UNIVERSITY OF SOUTHAMPTON

THE IMPACT OF INCREASED PHYSICAL ACCESS THROUGH THE OPENING OF A SUPERSTORE ON FRUIT AND VEGETABLE CONSUMPTION

by

Daniel Laurence Warm

Doctor of Philosophy

Faculty Of Medicine, Health And Biological Sciences
Institute Of Human Nutrition

October 2002

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF MEDICINE, HEALTH AND BIOLOGICAL SCIENCES

INSTITUTE OF HUMAN NUTRITION

Doctor of Philosophy

THE IMPACT OF INCREASED PHYSICAL ACCESS THROUGH THE OPENING OF A SUPERSTORE ON FRUIT AND VEGETABLE CONSUMPTION

by Daniel Laurence Warm

Fruit and vegetable consumption is perceived to be a major determinant of health status and may partly explain the inequalities in health that exist within the UK. Physical access to fruits and vegetables has been considered a critical factor affecting consumption levels and thus may be a rate-limiting step in their consumption. This study tests the theory by investigating the changes in fruit and vegetable consumption related to changes in physical access to fruit and vegetables through the opening of a new locally accessible superstore. It is the first study to examine changes in food intake through increased physical access in an area of low fruit and vegetable consumption. The changes in fruit and vegetables were explored in a framework of consumption comprised of changes in physical access, availability, affordability, attitudes and other factors impinging on the buying and consuming of fruits and vegetables.

The food habits, shopping patterns and socio-demographic characteristics were collected from 1009 respondents before the opening of the new superstore and 615 of the same respondents after the opening of the new superstore using a self-completed prospective seven-day food checklist, as well as interviewer-administered and self-completed questionnaires. Overall, fruit and vegetable consumption increased by 0.04 portions per day to 2.92 portions per day ($p=0.555$) following the opening of the new superstore. However, those respondents with lower intakes of fruits and vegetables before the opening of the superstore had significant increases in consumption levels irrespective of changes in physical access ($p<0.001$).

Two hundred and eighteen respondents used the new store as their main source of fruit and vegetable shopping, and increased their consumption levels by 0.15 portions per day to 2.75 portions per day ($p=0.229$). Analysis showed that distance to the new store was a major factor in its use – people using the store lived significantly closer to it than those who did not ($p=0.005$). Positive changes in the factors in the framework of consumption for those using the new superstore did not affect the level of fruit and vegetable consumption.

From the results it may be concluded that physical access to fruits and vegetables through the opening of a locally accessible superstore is not a rate-limiting step in their increased consumption for this population. Improvement of physical access to fruit and vegetables on its own may not be an effective strategy to improve fruit and vegetable consumption and thus health status.

Declaration

I hereby declare that this thesis was prepared as a result of work wholly prepared by myself whilst registered in postgraduate candidature.

Table of contents

List of tables

List of figures

List of publications

Peer reviewed abstracts

Warm DL, Margetts BM, Whelan AR and Wrigley N. Consumption of fruit and vegetables in a 'food desert' in the UK. *Annals of Nutrition and Metabolism* 2001;**45** S1:S182.

Warm DL, Margetts BM, Whelan AR and Wrigley N. Factors affecting and limiting food choice in a 'food desert'. *Proceedings of the Nutrition Society* 2001;**60**:177A.

Warm DL, Margetts BM and Wrigley N. (2002) Interaction between changes in physical access and other factors influencing consumption of fruits and vegetables in a food desert. *Proceedings of the Nutrition Society* (In Press)

Original papers

Wrigley N, Warm DL, Margetts BM and Whelan AR. Assessing the impact of improved retail access on diet in a 'food desert': A preliminary report. *Urban Studies* 2002;**39**:2061-2082.

Whelan AR, Wrigley N, Cannings E and Warm DL. Life in a food desert. *Urban Studies* 2002;**39**:2083-2100.

Wrigley N, Warm DL, Margetts BM. (2002) Deprivation, Diet and Food Retail Access: Findings from the Leeds 'Food Deserts' Study. *Environment and Planning A* (In Press).

List of appendices

Acknowledgements

This PhD thesis has been developed from a project entitled 'Food deserts in British cities' sponsored by the Economic and Social Research Council, and J. Sainsbury plc. This thesis whilst using the same dataset is distinct from the activities associated with the larger project. However, as an individual I have been responsible for the development of the sampling strategy for participant recruitment, the development of the interviewer-administered questionnaires and the respondent completed seven-day checklist, data cleaning and analysis. In addition, and distinct from the larger project, for this thesis I developed the framework of consumption and its subsequent analysis, as well as its other integral parts (the literature review, study aims, objectives and hypothesis, analysis, the discussion and conclusion), and thus do not necessarily reflect on the broader project from which it was derived.

I would like to take this opportunity to convey my thanks and gratitude to a number of people who have helped me with both this thesis and the food deserts project on which this thesis is based. Firstly, I would like to thank my supervisor and mentor Dr Barrie Margetts for his faith, trust and friendship. I am also grateful to my other supervisor Professor Alan Jackson for his useful comments and insights, and for his support of my studentship for this work. I would also like to thank the staff of the Institute of Human Nutrition, in particular Dr Rachel Thompson and Mrs Julie Hickman for their help and support over many years.

With respect to the food deserts project, I would like to thank the Economic and Social Research Council and J. Sainsbury plc for financially supporting the project, Professor Neil Wrigley for his considerable help and many insightful comments and Dr Amanda Whelan who worked alongside me for much of the project.

Finally but certainly not least, I would like to express my thanks, appreciation and love to Debs and Emily without whom this thesis would have been impossible – and it is to you two that I dedicate this work.

Abbreviations

COMA	- Committee on Medical Aspects of Food and Nutrition Policy
FAO	- Food and Agricultural Organization of the United Nations
FES	- Family Expenditure Survey
LIPT	- Low Income Project Team
MAFF	- Ministry of Agriculture Fisheries and Food
NACNE	- National Advisory Committee on Nutrition Education
NDNS	- National Diet and Nutrition Survey
NFS	- National Food Survey
SMR	- Standardised Mortality Ratios
UK	- United Kingdom
WHO	- World Health Organization

1 INTRODUCTION

1.1 Layout of thesis

The layout of this thesis is as follows; chapter one gives an overview of the research, describes a framework used to explore the factors that might influence fruit and vegetable consumption in relation to changes in physical access to fruit and vegetables, and states the hypothesis, aim, objectives and assumptions of the study. Chapter two explores the differences in food intake by age, gender, socio-economic status and geographical region of the country and relates this to inequalities in health. It reviews the published literature on physical access to food and relates this to issues of availability, affordability, attitude and other factors that can potentially affect fruit and vegetable consumption levels. Chapter three describes the study area, study design, research tools and sample size calculations. Chapter four reports on the results obtained from a repeatability study of the respondent administered prospective seven-day food checklist used to investigate the consumption of fruits and vegetables, and discusses the results with respect to the potential impact on the overall study results. Chapter five describes and discusses the cross-sectional results of the first wave data collection (pre-intervention), whilst chapter six reports on the post-intervention results. Chapter seven is a discussion of the overall results and relates the data collected to previously published data. This chapter also discusses the possible limitations of the study, implications of the study and future work. Finally, chapter eight presents the final conclusions of the study.

1.2 The determinants of fruit and vegetable consumption

It is widely acknowledged that there is a clear link between health status and food intake, particularly with respect to fruit and vegetables, and that the inequalities in health that exist in the United Kingdom (UK) at present are underpinned by differences in food intake (Acheson 1998, James et al 1997).

If a Governmental public health aim is to improve well-being through the increased consumption of fruits and vegetables, it is important to examine the factors that may prevent their increased consumption. As will be demonstrated in the first section of the literature review there are wide variations in fruit and vegetable intake in the UK by gender, age, socio-economic status and place of residence. However, on their own none of these factors will determine fruit and vegetable intake but are aspects that must be taken into consideration when analysing how best to try and improve the intakes of fruit and vegetables in the country. Additionally, it is necessary to examine other factors that may impinge on the ability of any individual to consume increased quantities of both fruits and vegetables.

Within the context of this thesis, the role of increased physical access to fruit and vegetables will be primarily examined. Therefore, it is necessary to examine the literature and evidence of the role of physical access to fruit and vegetables in order to try and assess its potential impact. However, it is also necessary to understand the role of other social, cultural and economic factors that may encroach on the decision making process. As a result, in order to effectively determine whether an increase in physical access to fruit and vegetables will lead to their increased consumption, it is important to establish the steps an individual must go through in order to consume fruit and vegetables. This is particularly important as for example Reisig and Hobbiss (2000) point out, that the ease with which people access food is a function of more than geography. Furthermore, as stressed by the Low Income Project Team, food purchasing and consumption patterns are a function not only of physical access, but economic access and availability, as well as constraints such as those set by social/cultural norms, food preparation facilities and practices, nutritional knowledge and motivation to consider health (Department of Health 1996). As Piachaud and Webb (1996, p14) observe, economic and physical access constraints are inextricably linked, '*we can define consumers with restricted choice as those with low incomes and low mobility. If people have low incomes, it is more important for them to have access to good value food, and if they have low mobility then they need to be able to buy food from shops nearby. But it is often the most accessible shops which are most expensive, and the shops which have low prices are more difficult to get to.*' As a result, even if physical access to fruit and vegetables in the study area changes, it is necessary to establish the role of these other factors within a framework of consumption of fruit and vegetables.

