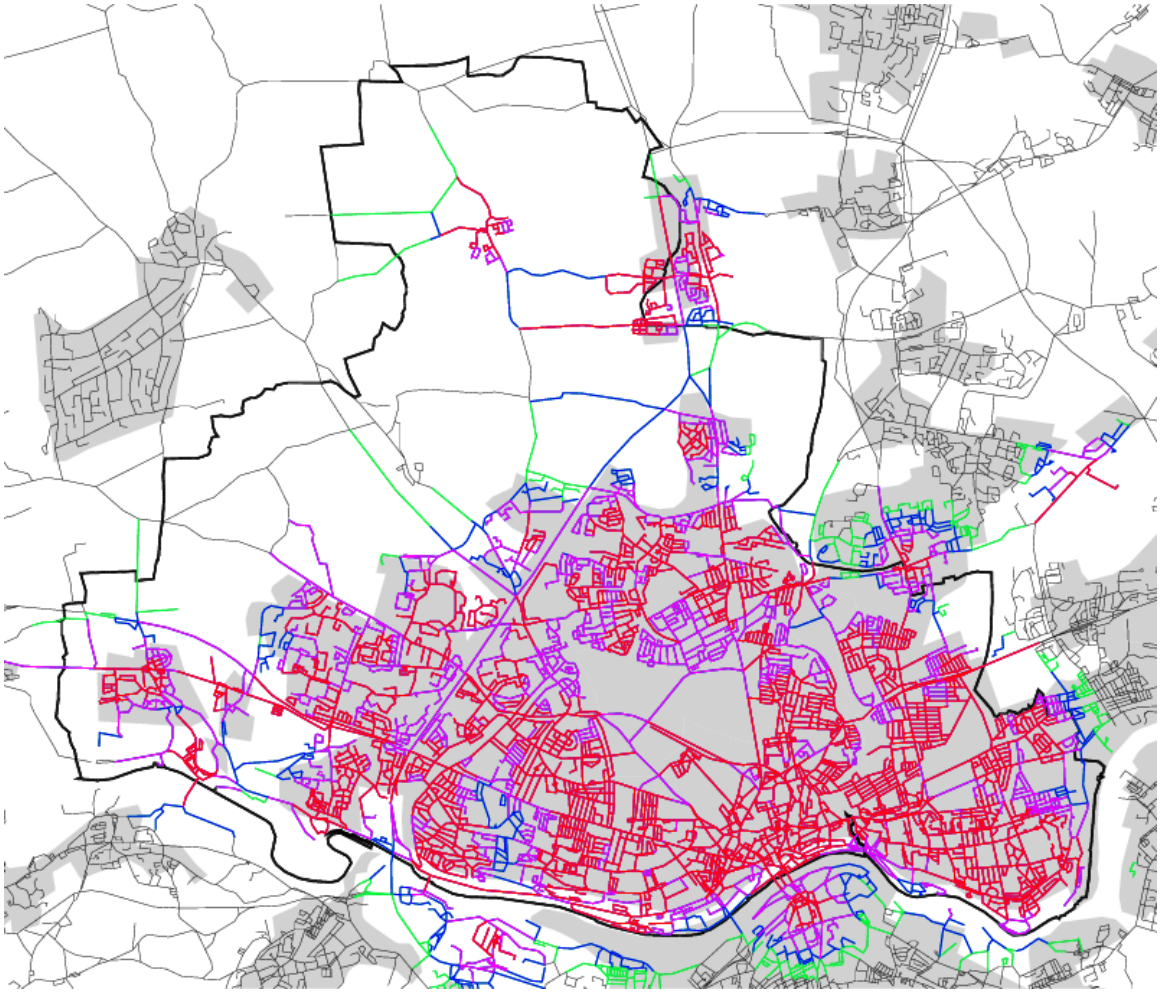


Figure 12 explores this relationship with respect to the basket of 'less healthy' food items and shows access to those shops selling at least 5 out of the 10 items. The pattern is similar to Figure 11 but there is slightly less coverage in the inner west riverside area (Scotswood and Benwell wards) of the city.

Figure 12: Geographical proximity to shops selling 5 or more 'less healthy' food items in Newcastle upon Tyne



Colour code for roads, distance to nearest shop selling 5 or more 'less healthy' food items:

≤250m 251-500m 501-750m 751-1000m >1000m

Figure 13 shows distance parameters (250m, 500m, 750m and 1000m) for those shops selling all 10 'less healthy' items. Coverage of the city is significantly reduced, again particularly in the inner west riverside area but also in the central riverside area and parts of the north and west of the city.

Figure 13: Geographical proximity to shops selling all 10 'less healthy' food items in Newcastle upon Tyne

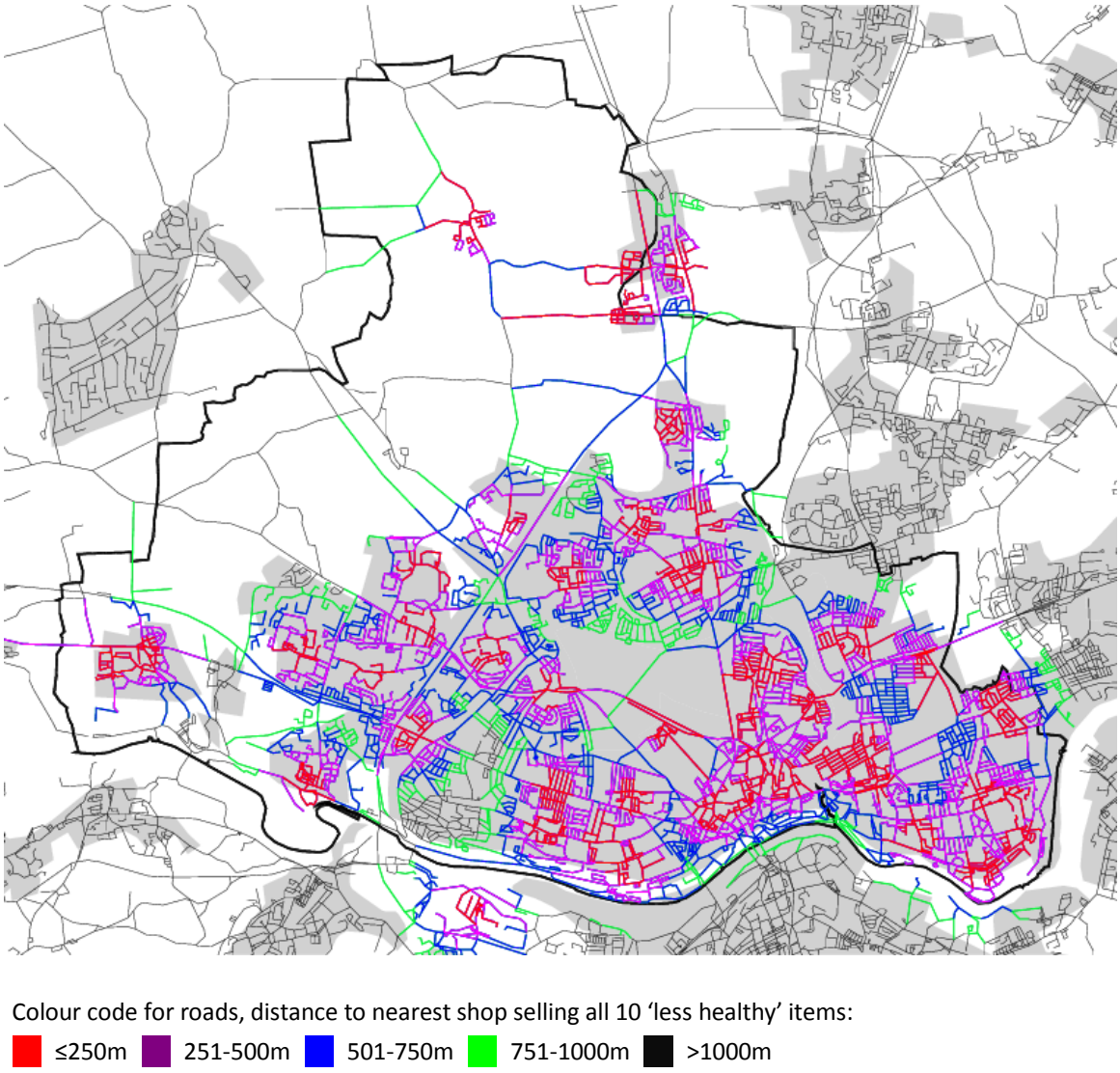
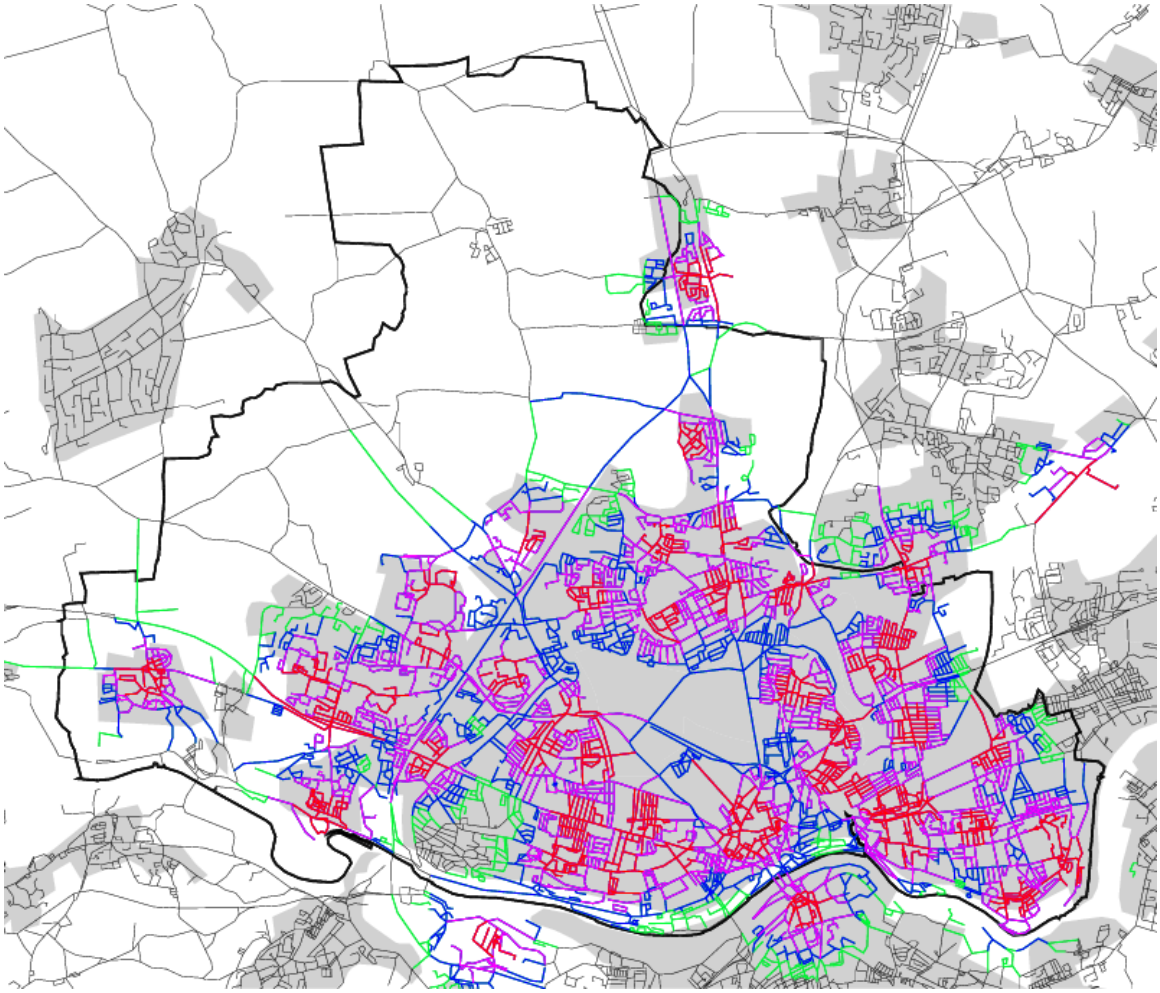


Figure 14 shows a similar map for shops selling all 10 fresh fruit and vegetable items. Proximity to shops selling all 10 fresh fruit and vegetables is reasonably good, although there are again gaps in the Scotswood and Benwell areas to the west of the city and parts of the north west of the city.

Figure 14: Geographical proximity to shops selling all 10 fresh 'fruit and vegetable' items in Newcastle upon Tyne

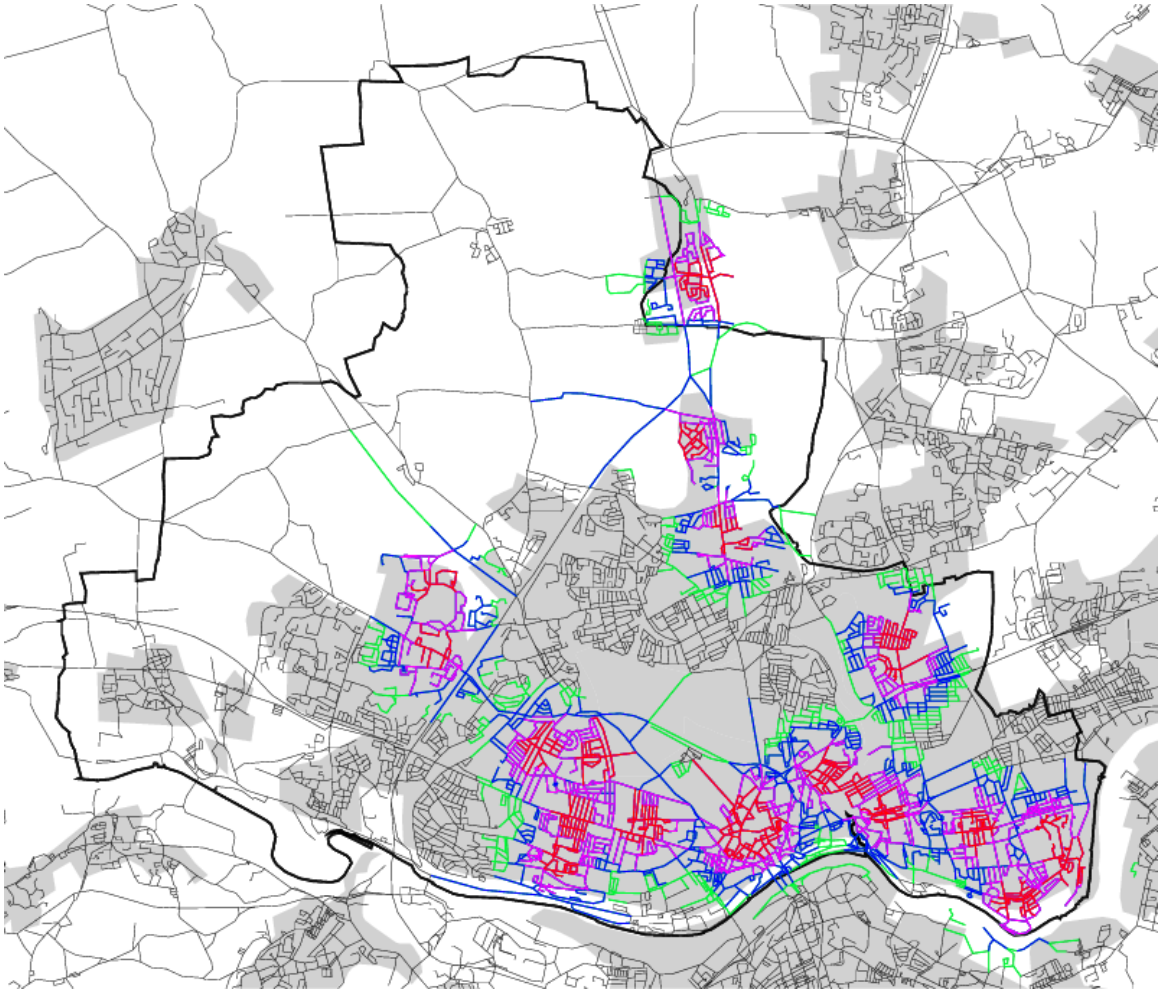


Colour code for roads, distance to nearest shop selling 10 fresh 'fruit and veg.' items:

≤250m 251-500m 501-750m 751-1000m >1000m

Figure 15 shows proximity to shops selling all 10 fresh fruit and vegetables of acceptable quality and less than or equal to the median basket price (£6.35) for the 10 fruit and vegetables. This represents a much smaller number of stores and, thus, overall coverage is less good. However, it is notable that the best served areas are predominantly in the east and inner west riverside areas and city centre, all relatively deprived areas.

Figure 15: Geographical proximity to shops selling all 10 fresh 'fruit and vegetable' items of acceptable quality and less than or equal to the median price (£6.35) in Newcastle upon Tyne



Colour code for roads, distance to nearest shop selling all 10 fresh 'fruit and veg.' items of acceptable quality and less than or equal to the median price:

≤250m 251-500m 501-750m 751-1000m >1000m

7.2.2 Distance to stores selling food baskets

Next, the linear distance from home to a range of stores defined by availability of the food baskets and indicators of socio-economic position was explored. Table 84 shows the median (IQR) distances for different types of household. Although many of the trends are not entirely linear, there was, for most baskets, an association between home to shop distance and affluence. Distance to a shop selling 10 fresh fruit and vegetables of good quality was positively associated with socio-economic position, as was distance to a shop selling 10 'less healthy' items. Distance to shops selling all of the baskets was negatively associated with TDS of home ED, suggesting that less affluent households generally live closer to shops selling a range of food baskets.