By doing this, it is possible to establish whether an increase in physical access to fruit and vegetables (exposure) will lead to a change in fruit and vegetables consumption (outcome), and whether any change in the outcome is actually down to the exposure. In order to test this, a framework has been developed (figure 1.1) that will act as the structure for the second section of the literature review, and the subsequent data analysis and discussion.

1.3 The structure of the framework of fruit and vegetable consumption

Although not explicitly shown in this framework, it is acknowledged that there is a biological imperative in all humans to consume the nutrients contained in fruit and vegetables in order to maintain body function, and that changes in fruit and vegetable consumption and thus the nutrients derived from them will affect health.

The framework starts with the exposure, i.e. changes in physical access to fruit and vegetables. Issues of physical access have become pertinent over the last decade with the dramatic changes in the geography of food shopping. Consequently it is necessary to understand these changes, particularly with respect to 'disadvantaged consumers' such as those with low-incomes or with poor mobility.

If a store is physically accessible, there are then issues with respect to the availability of healthy foods such as fruit and vegetables within the stores. Similarly, the foods available must meet with requirements of social, cultural (including religious) and personal norms and acceptability.

If the food is available, one must have the ability to afford it and so issues of level of income/poverty, the money available for food (i.e. financial elasticity), the cost of food, the relative cost of healthy food and concerns over enough money for food are paramount.

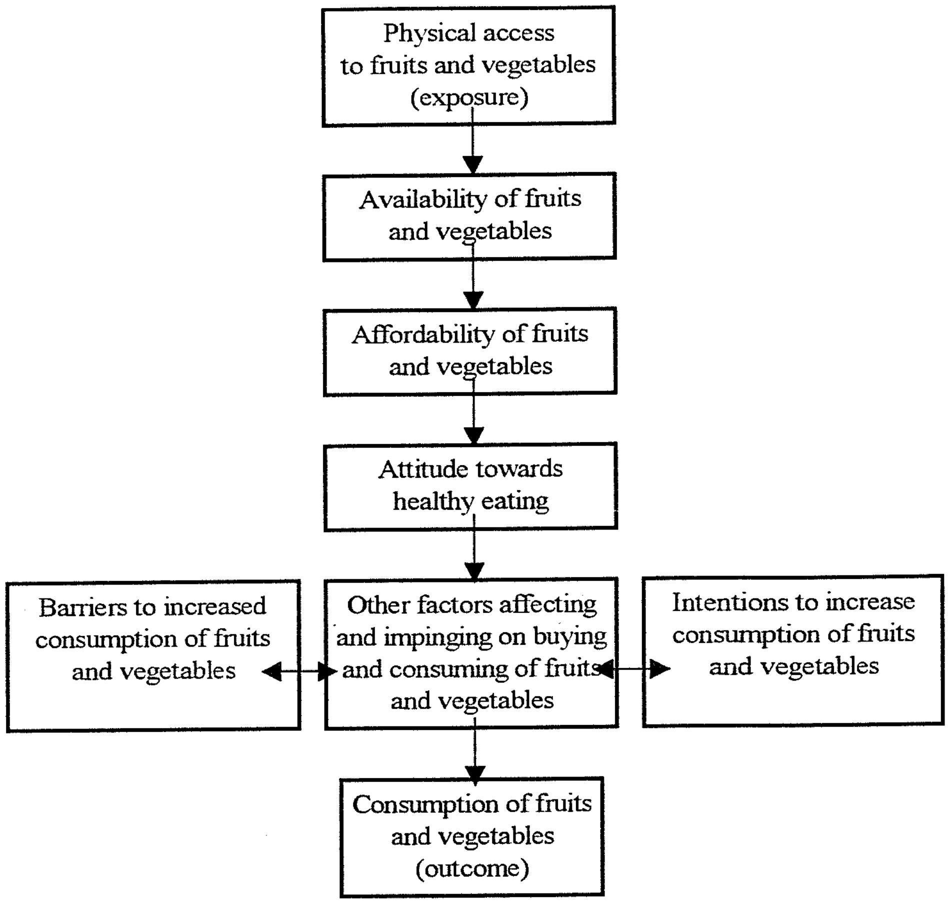
If the money is available, then an individual must want to buy fruit and vegetables. This is underpinned by attitudes towards and knowledge of a healthy diet. This will also be influenced by an array of other factors including self-perception, health and lifestyle factors such as smoking status.

If the suitable attitudes and knowledge are in place then there is the process of actually buying, preparing and consuming the fruit and vegetables. The assumption in this study is that these are one and the same, which may not be true. Features such as having appropriate preparation, cooking and storage facilities, having the time and skills to cook, but also matters of family acceptability, taste and preference, and intra-household distribution will influence these factors.

If all these different stages of access, availability, affordability, attitudinal impact and buying are negotiated, then an individual may be able to consume fruit and vegetables. The arrows in the figure are designed to illustrate the causal route and thus combination of factors that may lead to an increase in fruit and vegetable consumption. However, at each level of the framework, individuals may not undergo a change, and thus a different route and combination of factors will be experienced. There are a possible 32 possible combination of factors ranging from those who experience a positive change to each of the factors in the framework – i.e. in their physical access to fruits and vegetables, their availability of fruits and vegetables, their ability to afford fruits and vegetables, their attitudes towards healthy eating and factors perceived to impinge on the buying and consuming of fruits and vegetables, to those who do not experience any change in any of these factors.

It is perceived that an improvement in a factor in the framework will potentially have a positive influence on a respondents' fruit and vegetable consumption, whilst a respondent not undergoing an improvement in a factor will not have a positive influence on their fruit and vegetable consumption levels. Overall, it may be postulated that only respondents experiencing a positive change in each of the factors will increase their fruit and vegetable consumption.

Figure 1.1: Framework for fruit and vegetable consumption



1.4 Research question

Hypothesis:

People with poor physical access to fruit and vegetables, who have an increase in physical access to fruit and vegetables as a result of the opening of a superstore (exposure) will increase their consumption of fruit and vegetables by 20%, from an average of 2.88 portions per person per day to 3.46 portions per person per day (outcome).

Aim:

To determine whether an increase in physical access to fruit and vegetables through the opening of a locally accessible superstore in an area of low fruit and vegetable consumption will lead to increased consumption of fruits and vegetables.

Objectives:

- To assess changes in the amount of fruits and vegetables consumed.
- To identify those people who have increased their consumption of fruits and vegetables.
- To identify the factors influencing increased fruit and vegetable consumption.

Assumptions of the study:

- Increased physical access to food through the opening of a superstore will lead to changes in food buying.
- Increased physical access to fruit and vegetables through the opening of a superstore will lead to increased consumption of fruits and vegetables.
- Income is not a rate-limiting step in increasing fruit and vegetable consumption.
- Current lower and higher consumers of fruit and vegetables will not increase their consumption by the same relative amount.
- The profile of the people increasing their fruit and vegetable consumption will be different from those who do not increase their fruit and vegetable consumption.

2 LITERATURE REVIEW

The literature review presented may be regarded as having two distinct sections. The first of these deals with what people in the UK should be eating and what they are actually eating, particularly with regard to fruit and vegetable consumption. Additionally, differences by gender, age, socio-economic status and geographic region of the country, will be examined further. Connected to this will be an exploration of the socio-economic differences in health that exist within the UK and linking this to differences in fruit and vegetable consumption.

It is hypothesised that one of the determinants of fruit and vegetable intake and the differences that exist in consumption levels, are differentials in physical access to food shops selling fruit and vegetables. The second section of the literature review will examine the existing evidence on physical access to food and food stores and the possible implications for fruit and vegetable intake. It is acknowledged that physical access may only be part of a larger framework of influences, and so the issues of availability, affordability, attitudes and knowledge, and the buying and consuming of fruit and vegetables will also be explored in relation to physical access.

2.1 Food consumption in the UK

2.1.1 Current dietary recommendations

The Committee on Medical Aspects of Food and Nutrition Policy (COMA), in 1991 published recommended Dietary Reference Values for a range of macro and micronutrients to indicate what levels the UK population should be consuming (Department of Health 1991). These targets in turn have been used as part of the nutritional targets of the policy papers 'Health of the Nation' (Department of Health 1992) and 'Our Healthier Nation' (Department of Health 1999), which include:

- To reduce the average percentage of food energy derived by the population from saturated fatty acids by at least 35% by 2005 (to no more than 11%),
- To reduce the average percentage of food energy derived by the population from total fat by at least 12% by 2005 (to no more than 35%).

However, in order that the population is able to perceive the need for change in order to meet these and other nutritional targets, they need to be in a form that the general public can easily understand. This need for clear understanding by the general population has in part led to the development of food based dietary guidelines. These are guidelines that reflect food patterns rather than 'numerical' nutrient goals (FAO/WHO 1996, Kafatos and Codrington 2000).