Table 84: Median distance (IQR) to shop selling full baskets of food by SEI and TDS of home ED

	Median distance (IQR) to shop selling full basket				
	10 Fresh fruit & veg.	10 fresh fruit & veg. good quality	14 fruit & veg.	21 'healthier' items	10 'less healthy' items
Fifths of household SEI					
1. Most deprived	638 (394, 914)	709 (453, 1046)	982 (650, 1322)	1075 (716, 1421)	628 (427, 931)
2	652 (411, 931)	771 (484, 1153)	1032 (650, 1415)	1121 (736, 1551)	699 (448, 1052)
3	665 (435, 960)	769 (491, 1178)	1002 (633, 1437)	1135 (702, 1551)	712 (479, 1082)
4	703 (428, 1016)	832 (511, 1250)	978 (662, 1423)	1107 (750, 1497)	788 (518, 1181)
5. Most affluent	677 (404, 1006)	814 (462, 1236)	1018 (685, 1469)	1116 (730, 1527)	835 (500, 1245)
Fifths of TDS of home ED					
5. Most deprived	608 (378, 879)	706 (437, 1016)	981 (666, 1306)	1058 (763, 1370)	616 (424, 881)
4	645 (429, 941)	752 (497, 1036)	1015 (601, 1453)	1089 (673, 1586)	739 (481, 991)
3	616 (372, 868)	692 (435, 1066)	866 (533, 1307)	966 (645, 1406)	657 (396, 1019)
2	628 (388, 926)	718 (411, 1182)	951 (659, 1281)	1078 (698, 1405)	745 (511, 1180)
1. Most affluent	903 (577, 1255)	1059 (687, 1798)	1275 (860, 1871)	1289 (928, 1871)	983 (605, 1438)

7.2.3 Basket availability, choice of main food store and socio-economic position

The relationships between availability of food items in baskets, and type of main food store and two socio-economic indicators: household SEI and TDS of home ED are shown in Table 85. Whilst there were trends in food basket availability by type of store chosen, there were none in relation to socio-economic position of either the household or area of residence. This suggests that, although most people across the socio-economic spectrum have access to a full range of products, those few who shop, in particular, at convenience stores and department stores and, to a lesser extent, discount supermarkets, are somewhat disadvantaged in terms of food availability.

Table 85: Median number (IQR) of basket items available in usual main food store by store type and measure of household socio-economic position

	10 Fresh fruit & veg.	14 fruit & veg.	21 'healthier' items	11 'less healthy' items	All 33 items
Main food store type					
Multiple supermarkets	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
Discount supermarkets	9 (9,10)	13 (13,14)	20 (18,20)	11 (11,11)	30 (29,33)
Department stores	10 (10,10)	14 (14,14)	19 (19,21)	9 (9,11)	29 (29,33)
All other stores	9 (9,9)	12 (9,13)	16 (10,20)	8.5 (1,11)	24 (11,32)
Fifths of household SEI					
1. most deprived	10 (9,10)	14 (13,14)	21 (20,21)	11 (11,11)	33 (31,33)
2	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (32,33)
3	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
4	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
5 most affluent	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
Fifths of household TDS					
5 most deprived	10 (9,10)	14 (13,14)	21 (20,21)	11 (11,11)	33 (30,33)
4	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (32,33)
3	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
2	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)
1 most affluent	10 (10,10)	14 (14,14)	21 (21,21)	11 (11,11)	33 (33,33)

The availability of baskets at main food store by access to a car was also explored. There was no difference in median number of items for each of the baskets (10 fresh fruit and vegetables, 14 fruit and vegetables, 21 'healthier' items or 11 'less healthy' items) between car and non-car owners (median values were the maximum value for each basket – i.e. '10' for the fresh fruit and vegetables).

7.3 Analysis of factors independently associated with dietary quality

Here the results of simple and multilevel regression analyses exploring the factors independently associated with the dietary consumption indices are presented.

7.3.1 Data used in the analyses

Two hundred and forty-three of 5030 individual respondents left more than 13 (10%) of the 134 items on the food frequency questionnaire blank and were excluded from the analysis. A further 37 individuals reportedly ate more than 2000g of fruit and vegetables per day *and* more than 50g NSP per day and were thus excluded (see section 4.6.5.3). This resulted in a total of 4764 individuals available for analysis, living in 3153 households in 2099 neighbourhoods defined by 500m buffer zones. Descriptive statistics for the composite dietary indices (F&V, NSP, FAT) are given in Table 38 to Table 41.

There were on average 1.5 individuals per household (range 1-5), and 1815 (58%) one person households. There were on average 1.5 households per postcode unit (range 1-7), and 1378 (66%) one household neighbourhoods.

7.3.2 Multivariable analyses

In all three models presented below, the outcome (dependent) variables are the transformed (z-score) composite dietary consumption indices, representing relative intakes of fruit and vegetables (F&V), non-starch polysaccharide (NSP) and percentage energy from total fat (FAT) (See 4.6.5.2Development of healthy eating indices). Using the standardised score does not alter the distribution of each index and means that estimates can be interpreted as multiples of standard deviations of the relevant index.

7.3.3.1 The fruit and vegetable consumption index

Table 86 presents the null or empty multilevel model for the fruit and vegetable consumption index.

Table 86: Null model for fruit and vegetable consumption (n=4268*)

Variables	Estimate	Standard error	P-value (χ2, 1df)
Intercept	–0.004	0.017	
Random effects variance			
Level 1 (Individual)	0.651	0.023	
Level 2 (Household)	0.292	0.033	<0.001
Level 3 (Neighbourhood)	0.035	0.023	0.2

* Note, the total number included in each model is dependent on the number with sufficiently complete data for the dependent variable

The unexplained variation for the empty model was partitioned in to that due to differences between individuals within households, that due to differences between households within neighbourhoods and that due to differences between neighbourhoods. In this empty model, the variation between neighbourhoods accounted for only 3.6% (0.035/(0.651+292+0.035)) of the observed variation in fruit and vegetable intake and was not statistically significant (P=0.2). Thus there was no evidence of between neighbourhood variation in fruit and vegetable intake; rather the variation was attributable to factors at the household and individual level. There was statistically significant variation at the household level; 29.9% of the variation in fruit and vegetable intake was attributable to differences between households within neighbourhood areas. The majority of the variation in fruit and vegetable intake (66.6%) was attributable to differences between individuals within households.

Table 87 shows parameter estimates of the final multilevel model for the fruit and vegetable consumption index. The fixed part of the model explained 11.7% of the variation observed in the fruit and vegetable index (calculated using the proportional reduction in mean squared prediction error[125]).

Table 87: Parameter estimates for the multilevel model of the fruit and vegetable consumption index

Variables	*n*	Category/increment	Estimate	Standard error	P-value
Fixed effects variance					
Intercept			–0.046	0.043	
Individual level					
Age in years	4268	For an increase of 10 years	0.100	0.010	<0.001
Sex (baseline=female, n=2459)	1809	Male	–0.231	0.027	<0.001
Fifths of exercise score (baseline=least active	975	2nd fifth	0.036	0.046	0.4
fifth, *n* = 680)	872	middle fifth	0.157	0.047	0.001
	905	4th fifth	0.278	0.047	<0.001
	836	5 (most active fifth)	0.305	0.048	<0.001
Dietary knowledge score	4268	For an increase of one unit	0.056	0.005	<0.001
Smoking status (baseline never smoked,	802	daily	–0.200	0.040	<0.001
n = 2076)	170	occasionally	–0.053	0.073	0.5
	1220	ex-smoker	–0.046	0.034	0.2
Risk category for alcohol consumption	696	Risky/hazardous	–0.097	0.039	0.01
(baseline safe, *n* = 3572)					
Eats meat and/or fish (*n* = 4183)	85	vegetarian	0.205	0.102	0.04
Household level					
Household member in receipt of state	845	on benefits	0.122	0.102	0.003
benefit (baseline not on benefits, *n* = 3383)	40	not known	0.055	0.161	0.7
Interaction terms					
Ethnicity by usual mode of travel from main	11	non-white by taxi	0.255	0.284	0.4
food store (baseline white by car, *n* = 2978)	28	non-white by bus	–0.136	0.180	0.5
	3	non-white by metro	0.327	0.507	0.5
	28	non-white by foot	0.639	0.180	<0.001
	81	non-white by car	0.222	0.111	0.05
	14	white by bike	0.418	0.259	0.1
	180	white by taxi	0.219	0.079	0.006
	377	white by bus	0.061	0.056	0.3
	38	white by metro	–0.023	0.166	0.9
	530	white by foot	–0.123	0.048	0.01
Random effects variance					
Level 1 (Individual)			0.572	0.020	
Level 2 (Household)			0.280	0.030	<0.001
Level 3 (Neighbourhood)			0.012	0.020	0.6

Estimates are reported in multiples of standard deviations of the fruit and vegetable index

The intercept represents the estimated average relative daily fruit and vegetable intake for an individual who had the average value on numerical variables and belongs to the comparison category for the categorical variables (shown in the left hand column of Table 87).

Only variables at the individual and household level were significantly associated with fruit and vegetable intake; no neighbourhood level variables, including food retailing variables, entered the fixed part of the model. Seven individual level variables (age, sex, physical activity score, dietary knowledge score, smoking status, alcohol consumption and whether the respondent ate meat or fish) and one household level variable (household member in receipt of state benefits) were significantly associated with higher fruit and vegetable intake. Notably, none of the food retailing or distance and travel variables remained statistically significant after inclusion of the demographic, socio-economic, health, behaviour and food retail variables.

The interaction between ethnicity and mode of travel from main food store was statistically significant and thus the main effects for ethnicity and mode of travel from main food store cannot be interpreted on their own. In other words, the difference in fruit and vegetable intake between being non-white and being white-European was not consistent from one mode of travel to another. For example, compared with whites who travel from their main food store by foot, non-whites who travel from their main food store by foot are estimated to eat on average 0.762 SD more fruit and vegetables per day (0.639 – (–0.123)). Cell counts were very small for some combinations and there were no non-whites who travelled by bike for this model.

The dietary knowledge score ranged from zero to 20; higher dietary knowledge scores were associated with higher fruit and vegetable intake. Based on this model, for an increase of five points on the dietary knowledge score individuals would be estimated to eat on average 0.28 SD more fruit and vegetables per day (5 x 0.056)

The unexplained variation was partitioned in to that due to differences between households within neighbourhoods and that due to differences between individuals within households; there was no statistically significant residual variation at the neighbourhood level. As might be expected, differences between individuals accounted for the majority (66.2%) of the total unexplained variation. However, 32.4% of the unexplained variation in fruit and vegetable consumption occurred at the household level, suggesting that the effect of household membership remains strong, even after accounting for individual and household level variables.

7.3.3.2 The NSP consumption index

Table 88 presents the null or empty multilevel model for the NSP index.

Table 88: Null model for the NSP index (n=3544)

Variables	Estimate	Standard error	P-value (χ2, 1df)
intercept	-0.020	0.018	
Random effects variance			
Level 1 (Individual)	0.609	0.024	
Level 2 (Household)	0.306	0.036	<0.001
Level 3 (Neighbourhood)	0.010	0.025	0.3

In this model, the variation between neighbourhoods was negligible (1.1%) and was not statistically significantly different from zero (P=0.3). Thus, there was no evidence of between neighbourhood variation in NSP consumption; rather the variation was attributable to factors at the household and individual level. There was statistically significant variation at the household level; 33.1% of the variation in NSP consumption was attributable to differences between households within neighbourhood areas. The majority of the variation in NSP consumption (65.8%) was attributable to differences between individuals within households.

Table 89: Parameter estimates for the multilevel modelling of the NSP index (n=3544)

Variables	*n*	Category/increment	Estimate	Standard error	P-value
Fixed effects variance					
Intercept			–0.278	0.067	
Individual level					
Age in years	3544	For an increase of ten years	0.006	0.001	<0.001
Dietary knowledge score	3544	For an increase of one unit	0.025	0.006	<0.001
Fifths of exercise score	842	2nd fifth	0.032	0.050	0.5
(baseline=least active fifth	713	middle fifth	0.050	0.052	0.3
n = 560)	730	4th fifth	0.219	0.052	<0.001
	699	5 (most active fifth)	0.291	0.052	<0.001
Frequency of eating outside the home (baseline at most once/ month on all six types of eating,	2054	At least once or twice a week on one of the six types	0.111	0.034	0.001
n =1346)	144	almost every day	0.542	0.082	<0.001
interaction term					
Work status by sex (baseline	86	Unemployed male	0.155	0.105	0.1
employed female, *n* = 1222)	468	Not in paid employ/not unemployed male	0.094	0.055	0.08
	906	Employed male	0.050	0.038	0.2
	72	Unemployed female	0.351	0.113	0.002
	790	Not in paid employ/not unemployed female	0.079	0.047	0.09
Household level					
Annual household income	47	£0 - £2500	0.061	0.159	0.7
(baseline median group:	319	£2500 - £5000	0.161	0.080	0.04
£15000-£20000, *n* = 490)	656	£5000 - £10000	0.133	0.065	0.04
	610	£10000 - £15000	0.085	0.063	0.2
	502	£20000 - £25000	0.040	0.066	0.5
	357	£25000 - £30000	–0.090	0.073	0.2
	563	£30000+	–0.131	0.066	0.05
Household composition	847	≥2 adults, ≥1 child	0.191	0.049	<0.001
(baseline: two adults, *n* =1277)	122	1 adult, 1 or more child	0.024	0.095	0.8
	621	≥3 adults	0.025	0.055	0.7
	677	Single adults	–0.163	0.050	0.001
Availability of 14 fresh or pre-packed fruit and veg. at main food store (baseline: 5+, *n* =3468)	76	0 to 4	0.282	0.120	0.02
Interaction term					
Ethnicity by usual mode of	5	non-white by taxi	0.647	0.417	0.1
travel from main food store	22	non-white by bus	–0.156	0.208	0.5
(baseline white by car	3	non-white by metro	–0.013	0.512	>0.9
n = 2514)	25	non-white by foot	0.483	0.191	0.01
	70	non-white by car	–0.010	0.120	0.9
	14	white by bike	0.138	0.265	0.6
	143	white by taxi	0.058	0.089	0.5
	275	white by bus	0.122	0.067	0.07
	26	white by metro	0.243	0.201	0.2
	447	white by foot	–0.169	0.055	0.002
Random effects variance					
Level 1 (Individual)			0.586	0.023	
Level 2 (Household)			0.273	0.034	<0.001
Level 3 (Neighbourhood)			0.004	0.023	0.4

Estimates are reported in multiples of standard deviations of the NSP index.

The fixed part of the model explained 6.7% of the variation observed in the NSP consumption index. The intercept represents the estimated average NSP intake for the individual who takes the average value on numerical variables and belongs to the comparison category for the categorical variables (shown in the left hand column of Table 89).

Only variables at the individual and household level were statistically significantly associated with NSP consumption; no neighbourhood level variables entered the fixed part of the model. Four individual level variables (age, dietary knowledge score, physical activity score and frequency of eating outside the home) and three household level variables (household income, household composition, and availability of fruit and vegetables at usual main food store) were significantly associated with higher NSP intake.

At the individual level, there was a statistically significant interaction between work status and sex, and thus the main effects for work status and sex cannot be interpreted on their own. In other words, NSP consumption in any work category differed for men and women. Similarly, at household level there was a statistically significant interaction between ethnicity and mode of travel from usual main food store, as was seen in the F&V model.

The unexplained variation was partitioned in to that due to differences between households within neighbourhoods and that due to differences between individuals within households; there was no statistically significant residual variation at the neighbourhood level. Differences between individuals accounted for the majority (67.9%) of the total unexplained variation. However, 31.6% of the unexplained variation in NSP consumption occurred at the household level, suggesting that the effect of household membership remains strong, even after accounting for individual and household level variables.

7.3.3.3 The percentage dietary energy from fat index

Table 86 presents the null or empty multilevel model for the % dietary energy from fat index.

Table 90: Null model for percentage dietary energy from fat index (n=3919)

Variables	Estimate	Standard error	P-value (χ2, 1df)
Intercept	0.012	0.017	
Random effects variance			
Level 1 (Individual)	0.716	0.027	
Level 2 (Household)	0.228	0.035	<0.001
Level 3 (Neighbourhood)	0.031	0.024	0.1

The unexplained variation for the empty model was partitioned in to that due to differences between individuals within households, that due to differences between households within neighbourhoods and that due to differences between neighbourhoods. In this empty model, the variation between neighbourhoods accounted for only 3.2% (0.031/(0.716+0.228+0.031)%) of the observed variation in percentage dietary energy from fat and was not statistically significantly different from zero (P=0.1). Thus, there was no evidence of between neighbourhood variation in percentage dietary energy from fat; rather the variation was attributable to factors at the household and individual level. There was statistically significant variation at the household level; 23.4% of the variation in percentage dietary energy from fat was attributable to differences between households within neighbourhood areas. However, the majority of the variation in percentage dietary energy from fat (73.4%) was attributable to differences between individuals within households.

The fixed part of the model explained 9.6% of the variation observed in the percentage dietary energy from fat index. The intercept represents the estimated average percentage dietary energy from fat for the individual who takes the average value on numerical variables and belongs to the comparison category for the categorical variables, in the left hand column of Table 91. The intercept on the standardised scale (–0.292) equates to an estimated average percentage dietary energy from fat intake of 0.98 SD (–0.292x2.8).

Only variables at the individual and household level were significantly associated with percentage dietary energy from fat; no neighbourhood level variables entered the fixed part of the model. Seven individual level variables (age, sex, dietary knowledge score, smoking status, alcohol consumption, eating meat/fish and frequency of eating outside the home) and one household level variable (usual cost of weekly shopping per adult equivalent) were significantly associated with higher energy intake from fat intake.

Table 91: Parameter estimates for the multilevel modelling of the percentage dietary energy from fat index (n=3919).

Variables	*n*	Category/increment	Estimate	Standard error	P-value
Fixed effects variance					
Intercept			–0.292	0.041	
Individual level					
Age in years	3919	For an increase of ten years	0.004	0.001	<0.001
Sex (baseline=female, n=2276)	1643	male	0.206	0.029	<0.001
Dietary knowledge score	3919	For an increase of one unit	–0.045	0.005	<0.001
Smoking status (baseline never smoked,	737	daily	0.342	0.042	<0.001
n =1945)	152	occasionally	0.139	0.078	0.08
	1085	ex-smoker	–0.012	0.037	0.7
Risk category for alcohol consumption (baseline safe, *n* =3280)	639	Risky/hazardous	0.364	0.041	<0.001
Eats meat and/or fish (*n* = 3841)	78	vegetarian	–0.271	0.108	0.01
Frequency of eating outside the home (baseline at most once/month on all six	2252	At least once or twice a week on one of the six categories	0.089	0.032	0.006
types of eating out, *n* =1505)	162	almost every day	0.223	0.078	0.004
Household level					
Usual cost of weekly food	962	<£20	0.097	0.044	0.03
shopping per adult equivalent (baseline	1660	£20-£30	0.065	0.038	0.09
£30+, *n* =1297)					
Random effects variance					
Level 1 (Individual)			0.643	0.024	
Level 2 (Household)			0.198	0.032	<0.001
Level 3 (Neighbourhood)			0.040	0.022	0.04

Estimates are reported in multiples of standard deviations of the percentage dietary energy from fat index.

The unexplained variation was partitioned in to that due to differences between individuals within households, that due to differences between households within neighbourhoods and that due to differences between neighbourhoods. The differences between individuals accounted for the majority, 73.0%, of the total unexplained variation (0.643/(0.643+0.198+0.04)). However, there was still statistically significant unexplained variation at the household and neighbourhood levels; 22.5% of unexplained variation was attributable to differences between households and 4.5% to differences between neighbourhoods. Although the neighbourhood level residual variation is statistically significant (P=0.04) the size of the variation in terms of percentage dietary energy from fat is relatively small and equates to 95% of neighbourhoods being within approximately 1.12 (on the original scale) of the overall mean percentage dietary energy from fat.

8. Discussion

In this chapter I first summarise the main findings of the study. I then critically review the strengths and limitations of the research methods. Next, I discuss and interpret the findings in the light of these methodological issues and existing knowledge, and draw conclusions in relation to the primary and secondary research questions. Finally, I highlight the implications of the findings for policy and future research.

8.1 Summary of main findings

This is the first large-scale epidemiological study that has examined individual variation in dietary intake in relation to household socio-economic and food purchasing factors, as well as retail availability of food and socio-economic factors at a local level. It is the first study that has been able to answer specifically the question of whether dietary intake is independently associated with the availability and price of foodstuffs in either the food environment local to an individual's place of residence or with availability and price in their usual main food store. It is also the first study that has attempted to study the food habits and retail context in a whole, geographically defined population, using a representative sample of individuals and a census of food retail outlets.

8.1.1 Results of the retail survey

In this section, I summarise the findings which respond primarily to the question: do so-called 'food deserts' exist, and if so in what form?

8.1.1.1 Food shops

Overall there were high levels of food retail provision for the population of the city of Newcastle upon Tyne, with more than 560 shops selling food. There was no area of the city without reasonable access to at least one local store (e.g. within 500m). There was some differential patterning of types of store by TDS, with greengrocers, local discount stores, ethnic grocers and freezer centres more prevalent in less affluent areas, but this was not statistically significant.

8.1.1.2 Retail availability of food

Access to a wide range of products, including 'healthier' foods and fresh fruits and vegetables, was a little more limited, but not patterned such that more socio-economically deprived

groups were disadvantaged with regard to food access. In fact, good value, high quality fresh fruits and vegetables were more available in poorer than in more affluent areas. However, in general, only surprisingly few shops (i.e. 14 multiple and four discount supermarkets, one department store and three convenience stores) sold the full range of items surveyed and only these stores, together with market stalls and greengrocers sold a wide range of fresh fruits and vegetables. Excluding the specialist fruit and vegetable stores (market stalls and greengrocers), shops with greater numbers of checkouts sold a wider range of items, and those selling more items overall were more likely to sell more 'healthy' items and more fruit and vegetable items.

The most available food items were carbonated drinks (in 84% of stores), crisps (79%), Kit Kat (61%) and milk (61%). The ratio of the proportion of healthy to less healthy food basket items available was >1 in stores most frequently used by the population sample (i.e. multiple and discount supermarkets and department stores). However, the availability of individual items and baskets was not patterned socio-economically (i.e. by TDS).

Overall, households in more affluent areas (measured by TDS) lived closer to shop selling the full range of foods (both in the full basket of 33 items and in sub-baskets). However, differences were relatively small (e.g. a median difference between the top and bottom fifths of TDS of 367m, for the basket of 10 less healthy items).

8.1.1.3 Quality of fresh fruit and vegetables

Shops offering better value for money overall (as measured by average basket price for 33 items) also offered the best quality fruits and vegetables. However, overall, quality of fresh fruits and vegetables was poor, with only greengrocers and market stalls displaying reasonable reliability. Shops selling more fresh fruit and vegetable items were more likely to sell better quality fresh fruits and vegetables, and in practice, only those selling seven or more out of ten fresh fruit and vegetable items demonstrated reliable quality. Quality was not associated with the socio-economic characteristics of areas, as measured by TDS.

8.1.1.4 Cost of food

There were very wide variations in prices, both of individual items and of 'baskets' of items. There were also wide variations in prices of different baskets between different types of store, and between different stores within chains (so called 'price-flexing'). There were wide variations in prices of some healthier (fruit juice, frozen peas, chicken) and less healthy (sausages, white bread) items, and small variations in price for other healthy (bananas, Weetabix, semi-skimmed milk, low fat yogurt), less healthy (Frosties, crisps, biscuits, Kit-Kat, carbonated drinks, white sugar) and neutral (eggs, Cheddar cheese) items.

When examining only stores selling the full range of 33 items surveyed, discount supermarkets offered the best value for money both for healthy and less healthy baskets; and fresh fruits and vegetables were cheapest in market stalls and greengrocers. In regression analysis, value for money was independently associated only with a greater number of checkouts.

8.1.1.5 Opening hours

There was wide variation in the opening hours of stores selling food. Only petrol stations and a small number of multiple supermarkets were open 24 hours. However, many convenience stores and newsagents were open up to 112 hours/week. On average, shops were open a median of 10 hours/day for 7 days/week (71 hours/week, IQR 54-88). Both smaller stores (1 checkout) and larger stores (>5 checkouts) tended to be open longer hours, and those open longer hours tended to stock a wider range of foods. However, longer opening hours were also associated with higher costs, and fruits and vegetables of poorer quality.

8.1.1.6 Availability in respondents' main food store

There was no difference in availability of any of the food baskets in a household's chosen main food store between the fifths of either household SEI or TDS. There were, however, differences in availability in usual main food store according to the type of store chosen, with somewhat poorer availability in discount supermarkets than multiple supermarkets, and substantially poorer availability in convenience stores. When controlling for type of store, there were no differences in availability to households according to whether they owned a car or not.

8.1.2 Results of household and individual surveys

In this section, I summarise the findings that respond primarily to the questions: do certain types of household or individual choose to buy their food at certain types of food store, and which factors are associated with such choices? And, what social and environmental factors within households are associated with dietary intake?

8.1.2.1 Choice of main food store

Of the 560 stores selling food that were surveyed, only 55 were nominated by household respondents as their main food store. Of 3153 households, 2440 (77%) regularly used a multiple supermarket for their main food shopping, the most popular chains being Tesco (23%), Asda (22%) and Safeway (20%). A further 435 (14%) regularly used a discount supermarket as their main store. The remainder (10%) either used a department store (3%), an independent store or markets stalls (2%) or did not state a main store (5%).

There was a strong association between markers of socio-economic position and choice of main food store, with more affluent households more likely to choose a multiple supermarket and less affluent households more likely to choose a discount supermarket or other types of store. Multiple supermarkets were also chosen more often by those owning a car and by younger shoppers. Discount supermarkets were more often chosen by older people, those with no car, those living further from the city centre (e.g. in outer suburban estates), ethnic minority groups and those with a higher BMI.

Although, overall, food stores were more likely to be found in slightly more affluent areas, there was a correlation between home and store TDS, such that people living in more deprived areas tended to shop in more deprived areas.

People reported that they chose their main food store primarily on grounds of ease of access and convenience. However, the cost of food was the most important reason for those shopping primarily at discount supermarkets; quality of food was the most important reason for those shopping at department stores; and range of food another important reason for those shopping at multiple supermarkets. Ease of access was a more important reason for the over 75s, 16-24 year olds, those with no car and those with a lower SEI; and cost was more important reason for those with lower SEI and younger age groups.

8.1.2.2 The practicalities of shopping

Most people reported that they travelled to and from their main food store in journeys lasting 5-15 minutes, and by car (64%). Travel on foot (16%) or by bus (11%) was also popular, but the mode of travel was strongly patterned socio-economically and by type of store used. In particular, the less affluent, ethnic minorities and older people were more likely to travel by foot or public transport.

The phenomenon of 'trip chaining' – combining food shopping with other activities requiring a journey from home – was relatively common (30% of households' usual food shopping journeys). The most common activities with which food shopping was combined were other (non-food) shopping, travel to work, and visiting family and friends.

Only 35% of households reported problems associated with food shopping, most commonly carrying shopping home. This was most reported by the youngest and oldest age groups, the retired, single adults with one or more child and single adults, students, the poorest, those with poor health and those without a car.

8.1.2.3 Amount spent on shopping

Households spent a median (IQR) of £26 (£20-35) per adult equivalent on food per week (equivalent to approximately 18% (12-28%) of annual household income. Non-white ethnic minority groups, single adults with one or more child and the most socio-economically disadvantaged spent the least per week on food; middle-aged groups, adult only households, the most affluent and students spent the most. Amount spent on food was also associated with diet and health variables; greater spend was generally associated with a more healthy diet, lower BMI and greater dietary knowledge – and with food shopping variables; those shopping at departments stores spent the most and those shopping at discount supermarkets spent the least. Daily shopping was more expensive than less regular shopping, a pattern known to be associated with smaller households and lower disposable incomes. Those travelling to/from their main food store on foot or by public transport spent less on food than those travelling by car or taxi.

8.1.2.4 Variation in dietary intake

Dietary consumption was strongly patterned socio-economically, with higher consumption of fruit and vegetables and non-starch polysaccharide, and lower consumption of fat among the more affluent and those with greater dietary knowledge. Fruit and vegetable consumption was also more common among women and non-white ethnic groups and those spending more on food. Fat consumption was greater among younger age groups, non-white ethnic groups and families with children. Non-starch polysaccharide consumption was also most associated with younger people and households with children, which is likely to be due to higher consumption of bread, cereals and potatoes.

Eating out was relatively common: individuals ate out of the home on average 2.5 times/week. Eating at family or friends' homes or at a chip shop was most common among the least affluent groups and eating at work, pubs, cafes and restaurants most common among the more affluent.

Eighteen percent of individuals were on a special diet of some sort, either for health or personal reasons, and this was about twice as common among women as men, and among some ethnic minority and religious groups.

Although 43% of people reported having a body weight that placed them in the overweight category according to BMI, only 11% of this group reported being on a diet to lose weight. Similarly, although 31% reported that they were obese according to their BMI, only 20% of this group were on a diet to lose weight.

8.1.2.5 Dietary Knowledge

Dietary knowledge was also strongly patterned demographically and socio-economically: knowledge was greater among women, younger and middle aged people, the more affluent and better educated, white Europeans, those married and living as married, those with better kitchen facilities and those who regularly shopped at a multiple supermarket. Greater dietary knowledge was also strongly associated with eating a diet lower in fats and higher in fruits and vegetables.

8.1.2.6 Other health-related behaviours

Overall, 21.7% of men and 11.2% of women drank risky or hazardous amounts of alcohol per week and median alcohol consumption overall was 10 units/week (IQR 4-20) among men and 4 units/week (IQR 1-10) among women. However, these figures mask strikingly high levels of alcohol consumption among those who drank excessively, with for example, those drinking at risky levels consuming a median of 25 (IQR 20-30) units/week and those drinking at hazardous levels consuming a median of 60 (IQR 52.5-70) units/week. Alcohol consumption peaked among the middle aged and was higher among the more affluent. Higher levels of alcohol consumption were associated with higher BMI.

Levels of physical activity were, overall, low. Thirteen and a half percent undertook no mild activity, 37.7% no moderate activity and 74.5% no vigorous activity. Medians for these levels of activity were 5 (IQR 2-10), 2 (IQR 0-4) and 0 (IQR 0-1) hours/week respectively. Women were more likely to be active at work, though men were more like to do heavy work, and overall women had a higher activity score (4.6, IQR 2.5-8.8) than men (4.0, IWR 2.0-7.7). Activity decreased by age and the more affluent had higher activity scores, but were more likely to report sedentary work, suggesting that leisure time activity is much more common among the more affluent.

Smoking behaviour was strongly socio-economically patterned, but there were, surprisingly, no significant sex differences in current cigarette smoking. Overall smoking prevalence was 19.2% and was lowest amongst the highest (most affluent) fifth of SEI (8.4%) and highest among the poorest fifth (34.7%).

There striking associations between health-related behaviours and related factors, which tended to cluster together. For example, less healthy patterns of dietary intake, alcohol consumption, physical activity and smoking were all associated with poorer dietary knowledge. Higher fruit and vegetable intake was associated with greater physical activity, lower alcohol

consumption and not smoking; and higher fat intake was associated with higher alcohol consumption and smoking.

8.1.3 Relationship between diet, socio-economic position and food access

The relationship between individual diets, household factors and retail access was illuminated by integrated analysis of the combined data sets. In this section, I present findings of analyses that required integration of two or more of the data sets and which respond to the primary research question: is food retail access at a household's usual main food store or in the local neighbourhood independently associated with dietary intake?

The median distance from a household to its nearest food store was 361m (IQR 207-586m). Overall the less affluent households lived nearer to a shop selling any food item and to a range of food baskets of food. However, proximity to shops selling complete baskets of food was substantially greater than the distance to nearest store selling any food (e.g. median distance to a store selling 10 fresh fruits and vegetables was 665m (IQR 435-960m). This may, in part, help to explain why households travelled a median distance to their usual main food store of 1856m (IQR 885-3701m). The distance varied according to type of main food store (shorter for discount supermarkets and convenience stores, longer for multiple supermarkets and department stores), mode of travel (shorter if on foot or by public transport, longer if by car) and socio-economic factors (shorter for those living in less affluent areas or with lower SEI). Overall, availability of the entire food basket and the sub-baskets assessed in the retail survey was somewhat more limited geographically than availability of a more limited number of food items. This was particularly the case when stringent criteria were tested, such as the availability of a basket of 10 fresh fruits and vegetables of high quality and less than the median basket price.

Independent associations between a range of social and demographic factors and individual diets were found in simple regression models, which were later also found in multilevel analyses. Independent associations in these multilevel models are summarised in Table 92.

The importance of dietary knowledge and other health-related behaviours (physical activity, alcohol and smoking) in association with dietary intake is striking, as is the presence of socio-economic variables and the lack of area based variables. In particular, availability or price of food in the locality of households and, for the most part in a household's usual main food store, are notable by their absence from these models. One exception to this was that availability of 14 fruits and vegetables in a households' main food store was significantly but negatively associated with consumption of NSP. Higher NSP consumption was also

associated with greater dietary knowledge, higher levels of physical activity, eating out more often, older age groups, lower household income and having children in the household. The only stores likely to sell all 14 fruits and vegetables were multiple supermarkets and department stores; it is possible that the availability of 14 fruits and vegetables is acting in this model as an indicator of the type of main food store used by household's with higher NSP consumption (i.e. a discount supermarket or convenience store).

Table 92: Summary of results of all three multilevel models

Dependent variable	F&V index	NSP index	Fat index
Variance explained by model (%)	11.7	6.7	9.6
Individual level variables independently associated	↑ Age	↑ Age	↑ Age
	Female	↑ Dietary knowledge score	Male
	↑ Physical activity	↑ Physical activity	↓ Dietary knowledge
	↑ Dietary knowledge	↑ Eating out of home	Smoking
	Not smoking		↑ Alcohol consumption
	↓ Alcohol consumption		Not eating a vegetarian diet
	On a Vegetarian diet		↑ Eating out of home
Household level variables independently associated	Household member on benefits	↓ Household Income	↓ Cost of weekly food shopping
		Household composition (couples or with children)	
		↓ Availability of 14 F&V in usual main food store	
Area level variables independently associated			
Interactions between variables	Ethnicity x Travel mode to food store	Employment status x Sex	
Partitioning of unexplained variance (%)			
Individual	66.2	67.9	76.0
Household	32.4	31.6	22.5
Area	0	0	4.5

Similar relationships between food retail availability variables and other elements of diet were not found, suggesting that, overall, food availability, cost and quality, either in the locality around people's homes or in their usual main food store, was not importantly associated with the quality of diets consumed. However, none of the models accounted for more than 12% of variance in the dependent variable.

Overall, area level variables proved relatively unimportant in all multilevel models and, even after accounting for fixed effects, were only significant in the fat model, accounting for 5% of unexplained variance. By far the greatest proportion of unexplained variance was attributable to the individual level (between 66-76%) with somewhat less attributed to household level variables (between 23-32%).

8.2 Strengths and limitations of the methods

Very few studies are without methodological limitations, and this was no exception. A major constraint from the outset was that this research was commissioned by a national agency within a limited budget, and this financial constraint made it necessary to make a number of compromises in the design of the study and development of the methods. Such compromises were avoided if they were likely to jeopardise the likelihood of the study answering the primary research question. Nevertheless, compromises were made and the implications of these are discussed below. It is, however, also important to highlight the strengths of the design and methods used, for there were many advantages of this study over previous work in the same field. These, too, are discussed below.

8.2.1 Study design

A major strength of this study was that it overcame many of the design weaknesses of earlier studies, both in the UK and overseas. Earlier studies in the UK and elsewhere have predominantly focussed on the retail environment,[20 26 27 29 58 98 106 109 176 177] making the implicit (and sometimes explicit) assumption that diet is causally associated with the patterning of retail access. Other ecological studies[178] have attempted to measure both retail access and dietary consumption, albeit often crudely using secondary analysis of existing data, and have made the assumption that households do their food shopping in the immediate vicinity (e.g. census tract, unit postcode or ED) of their home. Where concurrent assessments of the retail environment and diet have taken place,[107 108] there has been a failure to identify where households do the majority of the food shopping (e.g. their usual main food store), again making the assumption that this is in their local neighbourhood. This is the first study in which a clear distinction has been made between retail access in the local environment surrounding people's homes and that associated with their usual main food store, situated as it often is, some distance (median 1.8km) from the home. This study also used prospective and concurrent primary data collection from all shops selling food in the geographical area of residence of the population under study, rather than sampling stores or areas.[20 26 27 58] In addition, in contrast to many previous studies, a detailed assessment of the entire diet intake

was undertaken, from which summary indicators were derived. Such an approach provides a more robust assessment of diet than the more limited inventories of specific dietary components (e.g. a limited list of fruits and vegetables) used in most previous studies.[107 108] As the analyses using the F&V, NSP and FAT indices showed, the complex relationships between dietary intake and social and environmental factors can only be explored with such a comprehensive assessment of diet.