Current food based dietary guidelines for the general population in the UK are based on the 'The National Food Guide' produced by the Nutrition Task Force and derived in part from the COMA reference value recommendations (Hunt et al 1995, Wearne and Day 1999). The eight guidelines for the National Food Guide are:

- Enjoy your food,
- Eat a variety of different foods,
- Eat the right amount to be a healthy weight,
- Eat plenty of foods rich in starch and fibre,
- Eat plenty of fruits and vegetables,
- Don't eat too many foods that contain a lot of fat,
- Don't have sugary foods and drinks too often,
- If you drink alcohol, drink sensibly.

The guidelines are supported by a food selection guide entitled 'The Balance of Good Health' which in the form of a tilted plate shows the five types and proportions of foods needed for a balanced and healthy diet. The food categories represented (along with their proportion) are:

- Bread, other cereals and potatoes 33%,
- Fruit and vegetables 33%,
- Meat, fish and alternatives 12%,
- Milk and dairy foods 15%,
- Fatty and sugary foods 8%.

Through the development of the food based dietary guidelines, what the population has been eating should be established, but what are the current dietary intakes and patterns of the UK population?

2.1.2 Current dietary intakes and patterns

Food/dietary assessment methodologies

In order that dietary intakes and patterns can be analysed, it is first necessary to be able to measure what is being consumed. In order to do this, commonly one of three approaches may be used, namely national, household and individual dietary assessment methodologies. Each measures consumption differently, and each possesses inherent advantages and disadvantages.

National data – the most widely used estimate of national food supply is that produced by the Food and Agricultural Organization (FAO) of the United Nations, and is an example of large-scale ecological data. The data produced are annual estimates of the food available per person on a daily basis, although the data reflect food purchasing patterns and food availability rather than intake per se. This type of data may allow time trends to be made and for analysis between countries, although these comparisons may be subject to biases depending on the quality of the data collected at national levels (Hiller and McMichael 1997). Furthermore, it does not allow for analysis of subgroups of the population for example by age or gender.

Household data – this is data where assessment from a 'representative' sample of households is extrapolated to describe the general population. An example of such a survey in the UK would be the annual National Food Survey (NFS), which provides information on household food purchases and their nutritional value. It is the longest running continuous survey of household consumption and expenditure in the world. Approximately 6000 households keep a diary of their household food and drink purchases for one week. The person in the house responsible for most of the food shopping is asked questions about the households' food purchasing practices and is required to keep the diary. An advantage is that it is possible to explore differences in subgroups of the population, for example social class (as assessed by occupation of head of household) and geographical region of the country. Additionally, as the survey is conducted annually it is a great source of trend data.

The NFS and studies like it that assess household consumption, are not able to give a true reflection of how the food is consumed/shared out between members of the household or what their actual food intakes are, they can only be worked out as a mean per person per week (Nelson et al 1985, Nelson 1986). However, the sharing of food may be a necessary strategy particularly when food supplies are limited or inadequate, particularly in low-income families (Wheeler 1991). Additionally, whilst the NFS measures purchases, it does not actually measure intake directly and consequently presumes that all that is bought is eaten and that there is no waste when eating. Therefore, this may lead to the overestimation of the intake of certain food groups, for example fruits and vegetables, whilst conversely it may underestimate certain aspects of food consumption, as it may not take into account foods eaten outside the home (Nelson and Bingham 1997).

One further source of information in the UK that can be used to assess social differences on income, expenditure and food is the Family Expenditure Survey (FES). As with the NFS it is an annual survey with a sample size of approximately 10,000 households. The aim of the FES is to provide information on household and personal incomes, but also all expenditures including money spent on food. Information is generally sought from the head of household, but all members of the household aged 16 and over are asked to record any expenditure made over a 14-day consecutive period.

Individual data – this is data collected either prospectively or retrospectively from individuals on their own food consumption. Both the methodologies have their intrinsic advantages and disadvantages. Prospective methodologies allow current diet to be measured and does not rely on memory. However, they can be labour intensive. Retrospective methodologies can be less labour intensive but do rely on memory (Nelson and Bingham 1997).

In the UK, the Food Standards Agency (and formerly the Ministry of Agriculture Fisheries and Food) conducts nationally representative studies on age specific groups within the population, called the National Dietary and Nutritional Survey (NDNS). Thus far, the groups studies have been adults aged 16 to 64 years (Gregory et al 1990), children aged 1½ to 4½ years (Gregory et al 1995), people aged 65 years and over (Finch et al 1998) and young people aged 4 to 18 years (Gregory et al 2000).

The survey of this type that is quoted most in this thesis is the NDNS of British adults conducted in 1986/1987. This study collected prospective seven-day dietary records from 2197 subjects. Because of the sampling strategy used, it allows for both socio-economic (social class as assessed by occupation of head of household) and regional differences to be explored in terms of both intake and percentage of consumers, although the data does not allow for exploration of dietary differences between gender groups (Gregory et al 1990, Ministry of Agriculture Fisheries and Food 1994). However, as the surveys are cross-sectional in design it is not possible to evaluate changes in intake over periods of time and do not allow causality to be determined (Cade 1997).

2.1.3 Data of food consumption in the UK

For the purposes of this thesis, data from the NFS will be used, primarily as it enables the review of food consumption data trends, which is critical in order to analyse how food consumption patterns are changing in the UK. Furthermore, it allows examination of a greater age range at particular points in time, which the NDNS surveys do not allow, and finally the sample size is larger which allows the data to be disaggregated more easily.

The dietary guidelines are an expression of a healthy balanced diet the population of the UK should be eating, but what do people in the UK actually eat? Data on the following groups will be examined:

- The population as a whole, including trends of food intake of the population,
- Gender differences,
- Age differences,

- Socio-economic differences,
- Regional differences.

2.1.3.1 The population as a whole

According to the NFS (Ministry of Agriculture, Fisheries and Food 2000) results for 1999, the average expenditure on household food in Great Britain was £14.75 per person per week. The biggest expenditure was meat and meat products £3.80, followed by cereal products £2.71, vegetable and vegetable products (including potatoes and potato products) £2.34 (£1.48 when potatoes and potato products excluded), and fruit and fruit products £1.34.

In terms of gram values, the average person per week consumes 2007ml of milk and cream, 1966g of vegetable and vegetable products (including potatoes and potato products), 1095g of vegetable and vegetable products when excluding potatoes and potato products, 1464g of cereal products and 1063g of fruit and fruit products. For vegetables (excluding potatoes and potato products) and fruit, this equates to approximately 2.0 and 1.9 portions per person per day, although this does not take into account the non-edible portions. Additionally, on average each person per week also consumes 104g cheese, 912g of meat and meat products, 144g fish, 1.68 eggs, 186g fats and oils, and 141g of sugar and preserves.

Trends in consumption in the UK

Figures 2.1 and 2.2 as well as table 2.1, show the trends in consumption of food groups and key target micronutrients (percentage food energy from total fat and percentage food energy from saturated fat). Table 2.1 shows that over the last decade or so the contribution of food groups to total food energy has changed little, although there has been an increase in cereals from 31% to 36% and reduction in fats and sugars/preserves from 14% and 6% respectively to 11% and 4% respectively.

Table 2.1: Contribution made by groups of foods to household energy intake in selected years according to the National Food Survey						
	1989		1998		1999	
Food group	kcal	%*	kcal	%*	kcal	%*
Milk and cream	202	10	179	10	175	10
Cheese	62	3	54	3	54	3
Meat and meat products	311	16	254	15	246	15
Fish	31	2	27	2	27	2
Eggs	24	1	19	1	18	1
Fats	277	14	192	11	182	11
Sugar and preserves	122	6	81	5	73	4
Vegetables	187	10	187	11	183	11
Fruit	71	4	79	5	78	5
Cereals	605	31	610	35	604	36
Other foods	50	3	54	3	53	3
Total food	1941	100	1736	100	1693	100