Although novel in its design and overcoming many of the limitations of earlier research, this study, in common with all others addressing the same topic, had some limitations. Firstly, the study was cross-sectional in design, thus limited in its ability to provide evidence of causation. Two alternative study types could have overcome this disadvantage: a cohort (longitudinal) study or an experimental design. To date there have been no published cohort studies exploring the relationship between dietary intake and food retail access, but there have been two quasi-experimental studies, both assessing the impact of a new multiple supermarket in a UK urban area where none previously existed.[110 111]

Whether a cohort study would be feasible to study this relationship is open to debate; a fundamental problem with attempting such a study is that the retail environment changes rapidly and continuously, and it might be logistically and economically challenging to capture retail access with the degree of detail achieved in this study at a population level over a prolonged period of time. Given that the immediate impact on food consumption of the retail environment, in terms of access to and price of foods, is almost instantaneous, such a study would need repeatedly to measure the food retail environment. In essence this would amount to using the same design as this study, but with repeated sweeps of data collection in the same individuals and their food retail environments over a number of months or years. Such a study would also need to take account of the movements of individuals and households, since migration among urban populations is commonplace. Such a study might also usefully document and analyse the influence of environmental change on physical activity and levels of obesity in a comprehensive study of the effects of environment on the factors affecting body weight. Such a study would be highly challenging technically and, most likely, prohibitively expensive.

Quasi-experimental designs are also not without their limitations. Neither of the studies undertaken to date[110 111] have achieved the comprehensive level of population coverage achieved in this study and the earlier study[110] was compromised by a lack of proper control. Inevitably such quasi-experimental studies tend to focus on one store development, rather than the total retail environment within an area (and changes in it over time) and the

population exposed to it, and thus to date have been unable to draw wider conclusions about the relationship between retail access and diet in the same way as this study.

Larger scale interventions, such as the Department of Health's Change4Life initiative to promote fruit and vegetable sales in convenience stores,[179] currently being piloted in North East England, may be amenable to evaluation and could be used to explore whether changes in the local retail environment have an impact on dietary intake.

One of the key challenges of this study was ensuring sufficiently robust exposure measurements to enable reliable assessments of the strength and direction of key relationships. Exposure assessments were limited to either self-reported data on individuals and households, or observations of a limited range of products for sale in stores surveyed. The strengths and limitations of the methods used are discussed below, in the context of the retail and population surveys.

8.2.3 Retail survey

The food retail basket was developed specifically for this study, based on evidence from previous studies and included a wide variety of items covering a range of healthy and less healthy products. In common with the food frequency questionnaire, the food retail basket had a relatively heavy emphasis on fruit and vegetables, since the purchasing and consumption of fruit and vegetables was one of the key outcomes of interest to the study's funder. The choice of 33 items was somewhat arbitrary and aimed to achieve a balance between comprehensiveness and practicality. It is unclear how the findings may have been influenced by using a larger and more comprehensive basket, though it was notable that only 22 stores stocked all 33 food items on our chosen basket. Using the various smaller, sub-set 'baskets' (e.g. 10 fresh fruit and vegetables, 11 'less healthy items') yielded useful results in univariable analyses and led to one significant finding in the multivariable analyses, suggesting that a larger basket may not have added a great deal. It is not clear how many products households buy regularly, though it can be anticipated that this varies hugely by socio-economic position and cultural background, and thus no constrained basket would be suitable to measure food access for all households.

The post-hoc definition of a convenience store may potentially have biased the findings, but was a necessary compromise, since the prior definition proved flawed once fieldwork had taken place. In practice the definition used in analyses fits comfortably with other, more recent, accepted definitions of a convenience store.[73 180] Nevertheless, the development of convenience store formats by some of the main multiple supermarket retailers (e.g. Sainsbury's

Local, Tesco Express) makes the classification of shops into different types increasingly complex. The analysis of the scale of the stores (using a number of checkouts as a proxy indicator) helped to overcome this problem and, indeed, number of checkouts proved to be a key correlate of a range of other factors (e.g. availability, quality, opening hours). However, number of checkouts can only be a proxy for more accurate measures of the scale of stores, such as shelf space, floor space or sales volume. Such measures would have been impossible to obtain for all stores in this comprehensive survey and number of checkouts had the advantage of being easily observed.

It is possible that the measurement of the quality of fruits and vegetables was not highly accurate as it was reliant on a number of different observers making individual judgements about whether items were of reasonable quality or not. Under the circumstances, however, it is hard to envisage an easily implemented method that might have been more reliable.

The initial sample of stores was limited to those within the boundary of the city of Newcastle, but of course the demarcation of any boundary is somewhat arbitrary and those living very close to the boundary are likely to cross it regularly to visit shops. We only took this into account when a household identified their main food store as outside Newcastle, and 36 such stores were subsequently visited to collect data. However, other stores immediately outside the boundary were not assessed and thus, for those living closer than 500m from the boundary, assessment of the retail environment in their 500m buffer zone will necessarily have been incomplete. Further work is needed to assess the impact of this on the findings. In retrospect, it may have been sensible to exclude such households from the analyses involving the integrated data sets, so as to avoid incomplete exposure assessment.

The assessment of distances between homes and food stores was somewhat simplistic, involving the straightforward measurement of linear distance between two grid references. Whilst linear distance is shorter than road network distance in most cases, except where distances are extremely short (e.g. <250m), in a small city, such as Newcastle, with a compact geography and dense road network, there is strong correlation between linear distance and distance by road network. It was therefore felt that linear distance would provide a reasonable proxy for network distance. However, it is possible that this may have introduced systematic bias affecting in particular the home to shop distances of those living in the semi-rural fringes of the city to the north and west, where distances to usual main food shop were somewhat greater than for those living closer to the city centre in more densely populated areas.

Decisions were also made about distances in relation to the arbitrary cut-offs used in other analyses. Thus, for example, distance parameters of 250m increments were used in the proximity mapping, and a distance of 500m was used to define the buffer zones around people's homes in which local food retailing was assessed. These distances were defined somewhat arbitrarily, though primarily in terms of what is widely considered as a 'reasonable' distance for people to travel to and from shops carrying food.(refs) For example, 250m is a distance that it is thought reasonable to expect the elderly, adults with limited mobility or parents with prams/buggies to travel with full shopping bags.[145] Five hundred metres is, likewise, a distance that we might reasonably expect an able bodied person without children/buggies or disabilities to walk with full shopping bags[145-148]. It is possible that setting these distance parameters at different values might have led to different results and conclusions, although in the case of the proximity mapping, sensitivity to a range of distances was built into the analysis.

8.2.2 Individual and household surveys

The sample size in this study (5044 individuals, 3153 households) make it the largest epidemiological study of its kind to date. This was achieved by a multi-stage sampling strategy with a relatively low level (24%) of uptake at household level, but a high response rate (83%) individual level. Nevertheless, overall only 5044 individuals (estimated fraction 18%) from the population sampled (an estimated 28,500 individuals in 17,801 households) participated and there were biases with respect to age, gender and socio-economic position.

An alternative approach to recruitment and data collection, such as the use of doorstep recruitment and face-to-face interviews might feasibly have led to higher participation and response rates. The use of two reminders, instead of one, might also have boosted response rate.[181] In practice, such approaches were not feasible on grounds of cost. However, to ensure as rigorous an approach as possible within the cost constraints of the project, pre-testing and pilot studies were undertaken to assess likely recruitment and response rates. Unfortunately, these studies, possibly due to their small size, provided somewhat inaccurate estimates of the likely uptake and response rates, thus necessitating a second sweep of the main population surveys in order to achieve the desired sample size for analysis. It is possible that the resultant demographic bias in the sample has affected the findings and conclusions. In particular, it may have led to a greater degree of homogeneity in the sample population than otherwise might have been expected; and this might have masked important differences. It is possible that weighting of the data in the analyses could have been used to compensate for this, but such an approach would also have run the risk of introducing a substantial distortion

of the results. Such biases are an inherent problem of all population surveys, but were not adjusted for by weighting, since the purpose of the study was not primarily to measure prevalence, but to explore relationships between potential risk exposures and outcomes. One strength of conducting the survey in two sweeps, six months apart, is that it helped to eliminate the strong seasonal bias in dietary intake assessment associated with a survey at one point in time.[182]

One obvious limitation is that the study population was from an urban area in the UK and, although Newcastle upon Tyne is in many ways representative demographically of the UK population, it does not include substantially rural populations, nor can it be said to mirror the large number of cities in the UK with greater ethnic diversity.

Asking about a single 'usual main food store' for each household may have placed an artificial constraint on responses, since although this pattern of shopping is common,[73] it is not universal. The data on trip-chaining suggested considerable complexity in peoples' lives and it is likely that a substantial number of households shopped regularly at more than one of the stores in Newcastle in order to fit in with journeys associated with work, visiting family and friends, transporting children to school or leisure activities, or other activities. With hindsight, a more sophisticated set of questions might have used to ascertain which shops households used regularly, but such an approach would have necessitated a complex weighting of data from two or more food stores to determine access parameters and food retail exposure data for households. Evidence suggests that for most households a single store predominates in their shopping patterns,[73] and thus this was accepted as a logical and necessary compromise, albeit one that may have blurred the relationship between food access and diet.

The use of a food frequency questionnaire, albeit a detailed and previously validated one, will have provided a less accurate assessment of dietary intake than either food diary or weight intake methods. However, such methods would have proven highly time consuming and costly and may have adversely affected response rate. Food frequency questionnaires are widely used in dietary epidemiology and provide the most accurate method of assessment at such a population scale.[128 129 140] The EPIC food frequency questionnaire[133 134] is weighted in favour of fruit and vegetables, making up 39 out of 134 items, and thus overestimates this element of diet. For this reason, the food frequency questionnaire was used to derive a number of composite indices of dietary intake, rather than attempt an accurate assessment of absolute nutritional intakes. Nevertheless, the possibility of response bias in those responding to the questionnaires remains. Overall, this is difficult to quantify and the assumption was made that, for the most part such biases are numerous, often individual and likely to balance

each other out. However, some instances suggest such biases may have been more systematic and may have influenced results. For example, those obese or overweight were more likely to report diets lower in fat than those of normal weight. Whilst it is possible that those overweight and obese are on low fat diets to reduce their weight, a separate question on dietary restrictions failed to identify this dietary choice for the majority of those obese or overweight, suggesting that reporting bias may have been a significant a problem.

Another limitation of the analysis of the FFQ was that only a score for total fat intake was derived, rather than separate scores for 'unhealthy' and 'healthy' fates (i.e. saturated and mono- or poly-unsaturated fats respectively). Whilst creating scores at such a greater level of detail would have been technically feasible, it was considered that this would have placed somewhat greater demands on the data than reasonable given the relatively crude nature of the FFQ instrument. Such analyses would require careful validation and will be considered for future analyses.

The FFQ asked respondents to estimate their food intake, but this method cannot determine the amount of food wasted. Such food wastage is likely to vary by a range of factors, including socio-economic position. Variations in accuracy of estimation of intake may thus be affected by differences in wastage, which could not be taken into account.

Lastly, the index developed to assess kitchen facilities in homes (SLI-Cook) was somewhat crude and the use of a simple cut-off score of two meant that it was not reliably able to identify those households which did not have the facilities to store *and* cook food (e.g. a score of two could mean that the home had a dishwasher and a freezer).

8.2.4 Analyses and assumptions

For the most part, analyses describing the data and some of those conducted to help answer secondary research questions, relied on univariable analyses, such as cross-tabulations, correlations and analyses of variance. Regression analyses may have provided more robust answers in some of these instances, but these were reserved primarily for the primary research question. Further regression analyses would be a sensible next step in exploring this data further.

A particularly difficult issue to manage in this study was how to deal with missing data. The approach taken was, for the most part, straightforward, though arguably at times perhaps overly simplistic. Once again, the constraints of resources dictated that more elaborate approaches were not feasible, but their potential is discussed briefly.

In the retail survey, the greatest problem arose in relation to how basket costs should be assessed when there was missing data. This occurred not because of errors in data collection, but because many food items were simply not available in all stores. The consequence of this was that it was impossible to create summary measures for cost, except in stores where all items were available. Exploratory analyses were conducted, imputing the maximum cost for any item, derived from the whole data set, resulting in what was termed a 'price and availability index', since imputing in this way applied a 'penalty' cost to stores with poorer availability. These were not included in the thesis as their interpretation was difficult and further work is needed to test the validity of the techniques. To derive more realistic imputed costs for each store would have required a considerably more sophisticated (and thus more time consuming and costly) analyses, involving for example, techniques such as geographically weighted regression,[183] which might permit the estimation of a price for each item, in relevant stores, appropriate to the area in which they were found.

Similarly, where composite variables were created, for simplicity imputation using median values from the overall distribution were used in most cases to ensure data was retained in analyses by all cases. A more robust (though again, more time consuming and costly) would have been to use multiple imputation[184] in all cases where imputation was needed in order to ensure the provision of complete data for each case. This would have had the advantage of providing more robust imputed values for each instance of missing data.

Another problem that was faced in managing the data to be used in analyses was the issue of outlying values. This was handled in two ways. Firstly, for the most part a number of composite indices and other variables were used as categorical variables (e.g. fifths of the annual cost of food shopping). This approach retained all data and managed outliers by including them in the highest and lowest fifth groups. For the most part such an approach was used to avoid the problems of non-normal distributions in the analyses, but it also effectively, if crudely dealt with outliers.

The second approach used was to eliminate extreme outliers. This approach was used only in relation to the dietary indices, for example discounting the values of those who claimed to eat unfeasibly large amounts of NSP or fruits and vegetables. This approach did result in some data loss, although this was minimal.

A more sophisticated approach in either of these circumstances might have been to undertake Winsorising,[185] which would have had the advantage of retaining all data, but could have 'managed' extreme outliers by assigning to them new values within the 5th and 95th percentiles.

Once again, such an approach was considered to be too time consuming and costly under the circumstances of this study.

Finally, whilst the analyses undertaken for this thesis have been extensive, they have not been exhaustive. For example, further analyses could have been undertaken to look at relationship between food access and obesity (measured using BMI). However, whilst of policy relevance and considerable interest, this was not felt to be relevant to the primary research question and thus not included.

8.3 Interpretation and conclusions in relation to existing knowledge

In this section, the findings of the study are interpreted in the light of the limitations of the methods and existing knowledge, and the research questions answered.

8.3.1 Do so-called 'food deserts' exist, and if so, in what form?

Taken together, the findings of the retail survey on its own, and when linked to the area level data and information on households' usual main food store, provide little evidence to suggest that food deserts – geographical areas where it is hard to buy the food necessary to eat a healthy diet[79 80] – exist in Newcastle upon Tyne. There is one caveat to this: the proximity mapping of availability geographically did identify some 'holes' in availability of fruits and vegetables, in particular when stringent criteria were applied in analyses (e.g. testing the availability of all ten fresh fruits and vegetables, of good quality and less than the median basket price). In such instances, availability appeared to be generally greater in many of the less affluent areas of the city. Nevertheless, some areas had poorer coverage and thus one cannot discount the possibility that this may have disadvantaged some consumers.

In contrast to the overall lack of differential food retail access geographically, there were significant variations in availability price and quality according to type of food store. Larger food stores (measured by the number of checkouts) sold a range of foods at lower prices and multiple supermarkets, and to an extent discount supermarkets, offered better availability and price than other types of store. Overall, multiple supermarkets offered the best option for 'one-stop-shopping', with greater availability at a marginally higher median basket price than discount supermarkets (i.e. an additional 7 pence for 33 food items). If consumers are prepared to shop around, then a combination of a discount supermarket (for packaged goods) and a greengrocer or market stall (for fresh fruits and vegetables) offers the best value for money overall. However, the guarantee of high quality produce is greater in larger stores, so

the cost-conscious consumer would also need to choose carefully in smaller stores, and possibly visit more than one store to source the best fresh produce.

These findings are in accord with other, recent studies from the UK, both observational and quasi-experimental.[20 186] In general, in compact urban areas, proximity to shops selling a wide range of foods appeared to be good, with availability of a range of products within relatively short distances (e.g. 500-1000m). These distances are substantially shorter than the distances that most people travelled to buy their food in this study.

The differential availability of food products, in particular fresh fruits and vegetables, in convenience stores, and to an extent discount supermarkets, has been observed by others[27 84 187] and has led to calls for interventions to be introduced in such stores.[187-189] The UK Department of Health has recently initiated such an intervention (the Change 4 Life Convenience Store Pilot) and outcomes are eagerly awaited.[179]

Much has been written about so-called 'food deserts',[55 79 190] but it has been clear in the UK for a number of years that the concept was not based on sound evidence.[80] Nevertheless, the concept appears to have greater currency in the USA, where a number of studies have consistently identified geographical inequalities in food retail access in urban areas.[107 112 115 178 191]

8.3.2 Do certain types of household or individual choose to buy their food at certain types of food store, and which factors are associated with such choices?

Over three quarters of the population of Newcastle do their main food shopping at one type of food store - the multiple supermarket. As indicated above, the reasons for this are evident from the findings of the retail survey – multiple supermarkets offer the logical choice for one-stop shopping and, whilst this may not always be the cheapest option, it seems likely that the marginal additional cost is traded-off by consumers against the greater convenience of shopping in this way. The remaining quarter of the population relies mainly on discount supermarkets (14%), department stores (3%) and other types of store (8%). These choices are not randomly distributed but largely associated with socio-economic factors. Poorer households primarily choose discount supermarkets and other types of store on grounds of cost and ease of access, choices that seem entirely rational in the light of the findings of the retail survey. Discount supermarkets, market stalls and greengrocers were cheaper than multiple supermarkets for most items in our food basket, and they were found more commonly in less affluent areas. Nevertheless, choices made on grounds of convenience may be quite different for those with access to a car compared with those without.

There is comparatively little quantitative data on consumers' choice of usual main food store, but a more substantial body of qualitative research that focuses on the plight of the poor in acquiring weekly food supplies at affordable prices.[25 30 101 192 68 193] In particular, the graphic accounts of poor consumers in Hitchman *et al's* report on research for Demos echo many of the findings of this study.[187] Poorer householders tend to be 'economic shoppers', taking advantage of in-store offers and spending carefully to ensure the food budget lasts all week. However, although many such households will regularly use discount supermarkets, they are also often dependent on convenience stores in their local neighbourhood, mainly due to the constraints of accessing affordable transport to more distant supermarkets.[101 187]

8.3.3 What social and environmental factors within households are associated with dietary intake?

A range of social and cultural factors at household level were associated with dietary consumption in univariable analyses. There were strong trends in fruit and vegetable, NSP and total fat consumption with measures of socio-economic position, as well as factors such as age, sex, ethnicity and household composition. These patterns extend beyond overall dietary intake to food eaten outside the home and specific components of the diet, such as fried food or type of milk consumed. The social patterning of diet was also reflected in household food shopping choices. There were strong trends in the healthiness of diet according to household weekly food expenditure, with households that spent a higher percentage of annual income on food eating less fruits and vegetables, more NSP and more fat.

These findings are entirely in accord with previous research in dietary epidemiology, in which detailed socio-economic factors have been analysed.[10 41 54 194-198] However, the explicit relationship found in this study between quality of diet, household shopping patterns and weekly food expenditure is novel and adds to the existing literature.

8.3.4 Is food retail access at a household's usual main food store or in the local neighbourhood independently associated with dietary intake?

The multilevel analyses in this study failed to identify any significant associations between food retailing variables, either at a household's main food store or in the local neighbourhood (500m buffer zone), and any of the dietary indices used to measure dietary quality. Both explained and unexplained variance in all three models was almost entirely attributed to factors at individual and household levels. Common to all these models were two factors: age and dietary knowledge. In all cases, healthier diets were consumed by those with greater

dietary knowledge. However, higher age was associated with greater fruit and vegetable, NSP and fat intakes. Other behavioural variables were common to all three models. Greater fruit and vegetable and NSP intakes were associated with a more active lifestyle, greater fruit and vegetable intake with not smoking, lower alcohol consumption and eating a vegetarian diet. Conversely, greater fat consumption was associated with smoking, higher alcohol consumption and eating meat. In all three models, dietary quality was also associated with socio-economic variables at household level (higher fruit and vegetable intake with a household member on benefits, higher NSP intake with lower household income, and higher fat intake with lower cost of weekly household food shopping).

Thus, overall, patterning of dietary quality was associated with indicators of a healthy lifestyle, dietary and socio-economic factors, but not with variables associated with the retail or wider physical and social environments.

It is self-evident that availability of food, at some level, must affect the healthiness of diet. For example, if there were severe limitations on the range of products available in shops (as there has been at times during history, due to food rationing) then people's diets would necessarily be constrained by what is available. What is apparent in this study is that, in Newcastle upon Tyne at least, the range of foods available is not significantly constrained geographically. And, given that on average a household is prepared to travel a median of 1.8km (IQR 0.9-3.7km) to their usual main food store, the geographical variation seen across much smaller distances may thus have no effect on diet. The obvious exception to this is for those who do not have access to a car or are otherwise unable to travel such distances to do their shopping. For example, an elderly person, not able to drive and unwilling or unable to negotiate public transport, would be likely to have their food shopping choices constrained by how far they could walk carrying shopping or push/pull a basket or trolley on wheels. Further analysis of the factors associated with healthy eating, powered for such subsets of the population, would be of value.

For the population as a whole, the main factors associated with dietary quality were not retail access or availability, but factors associated with current dietary knowledge and lifestyle. These factors are in turn associated with a range of social and demographic factors, which can be seen as upstream drivers of the social and cultural context in which households and individuals obtain, prepare and eat their food, as illustrated in Figure 7. Thus, for example, individuals with low dietary knowledge tend also to have low levels of education and thus are less likely to have well-paid jobs, or the resources to buy their home, equip it fully for food preparation, and own a car in which to do their food shopping. The socio-economic drivers

of a poor diet are thus likely to be compound in nature and engrained in a household's family background and cultural inheritance.

The findings of this study are thus in accord with what is currently the best longitudinal evidence on the relationship between dietary intake and food retail availability - the Glasgow-based quasi-experimental evaluation of a new supermarket development.[111] Cummins et al's study failed to demonstrate any changes in fruit and vegetable intake in the local population surrounding the development, either among those who switched to using the new supermarket, or among those who did not. However, as in this study, they confirmed strong social patterning of diet.[111] Qualitative findings from that study, as well as the similar, though uncontrolled Leeds (Seacroft) study,[110] also identified that those living in the poorest areas, close to the new supermarket development do not necessarily view a major new multiple supermarket as the kind of shop where they would feel comfortable shopping. In part, this may be on grounds of cost.[101] However, it may also be the case that shopping shoulder to shoulder with those arriving by car, filling more than one trolley and paying by credit card is simply too culturally alien and, perhaps, too starkly brings into focus the gross social disadvantages that they suffer.[101 187] The problem of unhealthy diet is widespread and strongly socially patterned, but this study, in common with others, has failed to demonstrate a relationship with a likely causal factor in the food retail environment. This does not mean that food retailers are necessarily blameless with regard to the present obesity epidemic or food poverty,[199] but that factors at individual and household levels appear to be more strongly associated with diet in the analyses undertaken to date. This may be because the data available to provide measures of exposure to the retail environment is insufficiently robust, or it may be truly the case that the retail environment is not the primary driver of dietary intake. In the final section, I will explore the implications of these findings.

8.4 Implications of the findings for research and policy

The findings of this study suggest that the problem of an unhealthy diet may be deeply ingrained and require interventions on a number of fronts, including economic, educational and environmental. However, they also suggest that the answer to the problems of unhealthy diets may lie primarily in tackling fundamental social inequalities, in particular by improving access to resources among the most disadvantaged. Whatever approaches are adopted, further research is needed to replicate these findings in other populations and contexts, and to develop and evaluate a range of interventions to promote healthier diets.

8.4.1 Implications for policy

Current UK policy on diet and health has evolved considerably since the fieldwork for this study was undertaken. The rapid rise of obesity led a wide ranging government enquiry (the Foresight Obesity Project),[6] which has since informed a cross-government obesity strategy with focuses on the environment, education and the food industry.[200] There has been a particular focus on children, since obesity is known to track from childhood to adulthood,[201] as do dietary patterns.[202] However, concerted campaigns will be needed that focuses simultaneously on all at risk groups in society – at all ages and stages of life – using a range of intervention techniques, tailored to the needs of specific groups. For example, dietary knowledge seems to be an important independent correlate of FFV, NSP and fat intake. The potential for increasing dietary knowledge to promote healthier eating thus needs to be further exploited in educational interventions, which focus on knowledge and the skills necessary to acquire, prepare, store food and eat healthily.[203]

Such approaches will need to be combined with interventions in the retail sector, aiming in particular to improve the range, quality and prices of healthy foods, including fresh fruits and vegetables in convenience stores,[179] and discount supermarkets, and point-of-sale interventions or incentives in large stores aimed at capitalising on improved knowledge and skills by increasing sales of healthier products.[189] Such interventions might be expected to have an immediate impact on poorer consumers, but they will need to be carefully planned and evaluated to ensure that they have their greatest impact on those groups who presently eat the poorest diets. Such interventions will require government, the Food Standards Agency and health authorities to work closely with the retail sector including the major players and small independent companies. The food chain, from farm to mouth, will need to be carefully examined, from both public health and economic standpoints, in order to find solutions that are acceptable to all parties as well as feasible within current resources.

However, the problem of eating healthily on a limited income is not simply one of dietary knowledge, skills and supply factors. Consumers need to be able to get to food stores and transport their food home. This study has demonstrated the challenges for those without access to a car and there is potential for innovative interventions involving free or subsidised transport that is easy to use for families collecting a weekly load of food shopping.

Ultimately, however, the root of an unhealthy diet appears to lie in access to limited resources. The data presented above on cost of weekly food shopping strikingly highlights the problem for low-income households, whereby they spend a significantly higher proportion of their household income on food than more affluent households. At the same time, the absolute

amount spent on food by the poorest households is substantially lower than that spent by more affluent households, which is likely to limit significantly their ability to feed household members healthily. A solution to this problem has been highlighted by Morris *et al*, who proposed a 'minimum income for healthy living';[204] achieving this would require major changes to the welfare state, with minimum wage and welfare benefit levels nationally, a significant challenge for national government in times of recession.

8.4.2 Implications for research

Such intervention development will need to be supported by further research. The limitations of this study have been highlighted above and many of the issues raised set out a future research agenda in this field. An initial challenge will be to replicate this work in other populations and settings, and over time to identify whether patterns are changing. Such studies should be complemented by longitudinal studies, which have the ability to demonstrate causal associations between food retailing and dietary intake. As has been shown with the Seacroft[205] and Glasgow[111] studies, the opportunity and feasibility of a quasi-experimental study may be greater than a cohort study, but an outstanding challenge is to measure the wider food retail environment, as well as that associated with the intervention food store. This study provides a model for the methods that might be used in such studies. Such intervention studies should be extended to the convenience store and discount supermarket sectors, with focuses on the foods available at such stores and point of sale education and promotions, rather than a focus solely on the presence of supermarkets in poorer areas.

Within studies, exposure and outcome assessment will need to be further evaluated to identify the best methods. The differential importance of the availability and price of a range of products needs to be evaluated in order to better measure exposure and to decide which sorts of retail interventions might best be used to promote healthier consumption patterns. More robust methods to assess the entire diet are also needed, without undue emphasis on specific components, and without placing an excessive burden on participants. This will require further evaluation of assessment methods for use in evaluation studies in terms of feasibility, acceptability, validity, reliability and cost, including food diaries, 24-hour recall methods and FFQs. Such research could be commissioned by the Food Standards Agency as a part of their ongoing programmes on food acceptability and choice.

Appendices

Appendix 1: Retail survey schedule

Appendix 2: Household Questionnaire

Appendix 3: Individual Questionnaire

Appendix 4: Piloting of household and individual questionnaire and survey methods

Appendix 5: Non-response interview schedule

Appendix 6: Table of variables entered in multivariable models

Appendix 1

Retail survey schedule

EASIN Retail Survey Data Collection Sheet

Date of completion: ☐☐ ☐☐ ☐☐ **Time of completion:** ☐☐:☐☐

Shop name: _____ **ID:** ☐☐☐☐

Postal address: _____

Postcode: ☐☐☐☐ ☐☐☐

Grid reference: ☐☐☐☐☐☐ ☐☐☐☐☐☐

Contact name: _____ **Position:** _____

1. Type of shop

☐ 1 supermarket
☐ 2 mini market
☐ 3 local store
☐ 4 freezer centre
☐ 5 news agency
☐ 6 off licence
☐ 8 butchers
☐ 9 bakery
☐ 10 health food store
☐ 11 delicatessen
☐ 12 greengrocers
☐ 13 petrol station
☐ 14 other _____

2. Number of checkouts ☐☐

3. Opening hours **(24 hour clock)**

If open all day then use unshaded boxes only, if not and it closes during the day then record closing and opening time in shaded boxes also.

Day	**From**				***To***				***From***				**To**			
Monday																
Tuesday																
Wednesday																
Thursday																
Friday																
Saturday																
Sunday																

4. Range of fruit and vegetables

To judge acceptability, check to see if skin is intact, discoloured or bruised. Check for firmness and freshness and whether it is mushy or soft. If any of these faults are present on a significant proportion (>50%) of items in each food category, rate as 'poor'.

Cost for the cheapest, smallest available item. Add in descriptors where necessary.

Fruit/vegetable	**Available**		**Quality**		**Unit price (/kg or /item)**	**Size/volume/ item assessed**
	Yes	**No**	**Good**	**Poor**		
1. Apples	☐1	☐2	☐1	☐2	_____	_____
2. Oranges	☐1	☐2	☐1	☐2	_____	_____
3. Bananas	☐1	☐2	☐1	☐2	_____	_____
4. Tomatoes	☐1	☐2	☐1	☐2	_____	_____
5. Cucumber	☐1	☐2	☐1	☐2	_____	_____
6. Lettuce	☐1	☐2	☐1	☐2	_____	_____
7. Peppers	☐1	☐2	☐1	☐2	_____	_____
8. Broccoli	☐1	☐2	☐1	☐2	_____	_____
9. Carrots	☐1	☐2	☐1	☐2	_____	_____
10. Onions	☐1	☐2	☐1	☐2	_____	_____

5. Range of fresh foods

Cost for the cheapest, smallest available item. Add in descriptors where necessary.

Food item	Available		Chilled		Unit price (/kg/item)	Size/volume/ item assessed
	Yes	No	Yes	No		
1. Whole milk *(1 pint)*	☐1	☐2	☐1	☐2	_____	_____
2. Semi-skimmed milk *(1 pint)*	☐1	☐2	☐1	☐2	_____	_____
3. Low fat yogurt *(any flavour)*	☐1	☐2	☐1	☐2	_____	_____
4. Full fat cheddar	☐1	☐2	☐1	☐2	_____	_____
5. Eggs *(half dozen)*	☐1	☐2	☐1	☐2	_____	_____
6. Sausages *(chilled sausages, usually pork)*	☐1	☐2	☐1	☐2	_____	_____
7. Chicken *(piece of chicken – specify type)*	☐1	☐2	☐1	☐2	_____	_____
8. Frozen peas	☐1	☐2	☐1	☐2	_____	_____
9. White bread *(loaf)*	☐1	☐2			_____	_____
10. Wholemeal bread *(loaf)*	☐1	☐2			_____	_____

6. Range of packaged, dry or tinned foods

Cost for the cheapest, smallest available item. Add in descriptors where necessary.

Food item	Available		Unit price (/item)	Size/volume/ item assessed
	Yes	No		
1. Weetabix *12 pack*	☐1	☐2	_____	_____
2. Frosties *375g*	☐1	☐2	_____	_____
3. Kit Kat *4 fingers, traditional*	☐1	☐2	_____	_____
4. Biscuits *small size packet, digestives*	☐1	☐2	_____	_____
5. Crisps *any flavour, 35g bag*	☐1	☐2	_____	_____
6. Bag of white sugar *1kg*	☐1	☐2	_____	_____
7. Carbonated drink *not diet, 330ml can or equivalent*	☐1	☐2	_____	_____
8. Pure fruit juice	☐1	☐2	_____	_____
9. Tinned meat *corned beef, Spam, luncheon meat etc. (please specify)*	☐1	☐2	_____	_____
10. Tuna (in brine)	☐1	☐2	_____	_____
11. Baked beans	☐1	☐2	_____	_____
12. Tinned tomatoes	☐1	☐2	_____	_____
13. Pasta	☐1	☐2	_____	_____

Notes:

Appendix 2

Household Questionnaire

ID						
Date						

For office use only *1/12*

Eating & Shopping in Newcastle

Household Questionnaire

This questionnaire is mainly about food shopping habits and should be completed by the *person who most often does the food shopping* in your household. If this is not you, please give it to the main food shopper to complete.

All information will be treated in strictest confidence.

When you have finished, please seal the booklet in the envelope provided and post it back to us as soon as possible. No stamp is needed.

Thank you for your time.

Please turn over and read the instructions for answering questions before completing the questionnaire.

How to answer different types of questions

There are several types of question in this booklet. Most of them can be answered by ticking a box. Please use blue or black ink to fill in your answers.

For example:

Q. Have you taken any vitamins in the past year?

Yes……☑
No……☐

Some of these questions have several boxes and you may be asked to tick ONE only.

For example:

Q. Overall, how satisfied are you with the shop where you do your main food shopping?

	1	2	3	4	5	
very satisfied		❒	☑	❒	❒	❒ very unsatisfied

Some have several boxes and you may be asked to tick all that apply.

For example:

Q. Which of the following educational establishments have you attended?

Please tick all that apply.

Primary or secondary school……☑
College of Further Education……❒
Polytechnic……❒
University (including OU)……❒
Still studying……❒
Some other type of College……☑

Another type of question asks you to write in your answer on a line or in a space provided.

For example:

Q. Of these shops, at which one do you do your main food shopping? Please also include *where* this shop is. For example, Asda, Gosforth.

Name of shop: ___Tesco_____ Place: __Kingston Park

Or to write a number on a line or box.

For example:

Q. How much do you usually spend *on food* (excluding alcohol) for the household in a week?

£ __25__ per week

If you need any help filling in the questionnaire, please contact -

[redacted]

Department of Epidemiology and Public Health
School of Health Sciences
21 Claremont Place
University of Newcastle
Newcastle upon Tyne
NE2 4AA

Telephone [redacted]

UNIVERSITY OF NEWCASTLE

About food shopping and preparation

1. How often do you shop for food for your household?

Please tick one box.

Daily……❒ 1
2 or 3 times a week……❒ 2
Weekly……❒ 3
Once a fortnight……❒ 4
Other……❒ 5

1/13

2. How much do you usually spend *on food* (excluding alcohol) for the household in a week?

£ _____ per week

1/18

3. What other costs are there when you do the food shopping? *(include costs such as public transport, delivery charges, petrol, parking, childcare).*

If there are no costs, please write 'none'.

£ _____ per week

1/23

4. Where do you usually shop for food?

Please tick as many as apply.