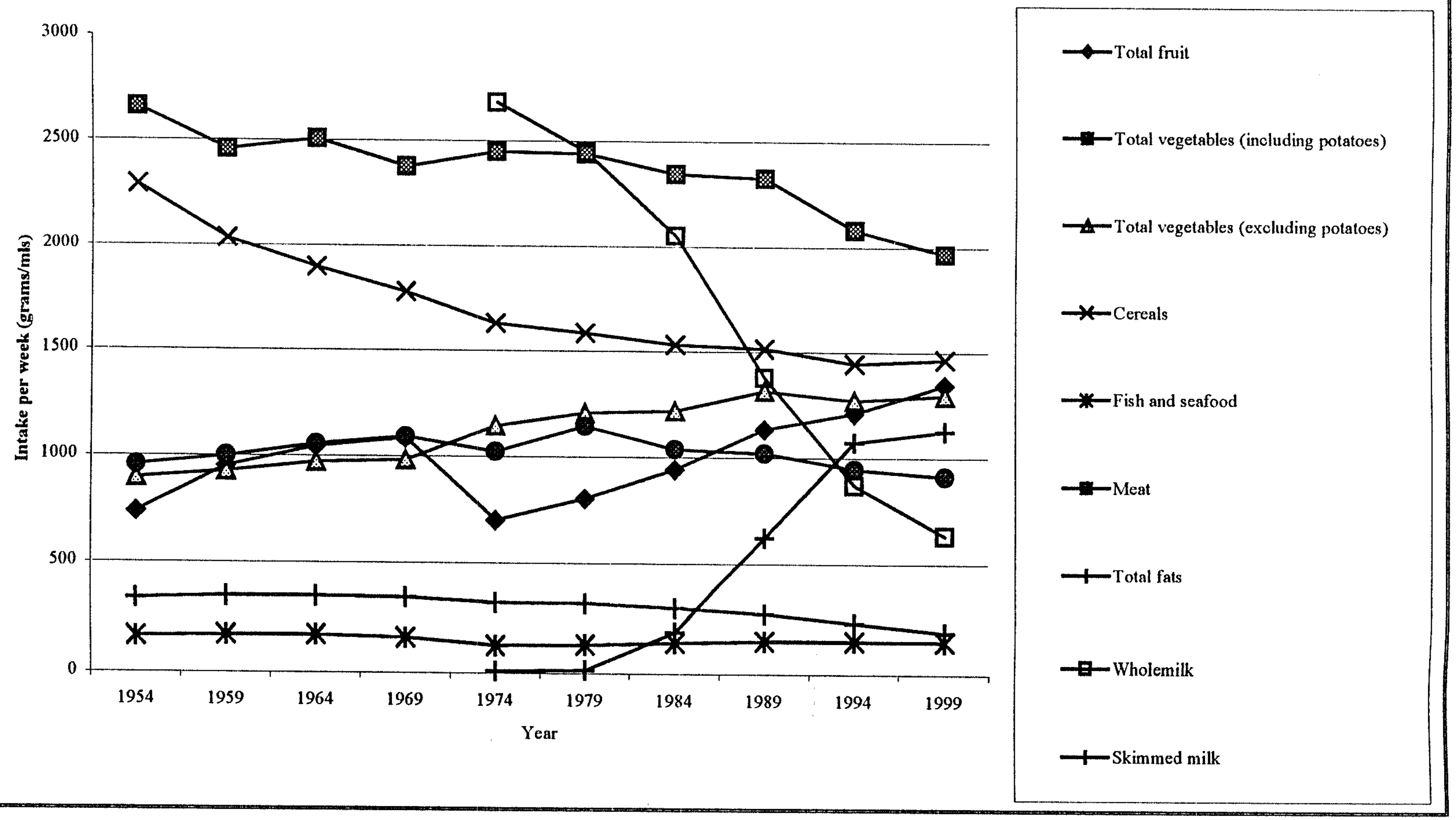
*percentage contribution to total food energy (Ministry of Agriculture, Fisheries and Food 2000)

Data from the NFS (figure 2.1) suggests that the amounts of fruit and vegetables (excluding potatoes) being consumed per person are increasing steadily. However, as a nation the UK has one of the lowest intakes of fruits and vegetables in Europe (Lagiou et al 1999). The population target and recommendations for the UK are based around eating at least five portions (or 400g) of fruits and vegetables a day (excluding potatoes and potato products), although the World Cancer Research Fund advocates a higher level of 400g to 800g per day (five to 10 portions per day) (World Cancer Research Fund 1997). Indeed with current trends the target of at least five portions of fruits and vegetables per day will not be met until the year 2047.

In terms of achieving the Health of the Nation targets regarding percentage energy from total fat and saturated fat, figure 2.2 shows the trends over the last 10 years. Whilst there has been a decline in both of these, the targets are still some way from being met. Changes in dietary practices are therefore needed in order to help meet these targets.

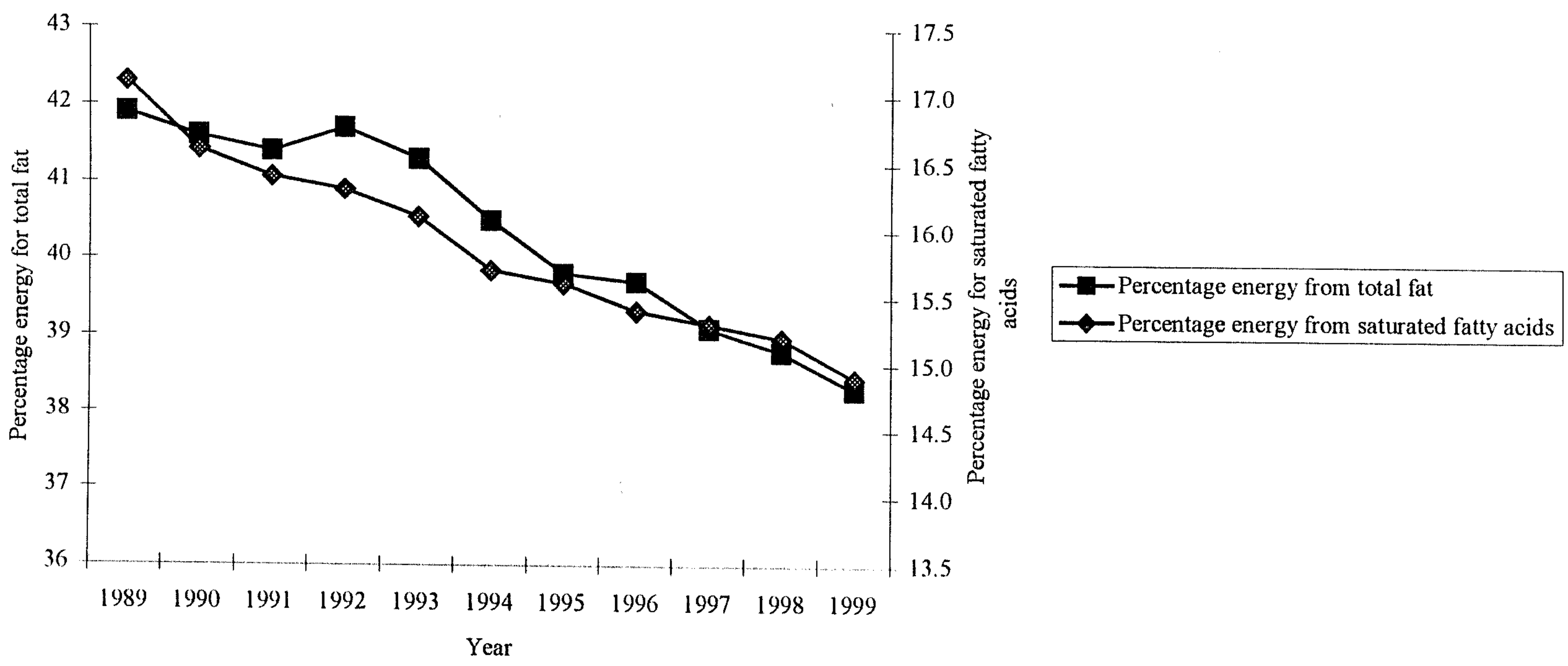
However, this overview does not show the variation there is in consumption of population subgroups. Some groups do meet (or are closer to) the targets, whilst others are falling short. To illustrate this, differences in gender, age and socio-economic groups will be examined as will regional differences.

Figure 2.1: Food group intake per person per week according to National Food Survey



(Adapted from Ministry of Agriculture, Fisheries and Food 2000)

Figure 2.2: Trends in percentage energy from fat and saturated fatty acids according to the National Food Survey



(Adapted from Ministry of Agriculture, Fisheries and Food 2000)

2.1.3.2 Gender differences

Whilst the NFS data does not allow for exploration of gender differences, other data sources do suggest there are consumption differences between the sexes. Evidence from the 1986 NDNS of British adults (table 2.2) shows that whilst the percentage of consumers from both sexes is similar for most food groups, there are differences particularly for some of the 'healthier' choices. For example, women reportedly consume more semi or skimmed milk, low fat spreads, and fruit than men (Gregory et al 1990).

Table 2.2: Percentage of consumers and mean gram weight of intake by gender, of foods according to 1986 National Dietary and Nutritional Survey of British Adults

	Men		Women	
	Percentage of consumers	Mean gram weight of consumers	Percentage of consumers	Mean gram weight of consumers
Whole milk	89	1440	87	1166
Semi skimmed milk	21	1324	54	953
Skimmed milk	15	1036	21	951
Butter	57	88	62	69
Polyunsaturated margarine	34	98	32	67
Low fat spread	18	99	21	67
Apples and pears	51	381	59	336
Oranges and citrus fruits	24	248	31	265
Bananas	26	212	37	194
Other fruits	38	284	49	308
Peas	73	179	71	131
Carrots	61	131	58	109
Leafy green vegetables	62	198	62	161
Other vegetables	88	341	88	289

(Gregory et al 1990)

Other studies demonstrate that gender differences exist particularly for the intake of fruit and vegetables. These studies have shown that women are more likely to be higher consumers of fruit and vegetables (Margetts et al 1998, Thompson et al 1999) and that their frequency of consumption is also higher – 84% of women eat fruit more than once a day compared to 53% of men, whilst 51% of women eat salad or vegetables or salad more than once a day compared to 32% of men (Office of Population Censuses and Surveys 1996).