Aldi..... ❒ 1
Alldays..... ❒ 2
Asda..... ❒ 3
Co-op..... ❒ 4
Happy Shopper..... ❒ 5
Iceland..... ❒ 6
Kwiksave..... ❒ 7
LIDL..... ❒ 8
Marks and Spencer..... ❒ 9
Morrisons..... ❒10
Netto..... ❒11
NISA..... ❒12
Fenwick..... ❒13
Safeway..... ❒14
Sainsbury..... ❒15
Somerfield..... ❒16
Spar..... ❒17
Tesco..... ❒18

Market..... ❒19
A mobile van..... ❒20
Out of this World..... ❒21
Small local shops..... ❒22
Tesco Internet shopping..... ❒23
Iceland Internet shopping..... ❒24
Other Internet shopping..... ❒25
Home delivery..... ❒26
Other..... ❒27

1/50

5. Of these shops, at which one do you do your main food shopping?
Please also include *where* this shop is. For example, Asda, Gosforth.

Name of shop:

_____

Place: _____

☐☐ 1/52

6. Why do you choose to do your main food shopping at this shop?

*Please identify the most important reason why you choose this shop. Please tick **one** box below.*

pleasant environment……❒ 1
friendly staff……❒ 2
easy to get to……❒ 3
near to home……❒ 4
special offers……❒ 5
quality of food……❒ 6
cost……❒ 7
range of food……❒ 8
range of healthy food……❒ 9
loyalty points……❒10
late opening hours……❒11
convenience……❒12

1/64

7. How do you *usually* travel to and from the shop where you do your main food shopping?

Please tick one box for going to and one box for coming back from this shop.

I travel to the shop…

On foot……❒ 1
By car……❒ 2
By bus……❒ 3
By metro……❒ 4
By bike……❒ 5
By taxi……❒ 6

1/65

I travel back from the shop…

On foot……❒ 1
By car……❒ 2
By bus……❒ 3
By metro……❒ 4
By bike……❒ 5
By taxi……❒ 6

1/66

8. Do you ever combine going to the shops for food shopping with other activities?

Please tick one box for each.

	Always	Usually	Occasionally	Never
Going to and from work	❒1	❒2	❒3	❒4
Visiting relatives/friends	❒1	❒2	❒3	❒4
Going to and from the gym/exercise class	❒1	❒2	❒3	❒4
Dropping off children at school	❒1	❒2	❒3	❒4
Non-food shopping (e.g. clothes shopping)	❒1	❒2	❒3	❒4
Other	❒1	❒2	❒3	❒4

1/72

9. How long does it *usually* take you to travel to the shop where you do your main food shop?

Less than 5 minutes……❒ 1
5 - 15 minutes……❒ 2
15 - 30 minutes……❒ 3
30 - 60 minutes……❒ 4
More than 60 minutes……❒ 5

1/73

10. Are any of the following problems for you when food shopping?

Please tick as many as apply.

Lack of childcare facilities……❒ 1
Distance……❒ 2
Lack of transport……❒ 3
Mobility problems……❒ 4
Carrying shopping home……❒ 5
Opening hours……❒ 6
Lack of time……❒ 7
Shops not easily accessible by public transport……❒ 8
I don't experience any problems……❒ 9

1/82

For each of the following questions please tick one box on the scale of 1 to 5.

11. How satisfied are you with the *range of foods* in the shop where you do your main food shopping?

	1	2	3	4	5	
very satisfied	❒	❒	❒	❒	❒	very unsatisfied

12. How satisfied are you with the *range of healthy foods* in the shop where you do your main food shopping?

	1	2	3	4	5	
very satisfied	❒	❒	❒	❒	❒	very unsatisfied

13. How easy do you find it to *get to* the shop where you do your main food shopping?

	1	2	3	4	5	
very easy	❒	❒	❒	❒	❒	very difficult

14. How easy do you find it to *get into and move around* the shop when you get there?

	1	2	3	4	5	
very easy	❒	❒	❒	❒	❒	very difficult

15. Overall, how satisfied are you with the shop where you do your main food shopping?

	1	2	3	4	5	
very satisfied	❒	❒	❒	❒	❒	very unsatisfied

16. Who usually cooks in your household?

Please tick the box that best represents the situation in your household.

You……❒ 1
Your partner……❒ 2
You and your partner together……❒ 3
You and your partner separately……❒ 4
Cook individually……❒ 5
Cooking shared on a rota system……❒ 6
Someone else in the household……❒ 7

2/6

17. Who usually chooses what the household eats?

Please tick one box.

You……❒ 1
Your partner……❒ 2
You and your partner together……❒ 3
You and your partner separately……❒ 4
You eat separately……❒ 5
Shared on a rota system……❒ 6
Someone else in the household……❒ 7

2/7

About your household

18. Including yourself, how many people live in your household?

Number of adults (aged over 16 years) _____

Number of children aged 5 and over _____

Number of children under 5 _____

2/13

19. Does any adult in your household do paid work?

Yes……❒ 1
No……❒ 2

2/14

If yes, how many adults do paid work in your household?

_____

2/16

20. Who is the main wage earner in your household?

Please tick the box that best represents the situation in your household.

You……❒ 1
Your partner……❒ 2
You and your partner earn equally……❒ 3
Not applicable……❒ 4
Someone else in the household……❒ 5

2/17

21. Are you, or anyone else in your household, receiving any state benefits?

Yes.....❒ 1
No.....❒ 2

2/18

If yes, please tick all that apply.

Income support.....❒ 1
Family credit.....❒ 2
Housing benefit.....❒ 3
Invalidity benefit.....❒ 4
State retirement pension.....❒ 5
Sickness benefit.....❒ 6
Job seekers allowance.....❒ 7
Mobility allowance.....❒ 8
One parent benefit.....❒ 9

2/27

22. Would you please tell us which group below best describes your total HOUSEHOLD income *after tax* and deductions (i.e. take home pay)?
Please include any allowances, benefits or pensions you or any members of your household receive.

Please tick one box.

Total take home pay per week	*Total take home pay per month*	
up to £47 per week	up to £208 per month	❒ 1
£48 - £96 per week	£209 – £416 per month	❒ 2
£97 - £192 per week	£417 – £833 per month	❒ 3
£193 - £288 per week	£834 - £1249 per month	❒ 4
£289 - £384 per week	£1250 - £1666 per month	❒ 5
£385 – £481 per week	£1667 - £2083 per month	❒ 6
£482 - £577 per week	£2084 – £2499 per month	❒ 7
over £578 per week	over £2500 per month	❒ 8

2/28

23. Is the accommodation in which you live:

Please tick one box.

Owned outright by you or your family……❒ 1
Being bought through a mortgage or similar commercial loan……❒ 2
Being bought by means of a personal/non commercial loan……❒ 3
Rented from a private landlord……❒ 4
Rented from the city council……❒ 5
Rented from a housing association or charitable trust……❒ 6
Rented or rent free with a job, farm, shop or other business……❒ 7

2/29

24. Please count the number of rooms your household has.

Enter total number of each - do not count bathrooms, toilets and small kitchens.

Living rooms _____
Bedrooms _____
Kitchens (at least 2 metres wide) _____
Other rooms _____

2/37

25. What is the present Council Tax Band of your house?

Please tick one box.

A……❒ 1
B……❒ 2
C……❒ 3
D……❒ 4
E……❒ 5
F……❒ 6
G……❒ 7
H……❒ 8
Don't know……❒ 9
Exempt……❒10

2/38

If you do not know this, please tell us how much you pay per year or in each instalment.

Yearly bill £ _____

or

Monthly instalment £ _____

2/48

Is this amount after a discount?

Yes……❒ 1
No……❒ 2

2/49

26. Which of the following do you have in your house?

Please tick all that apply.

Telephone……❒ 1	Mobile phone……❒10
Satellite or Cable TV……❒ 2	Bath/shower……❒11
Video recorder……❒ 3	Central heating……❒12
Dishwasher……❒ 4	Inside toilet……❒13
Vacuum Cleaner……❒ 5	Washing machine……❒14
Computer……❒ 6	Toaster……❒15
Internet access……❒ 7	Grill……❒16
Oven/hob……❒ 8	Microwave oven……❒17
Fridge……❒ 9	Freezer……❒18

2/67

27. How many cars and small vans are normally available for use by you or members of your household?

Write in total number of each. If none, write "0".

Number owned by you or your partner _____
Number owned by another member of your household _____
Number owned by an employer _____

2/73

28. In order to complete this research we would like to send a questionnaire about eating and health to all adults in your household. Could you please give the name of all adults (over 16 years of age) in your household (including yourself) who would be willing to take part in the next stage of the Eating and Shopping in Newcastle project. (Only include those who normally live at this address at least 5 days per week and *put yourself first*).

Title:	**Forename:**	**Surname:**
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Each of the above named people will be sent an individual questionnaire within the next few weeks.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

All information will remain completely confidential and will not be disclosed to any third party. All information concerning you and your household will be held under the terms of the Data Protection Act.

PLEASE RETURN THE QUESTIONNAIRE TO US AS SOON AS POSSIBLE IN THE ENVELOPE PROVIDED - NO STAMP IS NEEDED

Appendix 3

Individual Questionnaire

ID						
Date						

For office use only *1/12*

Eating & Shopping in Newcastle

Individual Questionnaire

Thank you for agreeing to participate in this study. This is a survey, not a test, so don't worry if you don't know the answers to some of the questions. It is your opinions that we are interested in.

All information will be treated in strictest confidence.

When you have finished, please seal the booklet in the envelope provided and post it back to us as soon as possible. No stamp is needed.

Thank you for your time.

Please turn over and read the instructions for answering questions before completing the questionnaire.

How to answer the questions

There are several types of question in this booklet. Most of them can be answered by ticking a box. Please use blue or black ink to fill in your answers.

For example:

Q. Have you taken any vitamins during the last year? Yes……☑1
No……❒2

Some of these questions have several boxes and you may be asked to tick ONE only.

For example:

Q. The food I eat has an important effect on my health

	1	2	3	4	5	
Agree strongly	❒	❒	☑	❒	❒	Disagree strongly

Some have several boxes and you may be asked to tick all that apply.

For example:

Q. Which of the following educational establishments have you attended?

Please tick all that apply.

Primary or secondary school……☑
College of Further Education……❒
Polytechnic……❒
University (including OU)……☑
Still studying……❒
Some other type of College……❒

Another type of question asks you to write in your answer on a line or in a space provided.

For example:

Q. If you eat cereal which brand and type do you usually eat?

Brand *e.g. Kellogg's* Type e.g. *Cornflakes*

Kellogg's *Fruit and fibre*

Or to write a number on a line or box.

For example:

Q. What is your current height? _5_ feet _8_ inches *or* _173_ cm

If you need any help filling in the questionnaire, please contact -

Department of Epidemiology and Public Health
School of Health Sciences
21 Claremont Place
University of Newcastle
Newcastle upon Tyne
NE2 4AA

Telephone

UNIVERSITY OF NEWCASTLE

About you

1. Are you:

Male……❒1
Female……❒2

1/13

2. How old are you?

Please give your age on your last birthday in years.

____ years

1/15

3. Are you:

Please tick one box

Single ……❒1
Married……❒2
Living as married……❒3
Separated……❒4
Divorced……❒5
Widowed……❒6

1/16

4. Which of the following educational establishments have you attended?

Please tick all that apply.

Primary or secondary school……❒1
College of Further Education……❒2
Polytechnic……❒3
University (including OU)……❒4
Still studying……❒5
Some other type of College……❒6

1/22

5. What is your ethnic origin?

Please tick one box

White European	❒ 1
White other	❒ 2
Black-Caribbean	❒ 3
Black-African	❒ 4
Black-Other	❒ 5
Indian	❒ 6
Pakistani	❒ 7
Bangladesh	❒ 8
Chinese	❒ 9
Any other ethnic group	❒ 10

1/23

6. Do you regard yourself as belonging to any particular religion?

Please tick the box that best represents your religion.

None	❒ 1
Christian	❒ 2
Buddhist	❒ 3
Hindu	❒ 4
Jewish	❒ 5
Muslim	❒ 6
Sikh	❒ 7
Any other religion	❒ 8

1/24

7. What is your current employment status?

Please tick all that apply.

Employed full-time (30 hours a week or more)	❒ 1
Employed part-time (up to 30 hours a week)	❒ 2
Self-employed	❒ 3
Unemployed	❒ 4
Retired	❒ 5
In full-time education	❒ 6
In part-time education	❒ 7
Not working because of long-term illness or disability	❒ 8
Looking after the home and the family	❒ 9
Doing voluntary work	❒10

1/34

8. What is your job? If you are not working now, what is/was your usual job?

1/35

9. Do you do shift work?

Yes……❒ 1
No……❒ 2

1/36

About food and health

The following questions are about food and health and the advice that you think experts are giving us. If you do not know the answer, mark "not sure" rather than guess.

10. Do you think health experts recommend that most people should be eating more, the same amount, or less of these foods?

Tick one box per food.

	More	Same	Less	Not sure
Vegetables	❒1	❒2	❒3	❒4
Sugary foods	❒1	❒2	❒3	❒4
Meat	❒1	❒2	❒3	❒4
Starchy foods	❒1	❒2	❒3	❒4
Fatty foods	❒1	❒2	❒3	❒4
High fibre foods	❒1	❒2	❒3	❒4
Fruit	❒1	❒2	❒3	❒4
Salty foods	❒1	❒2	❒3	❒4
Oily fish	❒1	❒2	❒3	❒4

2/9

11. How many servings of fruit and vegetables do you think experts are advising people to eat each day? (one serving could be, for example, an apple or a handful of chopped carrots).

If you are not sure please tick the 'not sure' box.

☐ servings ❒ not sure 0

2/10

12. Which fat do experts say is most important for people to cut down on?

Please tick one box.

monounsaturated fat……❒1
polyunsaturated fat……❒2
saturated fat……❒3
not sure……❒4

2/11

13. Which *one* of the following has the most calories for the same weight?

Please tick one box.

sugar……❒1
starchy foods……❒2
fibre/roughage……❒3
fat……❒4
not sure……❒5

2/12

14. Which kind of sandwich do you think is the healthier?

Please tick one box.

a) two <u>thick</u> slices of bread with a <u>thin</u> slice of cheddar cheese filling ❒1
b) two <u>thin</u> slices of bread with a <u>thick</u> slice of cheddar cheese filling ❒2
c) not sure ❒3

2/13

15. Many people eat spaghetti Bolognese (pasta with a tomato and meat sauce). Which do you think is healthier?

Please tick one box.

a) a <u>large amount</u> of pasta with a <u>little</u> sauce on top……❒1
b) a <u>small amount</u> of pasta with a <u>lot</u> of sauce on top……❒2
c) not sure……❒3

2/14

16. Which of these would be the healthiest pudding?

Please tick one box.

a) an apple……❒1
b) strawberry yoghurt……❒2
c) wholemeal crackers and cheddar cheese……❒3
d) carrot cake with cream cheese topping……❒4
e) not sure……❒5

2/15

17. Are you aware of any major health problems or diseases that are related to a low intake of fruit and vegetables?

Yes……❒1
No……❒2
Not sure……❒3

2/16

If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

2/17 ☐

18. Are you aware of any major problems or diseases that are related to the amount of fat people eat?

Yes……❒1
No……❒2
Not sure……❒3

2/18

If yes, what diseases or health problems do you think are related to fat?

2/19 ☐

About the food you eat

The following questions are about the food you usually eat and how often you eat certain foods. Please read the following instructions before answering the questions.

For each food there is an amount shown, either a "medium serving" or a common household unit such as a slice or teaspoon. Please put a tick (3) in the box to indicate how often, **on average**, you have eaten the specified amount of each food **during the past year.**

EXAMPLE:

For white bread the amount is one slice, so if you ate 4 or 5 slices a day, you should put a tick in the column headed "4-5 per day".

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
BREAD & SAVOURY BISCUITS (one slice or biscuit)	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
White bread and rolls								✓	

EXAMPLE:

For chips, the amount is a "medium serving", so if you had a helping of chips twice a week you should put a tick in the column headed "2-4 per week".

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
POTATOES, RICE & PASTA (medium serving)	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Chips				✓					

Please put a tick (✓) in each box to indicate how often, **on average**, you have eaten each food **during the past year.**

Please estimate your average food use as best you can, and please answer every question - do not leave **ANY** lines blank. **Please put a tick (✓) on every line.**

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
19. MEAT & FISH ***(medium serving)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Beef: roast, steak, mince, stew casserole, curry or Bolognese	1	2	3	4	5	6	7	8	9
Beef burgers	1	2	3	4	5	6	7	8	9
Pork: roast, chops, stew, slice or curry	1	2	3	4	5	6	7	8	9
Lamb: roast, chops, stew or curry	1	2	3	4	5	6	7	8	9
Chicken, turkey or other poultry: including fried, casseroles or curry	1	2	3	4	5	6	7	8	9
Bacon	1	2	3	4	5	6	7	8	9
Ham	1	2	3	4	5	6	7	8	9
Corned beef, Spam, luncheon meats	1	2	3	4	5	6	7	8	9
Sausages	1	2	3	4	5	6	7	8	9
Savoury pies, e.g. meat pie, pork pie, pasties, steak & kidney pie, sausage rolls, scotch egg	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE.