Evidence from the UK (East Anglia) arm of the European Prospective Investigation of Cancer (EPIC) also suggests that apart from differences in fruit and vegetable intake, men eat red and processed meats, meat pies, eggs, milk, bread, 'other' cereal products, cakes, potatoes, tea, alcohol and sugary foods significantly more frequently than women, although women's frequency of consumption of 'other' milk products is greater (Fraser et al 2000).

2.1.3.3 Age differences

If the 1999 NFS is used to explore age differences (table 2.3), it can be seen that older age groups spend considerably more on food than younger groups – for example at the extremes of expenditure, those aged 55 to 64 years spend nearly 175% compared to those aged less than 25 years - £18.36 against £10.54. Whilst there is differences in the absolute spend per food group particularly for fruits and vegetables, when these are expressed in terms of percentage of total expenditure, there are relatively few variations between ages.

However, in terms of consumption there is a strong age gradient, with 55 to 64 years olds eating twice as much fruit and fruit products, and vegetables as those under 25 – 5.1 portions per day compared 2.4 portions per day. Furthermore, this youngest age group are most likely to consume whole milk rather than skimmed or semi skimmed milk, although they are more likely to use low or reduced fat spreads than butter and traditional margarines.

Table 2.3: Expenditure and consumption of food groups by age of diary holder according to 1999 National Food Survey

	<25 years	25 to 34 years	35 to 44 years	45 to 54 years	55 to 64 years	65 to 74 years	≥75 years
Expenditure (£) per week							
Total	10.54	12.08	13.43	16.80	18.36	17.66	15.83
Meat – carcass and products	2.60 (25)	2.90 (24)	3.23 (24)	4.61 (27)	5.02 (27)	4.30 (24)	3.80 (24)
Cereals*	2.34 (22)	2.52 (21)	2.70 (20)	2.87 (17)	2.87 (16)	2.92 (17)	2.57 (16)
Vegetables (inclusive)†	1.92 (18)	2.03 (17)	2.21 (16)	2.69 (16)	2.86 (16)	2.50 (14)	1.97 (12)
Vegetables (exclusive) ‡	1.09 (10)	1.19 (10)	1.32 (10)	1.78 (11)	1.91 (10)	1.72 (10)	1.32 (8)
Fruit & fruit products	0.71 (7)	0.96 (8)	1.16 (9)	1.60 (10)	1.78 (10)	1.78 (10)	1.10 (7)
Consumption (grams) per week							
Milk and cream (ml)	1596	1848	1878	2018	2299	2414	2336
Vegetables (inclusive) †	1359	1472	1772	2255	2710	2494	1943
Vegetables (exclusive) ‡	704	827	948	1289	1501	1435	1115
Cereals*	1186	1249	1414	1528	1698	1809	1532
Fruit & fruit products	626	768	948	1241	1367	1406	1333
Portions of fruit and vegetables per day Φ	2.4	2.8	3.4	4.5	5.1	5.1	4.4

(Ministry of Agriculture, Fisheries and Food 2000). Figures in parentheses are percentage of total expenditure. *Cereals include bread, †Includes potatoes and potato products, ‡Excludes potatoes and potato products. Φ derived from gram weights of vegetables (exclusive) and fruit & fruit products

2.1.3.4 Regional differences

Evidence from the 1999 NFS (tables 2.4 to 2.6) implies that people in England spend £1.47 (11%) more per person per week on food than those living in Wales. Additionally, the data suggests that within England there is a 'North-South' divide in terms of the amount of expenditure on food, with those people in the South East spending £3.99 (25%) more than those people in the North East. However, overall there is little difference between the regions in terms of the percentage of total expenditure spent on specific food groups, although those people in the South do spend slightly more as a percentage on fruit and fruit products.

People living in England generally have higher intakes of vegetables (excluding potatoes) and fruit, and lower intakes of meat, whole milk and white bread. Within England, there is some evidence of a 'North-South divide' with greater consumption of vegetables, cereal products, and fruit & fruit products. Evidence of the regional differences in food intake has been found in other large-scale studies as well (for example Gregory et al 1990, Family Expenditure Survey 2000, Whichelow et al 1991).

There appears to be little literature on the differences of food intakes within cities, but the evidence that does exist suggests that intakes within areas of cities can differ significantly. Forsyth et al (1994) found that within Glasgow there was a significant variation between neighbourhoods (after controlling for sex, age and social class) in the consumption of fruit and vegetables, bread, fats and alcohol. Cade et al (1988) found that within three English towns there was an inverse relationship between socio-economic status and the mean daily intake of fat.

Table 2.4: Average expenditure of food groups by Government Office Region according to 1997- 1999 National Food Survey

	North East	North West	Yorkshire & Humberside	East Midlands	West Midlands	East	London	South East	South West
Expenditure (£) per week									
Total	12.78	14.18	13.52	13.80	13.70	15.44	15.96	16.77	15.11
Meat – carcass and products	3.48 (27)	3.93 (28)	3.65 (27)	3.57 (26)	3.15 (23)	3.72 (24)	3.62 (23)	3.97 (24)	3.81 (25)
Cereals*	2.49 (19)	2.63 (19)	2.49 (18)	2.64 (19)	2.46 (18)	2.82 (18)	2.94 (18)	2.99 (18)	2.70 (18)
Vegetables (inclusive)†	1.97 (15)	2.17 (15)	2.06 (15)	2.16 (16)	2.28 (17)	2.49 (16)	2.75 (17)	2.66 (16)	2.44 (16)
Vegetables (exclusive) ‡	-	-	-	-	-	-	-	-	-
Fruit & fruit products	0.94 (7)	1.16 (8)	1.05 (8)	1.13 (8)	1.17 (9)	1.55 (10)	1.74 (11)	1.69 (10)	1.47 (10)

(Ministry of Agriculture, Fisheries and Food 2000).
Figures in parentheses are percentage of total expenditure
*Cereals includes bread, †Includes potatoes and potato products, ‡Excludes potatoes and potato products

Table 2.5: Average consumption of food groups by Government Office Region according to 1997- 1999 National Food Survey

	North East	North West	Yorkshire & Humberside	East Midlands	West Midlands	East	London	South East	South West
Consumption (grams) per week									
Milk and cream (ml)	1905	2018	2080	2081	1998	1935	1823	2131	2024
Vegetables (inclusive) †	1863	1835	1952	2025	1977	2018	2035	2045	2112
Vegetables (exclusive) ‡	998	953	1110	1136	1093	1107	1218	1180	1245
Cereals*	1481	1423	1404	1534	1423	1482	1512	1505	1443
Fruit & fruit products	827	949	939	976	993	1171	1235	1252	1250
Portions of fruit and vegetables per day Φ	3.3	3.4	3.7	3.8	3.7	4.1	4.4	4.3	4.5

(Ministry of Agriculture, Fisheries and Food 2000)
*Cereals includes bread, †Includes potatoes and potato products, ‡Excludes potatoes and potato products
Φ derived from gram weights of vegetables (exclusive) and fruit & fruit products

Table 2.6: Average expenditure and consumption of food groups by Region according to 1997- 1999 National Food Survey

	England	Wales	Scotland	Northern Ireland
Expenditure (£) per week				
Total	14.84	13.37	14.68	13.97
Meat – carcass and products	3.77 (25)	3.91 (29)	4.04 (28)	4.11 (29)
Cereals*	2.72 (18)	2.35 (18)	2.87 (20)	2.68 (19)
Vegetables (inclusive)†	2.38 (16)	2.09 (16)	2.12 (14)	2.12 (15)
Vegetables (exclusive) ‡	-	-	-	-
Fruit & fruit products	1.37 (9)	1.06 (8)	1.21 (8)	1.06 (8)
Consumption (grams) per week				
Milk and cream (ml)	2007	1979	2018	2298
Vegetables (inclusive) †	1989	1989	1713	2251
Vegetables (exclusive) ‡	1121	986	882	841
Cereals*	1468	1383	1479	1473
Fruit & fruit products	1091	844	917	842
Portions of fruit and vegetables per day Φ	4.0	3.3	3.2	3.0

(Ministry of Agriculture, Fisheries and Food 2000)

*Cereals includes bread, †Includes potatoes and potato products, ‡Excludes potatoes and potato products

Φ derived from gram weights of vegetables (exclusive) and fruit & fruit products

2.1.3.5 Socio-economic differences

Socio-economic status may be measured a number of ways including social class, income, education, deprivation, occupation. However, irrespective of how socio-economic status is measured there is consistent evidence that people from lower socio-economic groups have the worst diets – they consume less fibre (e.g. Bolton-Smith et al 1991, Hulshof et al 1991, Hupkens et al 1997 & 2000, Kushi et al 1988, Roos et al 1996), more fat (e.g. Bolton-Smith et al 1991, Erkkilä et al 1999), and less vitamins and minerals (e.g. Block et al 1988, Bolton-Smith et al 1991, Haste et al 1990).

Foods

According to the 1999 NFS there is a consistent gradient between the amount spent on food and drink and weekly household income, for example, households with an income of £655 and over spend £18.28 per person per week, whilst those households with an income of under £165 spend £12.76 per person per week. The households with higher incomes spend less as a percentage on meat and meat products, milk and cream, but more on vegetables (excluding potatoes) and fruit & fruit products (table 2.7).

In terms of consumption, higher income households consume more wholemeal bread, vegetables and fruit & fruit products, less white bread and milk & cream (in particular whole milk) (table 2.7). Additionally, high-income groups used considerably less fats and oils, sugar and preserves, potatoes, tea and whole milk, whilst consuming more breakfast cereals, cheese and alcohol (data not shown).

This type of pattern of food consumption has been found consistently with many other studies of socio-economic status in the UK, including the NDNS survey of adults (Gregory et al 1990, Pryer et al 2001), the UK Women's Cohort Study (Greenwood et al 2000), the Health and Lifestyle survey (Whichelow 1989) and the Whitehall II study (Marmot 1991). Furthermore, there is also a consistent pattern with other countries, for example, Erkkilä et al (1999), Hulshof et al (1991) and Roos et al (1996) in Europe, and Smith and Baghurst (1992), Steele et al (1991), and Turrel (1998) in Australia.

Fruits and vegetables

Wynn (1987, p79) states '*Of all the many possible nutritional factors the strongest inverse correlates with death-rates within the United Kingdom and in other developed countries are the consumption of fresh vegetables and fruit.*' Equally, a diet high in fruit and vegetables is strongly correlated with healthy dietary habits (Thompson et al 1999).

Whilst it has been shown that as a nation the UK does not consume enough fruits and vegetables, this hides strong socio-economic variations in intake. As has been shown above, households with the highest income consume 4.9 portions of fruit and vegetables per day compared to 3.3 portions for households with the lowest income. This difference is particularly striking if fruit & fruit product consumption is examined, with twice as much being consumed in high-income households compared to low-income households (1524g compared to 793g) (tables 2.7 and 2.8). The percentage spend is also significantly different – 12% for both vegetables (excluding potatoes) and fruit & fruit products for higher-income households, compared to 10% and 7% respectively for lower-income households.

To further demonstrate these large socio-economic differences, data from the NDNS of adults in 1986 shows that for socio-economic groups, I and II (high), III non-manual, III manual (intermediates), IV and V (low) the average daily consumption for men and women was 302g, 267g, 212g and 192g respectively. This is equivalent to approximately 3.8, 3.3, 2.7 and 2.4 portions per person per day. Indeed, this pattern of consumption is reflected in evidence from the Health Survey for England on the proportion of people eating fruit and vegetables more than once a day (Office of Population Censuses and Surveys 1996) (table 2.9). For example people from socio-economic groups I and II consume fruit and vegetables more than once a day between six and 13% more than individuals from socio-economic groups IV and V.

Table 2.7: Expenditure on food items by gross weekly income of head of household according to 1999 National Food Survey

	Households with one or more earners				*Households with no earners*		*OAP*
	≥£655	**£345 to £655**	**£165 to £345**	**<£165**	**≥£165**	**<£165**	-
Total Expenditure (£) per week	18.28	14.98	13.26	12.76	19.09	12.26	15.32
Food items (£) per week							
Meat and meat products	4.21 (23)	3.90 (26)	3.63 (27)	3.31 (26)	4.68 (25)	3.05 (25)	3.93 (26)
Milk and cream	1.43 (8)	1.31 (9)	1.20 (9)	1.25 (10)	1.69 (9)	1.21 (10)	1.48 (10)
Vegetables (inclusive) †	3.06 (17)	2.45 (16)	2.14 (16)	2.14 (17)	2.79 (15)	1.91 (15)	1.94 (13)
Vegetables (exclusive) ‡	2.20 (12)	1.55 (10)	1.25 (9)	1.27 (10)	1.96 (10)	1.10 (9)	1.21 (8)
Cereals*	0.77 (4)	0.72 (5)	0.66 (5)	0.65 (5)	0.88 (5)	0.64 (5)	0.83 (5)
Fruit & fruit products	2.21 (12)	1.39 (9)	1.00 (8)	0.94 (7)	2.22 (12)	0.85 (7)	1.37 (9)
Semi/skimmed milk	0.58	0.56	0.50	0.49	0.75	0.47	0.63
Whole milk	0.19	0.24	0.30	0.38	0.33	0.40	0.50
Butter & margarines	0.15	0.10	0.11	0.11	0.23	0.12	0.26
Low/reduced fat spreads	0.10	0.12	0.13	0.12	0.18	0.13	0.18
White bread	0.21	0.25	0.27	0.30	0.27	0.31	0.39
Brown and wholemeal bread	0.16	0.12	0.10	0.11	0.25	0.12	0.21

(Ministry of Agriculture, Fisheries and Food 2000)

Figures in parentheses are percentage of total expenditure *Cereals includes bread, †Includes potatoes and potato products, ‡Excludes potatoes and potato products

Table 2.8: Consumption of food groups by gross weekly income of head of household according to 1999 National Food Survey

	Households with one or more earners				*Households with no earners*		*OAP*
	≥£655	**£345 to £655**	**£165 to £345**	**<£165**	**≥£165**	**<£165**	-
Consumption (grams) per week							
Milk and cream (ml)	1799	1899	1901	2149	2402	2192	2380
Vegetables (inclusive) †	1952	1877	1876	2069	2373	1984	2178
Vegetables (exclusive) ‡	1208	1075	1001	1047	1416	1050	1142
Cereals*	1402	1401	1400	1503	1622	1606	1684
Fruit & fruit products	1524	1095	850	793	1656	777	1133
Portions of fruit and vegetables per day Φ	4.9	3.9	3.3	3.3	5.5	3.3	4.1

(Ministry of Agriculture, Fisheries and Food 2000)

*Cereals includes bread †Includes potatoes and potato products, ‡Excludes potatoes and potato products, Φ derived from gram weights of vegetables (exclusive) and fruit & fruit products

Table 2.9: Percentage of socio-economic groups eating fruit and vegetables or salad more than once a day				
	Percentage eating fruit more than once a day		Percentage eating vegetables or salad more than once a day	
Socio-economic group	Male	Female	Male	Female
I and II (Professional and Managerial/technical)	17	29	12	21
IIIN (Non manual skilled)	13	21	8	12
IIIM (Manual skilled)	12	18	6	10
IV and V (Partly skilled and unskilled)	11	16	6	8

(Office of Population Censuses and Surveys 1996)

Billson et al (1999) demonstrated using data from the NDNS of adults, that respondents receiving benefits were three times as likely to be a low consumer of fruits and vegetables than a higher consumer. Further evidence for low fruit and vegetable consumers may be sought from the Health Education Authority's 1993 Health and Lifestyle Survey of England 1993. Whilst sex (male), age (young) and smoking status (current smoker) were the most significant predictors of low consumption, other significant predictors were the lack of education, not having access to a car, being unemployed or in a manual occupation, or be receiving family credit (Margetts et al 1998, Thompson et al 1999).

Irala-Estevez et al (2000) in a systematic review of studies from across Europe, found that pooled mean differences between socio-economic groups as assessed by level of education and occupation, were in the region of between 24 and 34g per person per day for fruit and 17g per person per day for vegetables - approximately equating to over half a portion difference per day. In a similar study by Roos et al (2000), it was found that both fruit and vegetable consumption were positively associated with level of education for nearly all countries in Europe. The only negative associations were found in Southern European countries where mean fruit and vegetable is consistently highest across all population groups. Other studies that have shown a socio-economic gradient for fruit and vegetable intake include Gerhardy et al (1995), Johansson et al (1999), Marmot et al (1991), Prevost et al (1997), Roos et al (1996) and Wandel (1995).

Summary

In conclusion, whilst it has been shown that as a nation the UK is changing its food consumption pattern it has not yet reached the target of national goals and guidelines. Fruit and vegetable consumption is a prime example of this, where current intake estimations are in the region of three portions per person per day, (representing a significant increase over recent years), but fall well below the five portion a day targets. However, within the population there are major differences in intake by gender, age, region and socio-economic status, with women, older age groups, those living in the South of England and those with a higher socio-economic status generally having higher intakes of fruits and vegetables. Indeed, these patterns appear consistent between different data sources; for example, household surveys such as the NFS and individual/cross-sectional surveys such as the NDNS of British Adults.

If there are such big differences within the population in terms of fruit and vegetable intake, it is necessary to establish why. Could physical access to fruits and vegetables be a factor in the variation in their consumption?

2.2 Health in the UK

2.2.1 The link between diet and health

There is much evidence that an individuals' diet is linked directly to their health status.