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
19. MEAT & FISH, (continued) ***(medium serving)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Liver, liver pate, liver sausage	1	2	3	4	5	6	7	8	9
Fried fish in batter, as in fish and chips	1	2	3	4	5	6	7	8	9
Fish fingers, fish cakes	1	2	3	4	5	6	7	8	9
Other white fish, fresh or frozen, e.g. cod, haddock, plaice, sole, halibut	1	2	3	4	5	6	7	8	9
Oily fish, fresh or canned, e.g. mackerel, kippers, tuna, salmon, sardines, herring	1	2	3	4	5	6	7	8	9
Shellfish, e.g. crab, prawns, mussels	1	2	3	4	5	6	7	8	9
20. BREAD & SAVOURY BISCUITS ***(one slice or biscuit)***									
White bread and rolls	1	2	3	4	5	6	7	8	9
Scones, teacakes, crumpets, muffins or croissants	1	2	3	4	5	6	7	8	9
Brown bread and rolls	1	2	3	4	5	6	7	8	9
Wholemeal bread and rolls	1	2	3	4	5	6	7	8	9
Cream crackers, cheese biscuits	1	2	3	4	5	6	7	8	9
Pitta bread, naan bread, chapatti	1	2	3	4	5	6	7	8	9
Garlic bread	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
21. CEREALS ***(one bowl)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Porridge, Readybrek	1	2	3	4	5	6	7	8	9
Sugar coated cereals e.g. Sugar Puffs, Cocoa Pops, Frosties	1	2	3	4	5	6	7	8	9
Non-sugar coated cereals e.g. Cornflakes, Rice Crispies	1	2	3	4	5	6	7	8	9
All Bran, Bran Flakes, Muesli	1	2	3	4	5	6	7	8	9
Wholegrain cereals e.g. Cheerios, Weetabix, Shredded Wheat	1	2	3	4	5	6	7	8	9
22. POTATOES, RICE & PASTA ***(medium serving)***									
Boiled, mashed, instant or jacket potatoes	1	2	3	4	5	6	7	8	9
Chips, potato waffles	1	2	3	4	5	6	7	8	9
Roast potatoes	1	2	3	4	5	6	7	8	9
Yorkshire pudding, pancakes, dumpling	1	2	3	4	5	6	7	8	9
Potato salad	1	2	3	4	5	6	7	8	9
White rice	1	2	3	4	5	6	7	8	9
Brown rice	1	2	3	4	5	6	7	8	9
White or green pasta, e.g. spaghetti, macaroni, noodles	1	2	3	4	5	6	7	8	9
Tinned pasta, e.g. spaghetti, ravioli, macaroni	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
22. POTATOES, RICE & PASTA (continued) ***(medium serving)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Super noodles, pot noodles, pot savouries	1	2	3	4	5	6	7	8	9
Wholemeal pasta	1	2	3	4	5	6	7	8	9
Lasagne, moussaka, cannelloni	1	2	3	4	5	6	7	8	9
Pizza	1	2	3	4	5	6	7	8	9
23. DAIRY PRODUCTS & FATS									
Single or sour cream *(tablespoon)*	1	2	3	4	5	6	7	8	9
Double or clotted cream *(tablespoon)*	1	2	3	4	5	6	7	8	9
Low fat yoghurt, fromage frais *(125g carton)*	1	2	3	4	5	6	7	8	9
Full fat or Greek yoghurt *(125g carton)*	1	2	3	4	5	6	7	8	9
Dairy desserts *(125g carton),* e.g. mousse	1	2	3	4	5	6	7	8	9
Cheese, e.g. Cheddar, Brie, Edam *(medium serving)*	1	2	3	4	5	6	7	8	9
Cottage cheese, low fat soft cheese *(medium serving)*	1	2	3	4	5	6	7	8	9
Eggs as boiled, fried, scrambled, omelette etc. *(one)*	1	2	3	4	5	6	7	8	9
Quiche *(medium serving)*	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
23.(b) The following on bread or vegetables *(teaspoon)*	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Butter	1	2	3	4	5	6	7	8	9
Block margarine, e.g. Stork, Krona	1	2	3	4	5	6	7	8	9
Polyunsaturated margarine, e.g. Flora sunflower	1	2	3	4	5	6	7	8	9
Other soft margarine, dairy spreads, e.g. Blue Band, Clover	1	2	3	4	5	6	7	8	9
Low fat spread, e.g. Gold	1	2	3	4	5	6	7	8	9
24. SWEETS & SNACKS									
Sweet biscuits, chocolate, e.g. digestive *(one)*	1	2	3	4	5	6	7	8	9
Sweet biscuits, plain, e.g. Nice, ginger *(one)*	1	2	3	4	5	6	7	8	9
Cakes e.g. fruit, sponge, sponge pudding *(medium serving)*	1	2	3	4	5	6	7	8	9
Sweet buns & pastries e.g. flapjacks, doughnuts, Danish pastries, cream cakes *(medium serving)*	1	2	3	4	5	6	7	8	9
Fruit pies, tarts, crumbles *(medium serving)*	1	2	3	4	5	6	7	8	9
Milk puddings, e.g. rice, custard, trifle *(medium serving)*	1	2	3	4	5	6	7	8	9
Ice cream, choc ices *(one)*	1	2	3	4	5	6	7	8	9
Chocolates *(small bar or ¼ pound of chocolates)*	1	2	3	4	5	6	7	8	9
Chocolates snack bars e.g. Mars, Crunchie *(one)*	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
24. SWEETS & SNACKS (continued)	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Sweets, toffees, mints *(one packet)*	1	2	3	4	5	6	7	8	9
Sugar added to tea, coffee, cereal *(teaspoon)*	1	2	3	4	5	6	7	8	9
Crisps or other packet snacks e.g. Wotsits *(one packet)*	1	2	3	4	5	6	7	8	9
Peanuts or other nuts *(one packet)*	1	2	3	4	5	6	7	8	9
25. SOUPS, SAUCES AND SPREADS									
Vegetable soups *(bowl)*	1	2	3	4	5	6	7	8	9
Meat soups *(bowl)*	1	2	3	4	5	6	7	8	9
Sauces, e.g. white sauce, cheese sauce, gravy *(medium serving)*	1	2	3	4	5	6	7	8	9
Tomato based sauces e.g. pasta sauces *(medium serving)*	1	2	3	4	5	6	7	8	9
Tomato ketchup, brown sauce *(tablespoon)*	1	2	3	4	5	6	7	8	9
Relishes e. g. pickles, chutney, mustard *(tablespoon)*	1	2	3	4	5	6	7	8	9
Low calorie, low fat salad cream or mayonnaise *(tablespoon)*	1	2	3	4	5	6	7	8	9
Salad cream, mayonnaise *(tablespoon)*	1	2	3	4	5	6	7	8	9
French dressing *(tablespoon)*	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
25. SOUPS, SAUCES AND SPREADS (continued)	Never or less than once/ month	1-3 per month	Once A Week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Other salad dressing *(tablespoon)*	1	2	3	4	5	6	7	8	9
Marmite, Bovril *(teaspoon)*	1	2	3	4	5	6	7	8	9
Jam, marmalade, honey, syrup *(teaspoon)*	1	2	3	4	5	6	7	8	9
Peanut butter *(teaspoon)*	1	2	3	4	5	6	7	8	9
Chocolate spread, chocolate nut spread *(teaspoon)*	1	2	3	4	5	6	7	8	9
Dips e.g. hummus, cheese and chive *(tablespoon)*	1	2	3	4	5	6	7	8	9
26. DRINKS									
Tea *(cup)*	1	2	3	4	5	6	7	8	9
Coffee, instant or ground *(cup)*	1	2	3	4	5	6	7	8	9
Coffee whitener, e.g. Coffee-mate *(teaspoon)*	1	2	3	4	5	6	7	8	9
Cocoa, hot chocolate *(cup)*	1	2	3	4	5	6	7	8	9
Horlicks, Ovaltine *(cup)*	1	2	3	4	5	6	7	8	9
Wine *(glass)*	1	2	3	4	5	6	7	8	9
Beer, lager or cider *(half pint)*	1	2	3	4	5	6	7	8	9
Port, sherry, vermouth, liqueurs *(glass)*	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
26. DRINKS (continued)	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Spirits, e.g. gin, brandy, whisky, vodka *(single)*	1	2	3	4	5	6	7	8	9
Low calorie or diet fizzy soft drinks *(glass)*	1	2	3	4	5	6	7	8	9
Fizzy soft drinks, e.g. Coca cola, lemonade *(glass)*	1	2	3	4	5	6	7	8	9
Pure fruit juice (100%) e.g. orange, apple juice *(glass)*	1	2	3	4	5	6	7	8	9
Fruit squash or cordial *(glass)*	1	2	3	4	5	6	7	8	9
27. FRUIT *(1 fruit or medium serving)* *For very seasonal fruits such as strawberries, please estimate your average use when the fruit is in season									
Apples	1	2	3	4	5	6	7	8	9
Pears	1	2	3	4	5	6	7	8	9
Oranges, satsumas, mandarins, tangerines, clementines	1	2	3	4	5	6	7	8	9
Grapefruit	1	2	3	4	5	6	7	8	9
Bananas	1	2	3	4	5	6	7	8	9
Grapes	1	2	3	4	5	6	7	8	9
Melon	1	2	3	4	5	6	7	8	9
*Peaches, plums, apricots, nectarines	1	2	3	4	5	6	7	8	9
*Strawberries, raspberries, kiwi fruit	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
27. FRUIT (continued) ***(1 fruit or medium serving)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Tinned fruit	1	2	3	4	5	6	7	8	9
Dried fruit, e.g. raisins, prunes, figs	1	2	3	4	5	6	7	8	9
28. VEGETABLES Fresh, frozen or tinned ***(medium serving)***									
Carrots	1	2	3	4	5	6	7	8	9
Spinach	1	2	3	4	5	6	7	8	9
Broccoli	1	2	3	4	5	6	7	8	9
Brussels sprouts	1	2	3	4	5	6	7	8	9
Cabbage	1	2	3	4	5	6	7	8	9
Peas	1	2	3	4	5	6	7	8	9
Green beans, broad beans, runner beans	1	2	3	4	5	6	7	8	9
Marrow, courgettes	1	2	3	4	5	6	7	8	9
Cauliflower	1	2	3	4	5	6	7	8	9
Parsnips, turnips, swedes	1	2	3	4	5	6	7	8	9
Leeks	1	2	3	4	5	6	7	8	9
Onions	1	2	3	4	5	6	7	8	9
Garlic	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

PLEASE PUT A TICK (✓) ON EVERY LINE

FOODS & AMOUNTS	AVERAGE USE LAST YEAR								
28. VEGETABLES Fresh, frozen or tinned (continued) ***(medium serving)***	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Mushrooms	1	2	3	4	5	6	7	8	9
Sweet peppers	1	2	3	4	5	6	7	8	9
Bean sprouts	1	2	3	4	5	6	7	8	9
Green salad, lettuce, cucumber, celery	1	2	3	4	5	6	7	8	9
Mixed vegetables (frozen or tinned)	1	2	3	4	5	6	7	8	9
Watercress	1	2	3	4	5	6	7	8	9
Tomatoes	1	2	3	4	5	6	7	8	9
Sweet corn	1	2	3	4	5	6	7	8	9
Beetroot, radishes	1	2	3	4	5	6	7	8	9
Coleslaw	1	2	3	4	5	6	7	8	9
Avocado	1	2	3	4	5	6	7	8	9
Baked Beans	1	2	3	4	5	6	7	8	9
Dried lentils, beans, peas	1	2	3	4	5	6	7	8	9
Tofu, soya meat, TVP, Vegeburger	1	2	3	4	5	6	7	8	9
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick (✓) on EVERY line

29. (a) What type of milk did you most often use?

Select one only

Full cream……❒1
Channel Islands……❒2
Dried milk……❒3
Semi-skimmed……❒4
Skimmed……❒5
Soya……❒6
Other……❒7
None……❒8

4/52

29. (b) Approximately, how much milk did you drink each day, including milk with tea, coffee, cereals etc?

None……❒1
Quarter of a pint (roughly 125mls)……❒2
Half a pint (roughly 250mls) ……❒3
Three quarters of a pint (roughly 375mls) ……❒4
One pint (roughly 500mls) ……❒5
More than one pint (more than 500mls) ……❒6

4/53

30. What kind of fat did you most often use for frying, roasting, grilling etc?

Select one only

Butter……❒1
Lard/dripping……❒2
Solid vegetable fat……❒3
Margarine……❒4
Vegetable oil……❒5
Olive oil……❒6
None……❒7

4/54

31. How often did you eat food that was fried at home?

Select one only

Daily……❒1
1-3 times a week……❒2
4-6 times a week……❒3
Less than once a week……❒4
Never……❒5

4/55

32. How often did you eat fried food *away* from home?

Select one only

Daily……❒1
1-3 times a week……❒2
4-6 times a week……❒3
Less than once a week……❒4
Never……❒5

4/56

33. (a) How often did you add salt to food while cooking?

Select one only

Always……❒1
Usually……❒2
Sometimes……❒3
Rarely……❒4
Never……❒5

4/57

33. (b) How often did you add salt to any food at the table?

Select one only

Always……❒1
Usually……❒2
Sometimes……❒3
Rarely……❒4
Never……❒5

4/58

34. Do you follow a special diet?

Please tick all that apply.

No……❒1
Yes, because of a medical condition/allergy……❒2
Yes, to lose weight……❒3
Yes, because of personal beliefs (religion, vegetarian)……❒4
Yes, other……❒5

4/63

35. Over the last year, how often have you eaten organic foods?

Select one only.

Most days……❒1
Once or twice a week……❒2
Once a month……❒3
Never/hardly ever……❒4

4/64

36. Have you taken any of the following during the past year?

a) Vitamins (e.g. multivitamins, vitamin B, vitamin C, folic acid)

Yes……❒1
No……❒2

4/65

b) Minerals (e.g. iron, calcium, zinc, magnesium)

Yes……❒1
No……❒2

4/66

c) Fish oils (e.g. cod liver oil, omega-3)

Yes……❒1
No……❒2

4/67

d) Other food supplements (e.g. oil of evening primrose, starflower oil, royal jelly, ginseng)

Yes……❒1
No……❒2

4/68

What you think about food

The following questions are about the foods you eat and the effect they might have on your health.

Please indicate by ticking the appropriate box on the scale of 1 to 5 whether you agree or disagree with the following statements.

37. The food I eat has an important effect on my health

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/1

38. To be a healthy person you have to *eat a balanced diet*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/2

39. To be a healthy person you have to *exercise regularly*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/3

40. 'Healthier eating' means eating a diet *high in fruit and vegetables*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/4

41. 'Healthier eating' means eating a diet *high in fatty foods*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/5

42. 'Healthier eating' means eating a diet *low in sugar*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/6

43. 'Healthier eating' means eating a diet *low in fibre*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/7

44. 'Healthier eating' means *frying foods rather than grilling them*

	1	2	3	4	5	
Agree strongly	❒	❒	❒	❒	❒	Disagree strongly

5/8

45. In your opinion, how healthy is the way you usually eat?

	1	2	3	4	5	
Very healthy	❒	❒	❒	❒	❒	Very unhealthy

5/9

46. How important is eating healthily to you?

	1	2	3	4	5	
Very important	❒	❒	❒	❒	❒	Very unimportant

5/10

47. Is there anything you want to change about your eating habits?

Yes……❒1
No……❒2

5/11

If yes, what would you like to change? Please list up to 3 things.

1. _____

5/13

2. _____

5/15

3. _____

5/17

48. How difficult do you find it to eat healthily?

	1	2	3	4	5	
very difficult	❒	❒	❒	❒	❒	not at all difficult

5/18

49. Do any of the following stop you from eating more healthily?

Please tick as many as apply.

Lack of time……❒ 1
Cost of healthy foods……❒ 2
Lack of willpower……❒ 3
Irregular work hours……❒ 4
Dislike healthy foods……❒ 5
Giving up favourite foods……❒ 6
Unsure of what to eat……❒ 7
Family preferences……❒ 8
Busy lifestyle……❒ 9
Inconvenience……❒10
I don't know enough about healthy eating……❒11
Nowhere to buy healthy foods……❒12

5/30

50. Who do you usually eat with?

Please tick one box for each meal.

Breakfast

Members of immediate family……❒1
Work (or similar) colleagues……❒2
Friends……❒3
Alone……❒4
Flatmates……❒5
Other……❒6

5/31

Midday

Members of immediate family……❒1
Work (or similar) colleagues……❒2
Friends……❒3
Alone……❒4
Flatmates……❒5
Other……❒6

5/32

Evening Meal

Members of immediate family……❒1
Work (or similar) colleagues……❒2
Friends……❒3
Alone……❒4
Flatmates……❒5
Other……❒6

5/33

51. How often do you eat food prepared outside the home?

Please tick one box for each line.

	Most days	Once or twice a week	Once a month	Never/ Hardly ever
Chip shop	❒1	❒2	❒3	❒4
Other take away food outlets	❒1	❒2	❒3	❒4
Restaurants/pubs/cafes	❒1	❒2	❒3	❒4
Meals on wheels	❒1	❒2	❒3	❒4
Work canteen	❒1	❒2	❒3	❒4
Friends/family	❒1	❒2	❒3	❒4

5/39

52. During the course of last year, on average, how many times did you eat the following foods?

Food Type	Times/week	Portion size
Vegetables (not including potatoes)		medium serving 5/41
Salads		medium serving 5/43
Fruit and fruit products (not including fruit juice)		medium serving or 1 fruit 5/45
Fish and fish products		medium serving 5/47
Meat, meat products and meat dishes (including bacon, ham and chicken)		medium serving 5/49

53. During the last year, on average, how often do you eat fruit or vegetables from a garden or allotment?

Select one only.

Most days……❒1
Once or twice a week……❒2
Once a month……❒3
Never/hardly ever……❒4

5/50

About you and your health

54. For your age, would you say that your health was:

Please tick one box on the scale of 1 to 5:

	1	2	3	4	5	
very good	❒	❒	❒	❒	❒	very poor

5/51

55. Which of the following best describes your daily work or other daytime activity that you usually do?

Please tick one box only.

I am usually sitting and do not walk about much……❒1

I stand or walk about quite a lot, but do not have to carry or lift things very often……❒2

I usually lift or carry light loads or have to climb stairs or hills often……❒3

I do heavy work or carry heavy loads often……❒4

5/52

56. Please give the average number of hours per week you spend doing sports and other activities.

Please write in the amount for each; if none write "0"

a) Mildly energetic
(e.g. walking, gardening, playing darts, general housework) _____ hour/s

b) Moderately energetic
(e.g. heavy housework or gardening, dancing, golf, cycling, leisurely swimming) _____ hour/s

c) Vigorous
(e.g. running, competitive swimming or cycling, tennis, football, squash, aerobics) _____ hour/s

5/64

57. Do you smoke?

Yes, I smoke daily……❒1
Yes, I smoke occasionally……❒2
No, I used to smoke……❒3
No, I have never smoked……❒4

5/65

58. If yes or you used to smoke, how much, on average, do you (or did you) smoke a day?

Please write in the amount for each; if none write "0"

cigarettes____
cigars____
ounces tobacco____

5/74

59. In the past 12 months have you taken an alcoholic drink:

Please tick one box.