Fruits, vegetables and health

The Government White Paper – 'Our Healthier Nation' estimates that there are 90,000 deaths each year in the UK of people under the age of 65 (i.e. premature death), of which more than 32,000 are due to cancer and 25,000 to heart disease, strokes and related illness (Department of Health 1999). In the European Union as a whole, cardiovascular disease accounts for 42% of all deaths, whilst cancer accounts for 29% of all deaths in men and 22% of all female deaths (Working Paper of the French Presidency 2000). Diet is implicitly involved in many of these deaths, with approximately 30 to 40% of cancer deaths and at least one third of cardiovascular deaths being attributed to dietary factors (Eurodiet 2000, Department of Health 1998 and World Cancer Research Fund 1997).

In particular and with respect to this thesis, there is a large body of evidence suggesting that the higher consumption of fruits and vegetables is associated with a lower risk of many chronic diseases including many sites with cancer and cardiovascular diseases (e.g. Block et al 1992, Department of Health 1998, National Heart Forum 1997, Ness and Powles 1996, World Cancer Research Fund 1997). The World Cancer Research Fund (1997) found convincing evidence for a relationship between lower fruit and/or vegetable intakes and higher risk of cancer of the mouth and pharynx, oesophagus, lung, stomach, colon and rectum. The COMA committee report into the nutritional aspects of the development of cancer (Department of Health 1998) is slightly more conservative in claiming that there is moderate evidence that higher vegetable consumption would reduce the risk of colorectal cancer, and that higher fruit and vegetable consumption would reduce the risk of gastric cancer. Nonetheless, the COMA committee did recommend that fruit and vegetable consumption in the UK be increased.

In a study by van't Veer et al (2000), it was estimated that an increase in consumption of 150g a day of fruit and vegetables (based on current Dutch intakes of 250g a day, which are similar to intakes in the UK) would on average reduce cancer incidence by 19% (best guess) and cardiovascular disease incidence by 16% (best guess). For Europe as a whole, if targets of 400g per day of fruits and vegetables were met, depending on the relative risk of the disease, nearly 90,000 deaths may be prevented of people aged under 65 years, including approximately 30,000 deaths due to ischaemic heart disease and 11,000 due to cerebrovascular disease (Joffe and Robertson 2001).

There are a number of different rationales for the effect of fruit and vegetable intake on health, but at present the exact mechanisms by which fruits and vegetables work or the specific beneficial factors they contain are not clear. Willett (1999) in explaining the difference between vegetarians and non-vegetarians proposes three possibilities – firstly it could be due to better non-dietary lifestyle factors such as lower prevalence of smoking; secondly it could be due as a result of lower intakes of harmful dietary components; and thirdly it could be as a result of increased intakes of beneficial dietary components such as fruits and vegetables. Whilst, Willett recognises that the first two possibilities do have an effect, he also acknowledges that increased intake of beneficial dietary factors are vitally important. This approach has also been highlighted elsewhere (e.g. Appleby et al 2002, Riboli and Norat 2001).

The possible components of fruit and vegetables and by which fruits and vegetable influence health often highlight the micronutrients, in particular antioxidants such as ß-carotene, Vitamin C, and Vitamin E, but may also involve other factors such as the high dietary fibre content of fruits and vegetables (National Heart Forum 1997, World Cancer Research Fund

1997). Lampe (1999) in an overview of potential disease prevention mechanisms highlights eight possible ways in which fruits and vegetables may work, namely: antioxidant activity; modulation of detoxification enzymes; stimulation of the immune system; decrease in platelet aggregation; alteration in cholesterol metabolism; modulation of steroid hormone concentrations and hormone metabolism; blood pressure reduction; and antibacterial and antiviral activity. Much effort is currently being put in to assessing what constituents of fruits and vegetables affect health and how, but the scope is wide and will be difficult to disentangle (Willett 1999). Work is also being carried out in order establish if fruits and vegetables act in the same manner and both affect health in the same ways.

2.2.2 Differences in health

Whilst there are mortality and morbidity differences in terms of gender and age, some of most significant differences in health in the UK are those between different regions of the country and socio-economic groupings. One rationale for this is differences in diet (James et al 1997).

Regional differences in health

Mortality rates in the UK vary by region – for example the all cause death rate per 1,000 populations in 1994 was 10.7 but varied from 9.2 in Northern Ireland to 11.6 in both Wales and Scotland, with England in between at 10.6 (Office of Health Economics 1997). Additionally, within the English regions and health authorities there are also large variations in mortality (table 2.10) (Department of Health 1997). In general there appears to be a 'North-South' divide, with higher standardised mortality ratios (SMR) in the north – the highest SMRs are all found in regional health authorities in the north and the lowest in the south. Furthermore, within regions (in this case Northern & Yorkshire) there also appears to be differences between health authorities (table 2.10).

It is important to acknowledge that there are significant differences in health not only on large-scale areas (nationally or regionally), but also at local levels, i.e. within a city, and can be largely dependent on individuals' living conditions and lifestyles (Saul and Payne 1999, Takano and Nakamura 2001). For example, within Leeds (part of Northern and Yorkshire) for the years 1991 to 1995, the SMR for the outer city (in prosperous areas) was 92, whilst the more deprived inner city had an SMR of 115. The differences are even more marked for heart disease and cancer, with certain wards having an SMR of over 190 (Leeds Health Authority 1999) (table 2.11).

Table 2.10: Standardised mortality ratios for years 1993 to 1995 by selected disease and geographical location				
	All cause mortality	Ischaemic heart disease	Cerebrovascular disease	Female breast cancer
Country				
England†	100	100	100	100
Region				
Northern & Yorkshire	107	113	109	94
Trent	101	105	104	105
Anglia & Oxford	86	88	94	104
North Thames	100	92	86	101
South Thames	93	88	92	101
South West	88	91	95	99
West Midlands	102	105	110	102
North West	116	116	111	96
Regional Health Authority (within Northern & Yorkshire)				
Bradford	111 (70)	110 (74)	113 (85)	94 (23)
County Durham	114 (79)	126 (92)	120 (95)	91 (9)
East Riding	101 (58)	104 (61)	98 (47)	98 (43)
Gateshead & South Tyneside	120 (89)	123 (89)	107 (65)	91 (11)
Leeds	101 (60)	100 (54)	89 (19)	89 (7)

(Department of Health 1997) † Figure of 100 for England is baseline

Table 2.11: All age standardised mortality ratio for 1991 to 1995 for Leeds Health Authority				
Area	All cause mortality	Coronary heart disease	All cancers	Lung cancer
Leeds	101	103.7	101.6	117.1
Inner City	115	117.8	118.2	163.7
Outer City	92	97.7	94.5	97.2

(Leeds Health Authority 1999)

Socio-economic differences in health

People with lower socio-economic status have significantly higher rates of both morbidity and mortality (e.g. Blane et al 1997, Davey Smith et al 1990, Lynch et al 1997, Marmot et al 1991, Macintyre et al 1998, Rose and Marmot 1981). Furthermore, in recent years in the UK there has been a sharp increase in these inequalities between socio-economic groups (Acheson 1998, Wilkinson 1997), a trend that is being reflected in other European countries (Halldórsson et al 2000, Van Rossum et al 2000, Villanueva and García 2000).

To illustrate the widening divide between socio-economic groups, examination of all cause mortality figures for men aged 20-64 years in the early 1970s and 1990s should be noted (table 2.12) (Acheson 1998). As can be seen the mortality rate in the early 1970s amongst these men was almost twice as high for those in class V compared to those in class I. However, by the beginning of the 1990s, it was almost three times higher.

Table 2.12: All cause mortality and reduction in all cause mortality by socio-economic status

Socio-economic status	Year (all cause mortality rates per 100,000)		Reduction in all cause mortality
	1970-72	1991-93	(Percentage)
I – Professional	500	280	44%
II – Managerial and Technical	526	300	43%
III (N) – Skilled (non-manual)	637	426	33%
III (M) – Skilled (manual)	683	493	28%
IV – Partly skilled	721	492	22%
V - Unskilled	897	806	10%
England and Wales	624	419	33%

(Acheson 1998)

Work in the UK on exploration of the differentials in health between socio-economic groupings has been extensive – examples include the Whitehall & Whitehall II studies (Davey Smith et al 1990, Marmot et al 1991). These studies have shown that even within a group where nobody was in absolute poverty, there are large differentials in health. Even when taking into account smoking, which accounted for the single largest effect, there were significant differences between the grades, with administrative (highest) grade employees having illness and death rates significantly lower than other lower grades (Davey Smith and Brunner 1997).

In conclusion, as with diet, it has been shown that mortality and morbidity are not distributed uniformly across the UK but differ by age, gender and socio-economic grouping. Furthermore, there are both national and local level differences in health. These differences also mirror the differences found in diet in these groupings.

Summary

Both diet, and mortality and morbidity vary by age, gender and region. As diet and health are so implicitly linked, the variation in health is likely to be linked to poor nutrition that includes inequitable consumption of fruits and vegetables. As has been shown, an increase in both total food expenditure and as a percentage of total household expenditure coincides with an increase in fruit and vegetable intake and a decrease in SMR. This is not to say that these factors taken together necessarily imply causality, as ecological level data are not able to infer causality. However, these ecological association are reinforced by review of epidemiological evidence from for example cohort studies such as the COMA report on the nutritional aspects of the development of cancer (Department of Health 1998).