Twice a day or more……❒1
Almost daily ……❒2
Once or twice a week……❒3
Once or twice a month……❒4
Special occasions only……❒5
Not at all……❒6

5/75

60. In a typical 7-day week, including the weekend, how many standard drinks of alcohol do you drink? *(see the table below)*

Please write the number in the box below.

I usually drink ____ standard drinks of alcohol per week

5/78

ONE STANDARD DRINK = ½ pint of beer or ½ pint cider or ½ pint lager or 1 glass of wine, martini, or cinzano or 1 small glass of Sherry or Port or 1 measure of Spirits (gin, whiskey, vodka etc.) or 1 measure liquor **A PINT OF BEER, CIDER, OR LAGER COUNTS AS TWO STANDARD DRINKS**
A DOUBLE MEASURE OF SPIRITS COUNTS AS TWO STANDARD DRINKS

61. What is your current height? ____feet _____inches *or* _____cm

5/81 5/84

62. What is your current weight? ____stones _____pounds *or* _____kg

5/88 5/90

63. (a) Do you have any long-term illness, physical or mental health problem or handicap?

Yes……❒1
No……❒2

5/91

63. (b) If yes, does this limit your daily activity in any way?

Yes……❒1
No……❒2

5/92

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

PLEASE RETURN THE QUESTIONNAIRE TO US AS SOON AS POSSIBLE IN THE ENVELOPE PROVIDED - NO STAMP IS NEEDED

Appendix 4

Piloting of household and individual questionnaires and survey method

Before commencing the main surveys, two pilot studies were conducted in order to test two survey method options. In the first, the household questionnaire and a letter were sent directly to households. In the second, a letter was sent first, asking if households wished to take part and then questionnaires were sent to those consenting. Following this, face-to-face qualitative semi-structured interviews were undertaken with a sample of non-respondents to Pilot study 1. These three elements are reported below.

Pilot study 1

Study 1 tested the questionnaires and methods on a random sample (n=400) of households across the whole of Newcastle in order to: gauge response rates from areas with different socio-economic profiles; assess willingness to participate at household and individual levels; and assess the validity and ease of completion of the household and individual questionnaires.

Procedure

A random sample of 400 private households in Newcastle was selected using the Post Office's Postcode Address File (PAF), which lists all residential addresses.

Each selected household was sent a questionnaire pack, addressed to the householder, containing a covering letter, a leaflet explaining about the project, a household questionnaire (see Appendix 2) and a pre-paid envelope. Households were asked to complete the questionnaire and return it in the pre-paid envelope. Those who had not replied within 3 weeks were sent a postcard reminder. A cut-off point of 6 weeks was set and those who had not replied by this time were a sent final reminder letter and repeat questionnaire. The names of individuals who agreed to be included in the individual level survey were added to the sample list and sent an Individual Questionnaire (See Appendix 3) (n=218).

Response rates

Out of the 400 initial mailings, 183 (46%) of households responded positively, 52 (13%) refused or were returned by the Post Office and 165 (41%) did not respond. No significant

differences were found in the geographic distribution of responses by postcode area. Of the 183 responses, 132 (72%) of households agreed to take part in the next phase of the study, generating a sample of 218 adults. The response rate for the individual questionnaire was high - 188 (86%) questionnaires were returned.

Conclusions

The yield of individual questionnaires (188) from 400 households was lower than anticipated, despite using survey methods established in other recent local research. It was felt that the unannounced arrival of a household questionnaire may have been daunting for some households, resulting in nearly 30% of those responding deciding not to participate further. An alternative approach to households was therefore explored in a second, pilot study.

Pilot study 2

Procedure

The second pilot randomly sampled 208 households (using the same sampling methods as Pilot 1). However, in this pilot, the first point of contact was a letter of invitation to participate in the survey. It was thought that this, as well as being more cost effective, might be less daunting to potential respondents than the questionnaire and information pack arriving at the same time. Householders were asked to name all members of their household over the age of 16 years who were willing to take part in the study. Respondents to this letter were then sent the household questionnaire and, as in the first pilot, sent an individual questionnaire upon return of the household questionnaire.

Response rates

Just over half 104 (50.5%) of the consent forms were returned, but only 39 households (18.8%) agreed to take part in the survey. A further 8 (4%) refused or were returned by the Post office and 95 (46%) did not respond. Those who responded positively were sent a household questionnaire of which 36 (92%) were returned completed. In total 64 individuals agreed to take part and were sent an individual questionnaire, of which 58 (90%) were returned.

Conclusions

Despite 50% of the sample responding to the initial letter, the yield of individual questionnaires (58 from 208 the sample) was substantially lower than in pilot study 1. It was thus decided that this was not a viable method for the main survey.

Interview study of non-respondents

Procedure

To investigate further the non-response to the initial mailing in pilot study 1, a number of qualitative interviews were carried out in two socially contrasting areas of Newcastle, namely Gosforth (NE3 – more affluent) and Heaton (NE6 – less affluent). Those who had not responded to the questionnaire were visited and asked some brief questions concerning their decision not to complete the questionnaire. Individuals were asked whether they remembered receiving the envelope, questionnaire and reminder card and, if they remembered receiving the questionnaire, what they decided to do with it. This was asked to gain some understanding of whether the content of the questionnaire was off-putting or whether the questionnaire packs had been dismissed as 'junk mail'. Where appropriate respondents were also asked why they had not answered the questionnaire and whether there was anything that would make them more likely to respond to the survey. A copy of the interview schedule is shown in Appendix 5.

Findings

Of the 36 addresses visited (16 in Gosforth and 20 in Heaton), 17 were empty on the initial visit, one was a residential home and three people refused to participate. Empty properties were visited again on a different day and at a different time, when 12 were found still empty. Of the 20 interviewed, 12 said they did not remember receiving the questionnaire and/or the reminder and five had received the questionnaire, but did not want to take part in the study. Two stated that they had received the questionnaire and had since returned it (although only one of these was received) and one had just moved into that property. Further questioning of those who did not want to take part in the survey revealed that there were few steps that could have been taken to entice them to take part in the survey. There were no obvious differences in the two socially contrasting areas.

Conclusions

Following this qualitative assessment, the following changes were made to the design adopted in Pilot Study 1 before implementing this method in the main study:

- The overall sample size was increased to account for empty properties, as the number appeared to be higher than anticipated.
- Steps were taken to change the design of the materials for the main survey to make them more distinctive, and thus more likely to receive a favourable response. The Newcastle University logo and a return address were added to the envelope to distinguish our mail

from "junk mail" and to facilitate Post office returns of undelivered letters. The project logo was applied to all project materials.

- With the help of the University Public Relations Office, a publicity campaign was planned and executed to coincide with the main surveys.

Appendix 5

Non-response interview schedule

Date: _____ Household ID: _____

Address: _____ Postcode: _____

Type of questionnaire sent: HQ1 HQ2 HQ3 HQ4

Introduction

Are you the householder?	☐ Yes	☐ No
Do you remember receiving an envelope like this?	☐ Yes	☐ No
Do you remember seeing this questionnaire?	☐ Yes	☐ No
Do you remember receiving a reminder card like this?	☐ Yes	☐ No

(If no – is there anyone else who might have seen it?)

Do you remember what you did with it?

☐ Did you throw it away without opening it? – or keep it?
☐ Did you open it first and then throw it away? – or keep it?
☐ Did you look through it and then throw it away? – or keep it?

Can you tell me why you did this?

☐ Lack of time
☐ Too invasive
☐ Questionnaire too long
☐ Lack of interest
☐ Too much junk mail
☐ Content of questionnaire

What would make you more likely to open the envelope? Read the contents? Respond to the survey?

☐ University logo on envelope
☐ EASIN logo on envelope
☐ Incentives, do they have any ideas what?

Thank you for your help

Appendix 6

Variables entered in multivariable analyses

Table 93: Variables entered in multivariable analyses

Variable name	Definition	Type	Values/levels	Comparison group/centred at
Outcome variables (individual level)				
z2_fv	Consumption of Fruit and vegetables (standardised F&V index)	Continuous numerical	Range: -1.7 to 7.9	Mean
z2_nsp	Consumption of Non-starch polysaccharide (standardised NSP index)	Continuous numerical	Range: -2.9 to 8.6	Mean
z2_fate	Consumption of Fat (standardised Fat index)	Continuous numerical	Range: -8.1 to 3.5	Mean
Outcome variable (household level)				
cat_shop	Type of main food store	Nominal categorical	0=no code, 1=discounter, 2= all other, 3=department store, 4= multiple supermarket	multiple supermarket
Independent variables				
Individual level				
age_cent	Age in years	Continuous numerical	Range (age): 16 to 97years	Mean (48yr)
agegroup	Age in 10 year groups	Ordinal categorical	1=16-24 years, 2=25-34 years, 3=35-44 years, 4=45-54 years, 5=55-64 years, 6=65-74 years, 7=75 years or more	16-24 years
sex	Sex	binary	1=male, 2=female	female
rev_eth	Ethnicity	binary	1=non-white, 2=white,	White
rev_ret	Retired	binary	1=retired, 2=not retired	not retired
mstat4	Marital status	Nominal categorical	1=widowed, 2=sep/div,3=single, 4=married + living as married	married + living as married
ed_level	Educational attainment	Nominal categorical	1=university or equivalent, 2=college of further education, 3=primary or secondary education only	primary or secondary only
workstat	Work status	Nominal categorical	0=unemployed, 1= not in paid employment/not unemployed, 2=employed	employed
know_cen	Dietary knowledge score	Discrete numerical	Range 1 to 20	Mean (12.5)
smoker	Smoking status	Nominal categorical	1=daily, 2=occasionally, 3=ex-smoker, 4=never smoked	never smoked
rev_alc	Risk categories for alcohol consumption	binary	1=risky or hazardous, 2=safe	Safe
qexscore	Physical activity score	Ordinal categorical	fifths of activity score: 1=low, 5=high	entered as numerical
qexscore_cat	Physical activity score	categorical	1=least active 2 4 5=most active fifth 6=middle fifth	middle fifth

Variable name	Definition	Type	Values/levels	Comparison group/centred at
rev_alti	Activity limiting long term illness	Ordinal categorical	1=has activity limiting LTI, 2=LTI with no limitation, 3=no LTI	no LTI
rev_nomea	Vegetarian or not	binary	1=vegetarian, 2=eats meat or fish	
srhealth	Self-reported health	Ordinal categorical	1=very good, 2=good, 3=neither good nor bad, 4=poor or very poor	4=poor or very poor
eat_out	Eating out score derived by combining data from q51, individual questionnaire	Continuous numerical	Range: 0.6 to 33.0	Mean
Household level				
Characteristics of households				
carowner	Access to car	binary	1=no, 2=yes	yes
rev_own	Home ownership	Nominal categorical	1= rented, 2=rent free 3=home owner	home owner
rooms	Number of rooms in home	Discrete numerical	Range 1 to 20	
revhcom	Household composition	Nominal categorical	1=two or more adults, one or more children, 2=1 adult, 1 or more child, 3=3 or more adults, 4=Single adults, 5=two adults	two adults
numadult	Number of adults in home	Discrete numerical	Range 1 to 7	
numadult_c	Number of adults in home with highest categories collapsed	Ordinal categorical	Range 1 to 5+	
numkidu5	Number of children under 5 in home	Discrete numerical	Range 0 to 4	
numkidu5_c	Number of children under 5 in home with highest categories collapsed	Ordinal categorical	Range 1 to 3+	
numkido5	Number of children over 5 in home	Discrete numerical	Range 0 to 5	
numkido5_c	Number of children over 5 in home with highest categories collapsed	Ordinal categorical	Range 1 to 3+	
inc_gp	Household income (£)	Ordinal categorical	1=0 to 2500, 2=2500 to 5000, 3=5000 to 10000, 4=10000 to 15000, 8=15000 to 20000, 5=20000 to 25000, 6=25000 to 30000, 7=30000+	15000 to 20000
rev_benh	Household member on health-related benefit	binary	1=yes, 2=no	no
welfare	Receipt of state benefit	Nominal categorical	1=On benefits, 3=not known, 5=not on benefits	not on benefits
noprobs	No problems when shopping	binary	0=problems, 1=no problems	No problems
kitchen	Standard of living index for kitchen equipment (oven/hob, grill, toaster, microwave)	Discrete numerical	Range: 0 to 4	
foodstore	Standard of living index for food storage (fridge, freezer)	Discrete numerical	Range: 0 to 2	
slinotinc	Standard of living index (excluding kitchen equipment/storage)	Discrete numerical	Range: 2 to 15	
sli	Standard of living index	Discrete numerical	Range: 4 to 18	

Variable name	Definition	Type	Values/levels	Comparison group/centred at
Characteristics of interaction between household and retail environment, attributed to households				
dist_shop	Distance to usual food store in km	continuous numerical	Range 0-23.7	Mean
f_shop_c	Frequency of food shopping	Nominal categorical	1=daily, 3= weekly 4=Once/fortnight, 5=other, 6=2 or 3 times/week	2 or 3 times/week
fcos_cen	Usual cost of weekly food shopping per adult equivalent i(£)	continuous numerical	2.31 to 100.00	28.37
fcost_group	Usual cost of weekly food shopping per adult equivalent (£) categorised into three roughly equal freq groups	categorical	1=<30 2= 20-30 3=30+	
fcost_group_c	Usual cost of weekly food shopping per adult equivalent (£) categorised into three roughly equal freq groups, with median cost as comparison group	categorical	1=<30 3=30+ 4=20-30	20-30
cat_shop	Type of main food store	Nominal categorical	0=no code, 1=discounter, 2= all other, 3=department store, 4= Multiple supermarket	multiple supermarket
travtim2	Travel time to main shop (minutes)	Ordinal categorical	1=<5, 2=5 to 15, 3=>15	5-15 (median time)
rev_car	Main mode of travel from usual store	Nominal categorical	1=bike, 2=taxi, 3=bus, 4=metro, 5=foot, 6=car	car
tripchain	Trip chains when food shopping	binary	1=always or sometimes, 0=never	always or sometimes
Characteristics of main food store, attributed to households				
n_total	Number out of 33 food items available	Discrete numerical	0 to 33	
n_fresh	Number of fresh fruit and vegetables (F&V) available	Discrete numerical	0 to 10	
n_4ppfv	Number of pre-packed F&V available	Discrete numerical	0 to 4	
n_frveg	Number of fresh or pre-packed F&V available	Discrete numerical	0 to 14	
n_7pphealthier	Number of pre-packed 'healthier' items available	Discrete numerical	0 to 7	
n_bad	Number of 'less healthy' items available	Discrete numerical	0 to 10	
n_neutral	Number of 'neutral' items available	Discrete numerical	0 to 2	
n_good	Number of 'healthier' items available	Discrete numerical	0 to 21	
main5	Number of fresh or pre-packed (£), out of 14, available at main food store	binary	0 = 0 to 4 1 = 5 to 14	
Hourstot	Opening hours/week	Discrete numerical	6 to 168 (366/3153 missing)	
Quality	Number of fresh fruit and vegetables (out of 10) of acceptable quality	Discrete numerical	0 to 10 (332/3153 missing)	
Checkout	Number of checkouts (as measure of retail volume)	numerical	0 to 55 (259/3153 missing)	
tds_shppc	TDS of LSOA of main food shop postcode	Continuous numerical	(447/3153 missing)	
Neighbourhood (unit postcode) level				
qtds_lsoa	Fifths of TDS of LSOA of home postcode	Ordinal categorical	1= most affluent, 5=most deprived	
500m circular buffer zone around home				
qtds_b500	Fifths of TDS of aggregated LSOAs in 500m buffer.	Ordinal categorical	1= most affluent, 5=most deprived	

Variable name	Definition	Type	Values/levels	Comparison group/centred at
MultipleSupermarket	Presence of multiple supermarket in 500m buffer zone	binary	0=no, 1=yes	
DiscountMultipleSupermarket	Presence of discount supermarket in 500m buffer zone	binary	0=no, 1=yes	
ConvenienceStore	Presence of convenience store in 500m buffer zone	binary	0=no, 1=yes	
GreenGrocer_MarketStall	Presence of greengrocer or market stall in 500m buffer zone	binary	0=no, 1=yes	
TotalOf33Fooditems_all_stores	Total number out of 33 food items available in all stores in 500m buffer	Discrete numerical	0 to 33	
MaxOf33Fooditems_singlestore	Maximum number out of 33 food items available in any single store in 500m buffer	Discrete numerical	0 to 33	
TotalOf10FFV_all_stores	Total number of fresh F&V available in all stores in 500m buffer	Discrete numerical	0 to 10	
MaxOf10FFV_singlestore	Total number of pre-packed F&V available in all stores in 500m buffer	Discrete numerical	0 to 10	
TotalOf4PPFV_all_stores	Maximum number of fresh F&V available in any single store in 500m buffer	Discrete numerical	0 to 4	
MaxOf4PPFV_singlestore	Maximum number of pre-packed F&V available in any single store in 500m buffer	Discrete numerical	0 to 4	
TotalOf7Healthier_all_stores	Total number of pre-packed healthier items available in all stores in 500m buffer	Discrete numerical	0 to 7	
MaxOf7Healthier_singlestore	Maximum number of pre-packed healthier items available in any single store in 500m buffer	Discrete numerical	0 to 7	
TotalOf10LessHealthy_all_stores	Total number of less healthy items available in all stores in 500m buffer	Discrete numerical	0 to 10	
MaxOf10LessHealthy_singlestore	Maximum number of less healthy items available in any single store in 500m buffer	Discrete numerical	0 to 10	
TotalOf2Neutral_all_stores	Total number of neutral available in all stores in 500m buffer	Discrete numerical	0 to 2	
MaxOf2Neutral_singlestore	Maximum number of neutral available in any single store in 500m buffer	Discrete numerical	0 to 2	
LongestOpeningHrs	Longest opening hours/week in 500m buffer	Discrete numerical	6 to 168	
HighestQualityFFV	Highest quality of fresh F&V available in 500m buffer	Discrete numerical	0 to 10	
NumberofCheckouts	Number of checkouts (as measure of retail volume) available in 500m buffer	Discrete numerical	0 to 207	
radius5	Number of fresh or pre-packed F&V, out of 14, available in 500m buffer	binary	0=0 to 4, 1=5 to 14	

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