2.3 The question of physical access

As has been shown, the UK has one of lowest mean consumptions of fruit and vegetables within Europe. Moreover, there are strong internal differences within the UK with regards to consumption by different gender, age, socio-economic and regional groups. A possible reason for this differential in intake may be due to unequal access to food stores, particularly those selling fruit and vegetables.

The second section of the literature review will examine the issue of physical access to food stores. However, it is also necessary to understand the role of other economic, social, cultural and personal factors that may encroach on the decision making process with regards to increasing fruit and vegetable consumption. As a result, in order to effectively determine whether an increase in physical access to fruit and vegetables will lead to their increased consumption, it is important to establish the steps an individual must go through in order to consume fruit and vegetables, and what other factors impinge on their consumption. This is particularly important as Reisig and Hobbiss (2000) point out that the ease with which people access food is a function of more than geography. Furthermore, as stressed by the Low Income Project Team, food purchasing and consumption patterns are a function not only of physical access, but economic access and availability, as well as constraints such as those set by social/cultural norms, food preparation facilities and practices, nutritional knowledge and motivation to consider health (Department of Health 1996). As a result, even if physical access to fruit and vegetables in the study area changes, it is necessary to establish the role of these other factors. This is in part the rationale for the creation, development and investigation of the framework of consumption as described in chapter 1.3. Thus, the following part of the literature review will examine the issues of physical access, availability, affordability, attitudes and knowledge, and the buying and consuming of fruit and vegetables.

2.3.1 Physical access

The Rome Declaration on World Food Security, adopted by heads of Government in November 1996, affirms the *'right of everyone to have access to safe and nutritious food,* *consistent with the right to adequate food and the fundamental right of everyone to be free from hunger.*' (FAO 1996 cited in Leather and Dowler 1997, p1412).

For scores of people especially in developing countries the issue of hunger and under-nutrition and access to safe and nutritious food is a serious problem with nearly 800 million people suffering malnutrition (McMichael 2001) and approximately 6 million children dying each year due to its consequences (Lipton 2001). Whilst not nearly on the same scale as in developing countries, under-nutrition and access are a matter of concern in many developed countries such as the UK and USA (Carlson et al 1999, Darnton-Hill and Coyne 1998, Lang et al 1984). Unlike in developing countries, there are rarely clinical signs of malnutrition (although it does occur) (Townsend et al 2001) but hunger and under-nutrition caused by lack of access and availability to and of food is a growing phenomenon in affluent First World Countries. Access and availability of food for all people in developed countries has become a major public policy issue (Riches 1997, Robertson 2000), although it is only relatively recently that the issue been established on the political agenda in these countries (Uttley 1997 cited in Riches 1997).

One of the reasons that food access both in terms of monetary and physical access has become both a political and social issue is the fact that in developed countries the percentage of people below the poverty threshold has increased (Frongillo Jr. et al 1997) and that in these countries that in general have enough food, the interest has shifted from national level to household and individual levels (Lorenzana and Sanjur 1999). This may be a consequence of the growing gap between rich and poor within countries, i.e. the growing problem of social inequality (Darnton-Hill and Coyne 1998, Labonte 1998). Further to this, Riches (1997) argues that in the UK changes to food access both in terms of its physical and monetary characteristics has been partially underpinned as an outcome of prolonged high rates of unemployment, growing inequality in terms of wealth distribution, the declining value of real wages and welfare benefits, and the purchasing power of households, whilst Lang (1995, 1998, 1999a, 1999b) argues that these factors are directly related to forces of market globalisation of the food system.

The physical access that UK consumers have to food stores including those that stock fruit and vegetables has undergone a dramatic change over the last 15 years or so. In this period of time the number of supermarkets/superstores has increased significantly, although the distance people now have to travel to them is also greater. This greater distance travelled may be due to the fact that many of the stores that have opened have been created in out-of-town sites. These sites are often only accessible by those people who have cars or have easy access to public transport (if such a route exists). If a car is required to access a superstore this may disadvantage lower income groups who are not as likely to have access to a car. Moreover, the number of independent stores has diminished over the same period and these have disproportionately been stripped away from low-income areas. Hence, people particularly from low-income areas may be disadvantaged in trying to access food.

2.3.2 Changes in physical access to food and food stores

This section of the chapter explores the issues of changes in physical access that have occurred over recent times, the importance placed on physical access and what evidence there is that a lack physical access is a possible cause of reduced fruit and vegetable intake.

Over the last 15 to 20 years there have been dramatic changes in the way people in the UK access food, particularly with respect to the type of food stores that they can now use. Much of this is due to the expansion by many of the major food retailers in the UK in the number of supermarkets/superstores, which has seen a rise from 457 in 1986 to 1,102 in 1997 (Project Action Team 13 2000), but also a sharp increase in the number of discount type stores which offer a limited number of product lines. However, in the same period the number of independent stores has declined by almost 40% (Project Action Team 13 2000), and includes a fall in the number of bakers, fruitier/greengrocers, fishmongers, butchers and independent grocery shops of 68%, 52%, 60%, 54% and 39% respectively (National Food Alliance 1997). In total, during the late 1980s and early 1990s, more than 15million square feet of new food retail selling space were constructed (Wrigley 1999b).

However, the majority of new superstores built by the major food retail chains such as Tesco, Sainsbury and Asda during this period were sited on the outskirts of towns and cities, in what have become known as 'out-of-town' complexes (Wrigley 1998). These stores were designed to be highly accessible by car with significant amounts of dedicated customer parking but also with negligible catchment area competition. To the major food retail chains, these sites were more profitable through lower running costs and higher consumer spending – through attracting certain clientele with more disposable income. This in turn allowed for greater investment by the major owners and the further opening of large out-of-town stores.

Indeed, during this period there was a dramatic increase in number of shopping journeys undertaken by car and an increase in the distance travelled in order to access food shops. The number of shopping journeys by car increased from 44.9% in 1975/6 to 64.1% in 1993, and the average distance increased from 13.7 miles in 1989/91 to 15.3miles in 1991/3 (Department of Health 1996). Subsequently, only 20% of shopping journeys are on foot and 12% by bus.

The role the major superstores have had in this process can not be understated, as just five companies control over 60% of the UK food market, including 60% of the fruit and vegetable market (Leather 1995). Indeed £66 out of every £100 spent on groceries is at a supermarket (Sustain 2000). According to Wrigley (1998a) the nation's diet has been transformed to an extent by the emergence of this small group of retail corporations whose turnover, profitability, employment levels and sheer market power has caused major changes in the way people shop as a nation. Indeed, as Raven and Lang (1995 cited in Leather 1995) proposed, the major food retailers are often the key determinant of food consumption in this country as they are extremely influential in determining, *what, where and at what price* people can buy food.

Retailing has changed in the 1990s to a large extent (Wrigley 1994, 1996, 1998b, Wrigley et al 2002). The money spent during the period of large-scale expansion, for example to obtain green-field sites for the out-of-town superstores, was huge and put many of the companies into debt. Also tightened land use planning regulations were brought in (often referred to as the 'Gummer' effect) through Planning Policy Guidance Note 6 (PPG 6) Shopping Centres and their Development and PPG 13 on transport. These policies made it much more difficult for planning permission to be granted for out-of-town developments (Lowe 2000, Wrigley 1998, Wrigley et al 2002a), as the guidance explicitly states that an out-of-town site should only be considered if there are no viable alternatives closer to the town centre and if it is genuinely accessible by a choice of transport (Sustain 2000).

In some ways this has led to the opening of more stores back in the towns and cities, but the major superstore owners have been very careful in where they open such stores in order to maximise the return on their investments, by placing them within the reach of richer consumers rather than lower income groups (Sustain 2000). Acheson, understanding this problem, urged that Town and Planning policies be amended or emphasised to ensure that the development of retail food outlets do not have an adverse effect on those most vulnerable to poor nutrition, as at present they do not have to consider the impact on low income groups (Acheson 1998).

The expansion in the number of out-of-town superstores has coincided with the major demise of city centre and local community stores, particularly in low-income areas (Social Exclusion Unit 2000). Additionally, with respect to small stores, it has been found that those people from ethnic minority communities who run a large proportion of small shops are subject to a considerable amount of crime, and this had led many of them to leave thus further reducing the number of available stores (Social Exclusion Unit 2000). Moreover, the large retail chains might be unwilling to enter low-income areas, as they may not be commercially viable due to the size of the population, and attractiveness to people from outside the neighbourhood (Social Exclusion Unit 2000). This parallels changes in other countries, for example in the US, where the number of supermarkets in central 'metro' areas has fallen on average by nearly 20%, such that there are fewer and smaller supermarkets in postcodes with above average numbers of low income residents (Nayga et al 1999).

Thus whilst there has been an increase in food accessibility for the 'mobile' affluent majority, there is a significant proportion of people who have been left as 'disadvantaged consumers' (Cummins and Macintyre 1999). Indeed, as Acheson (1998, p65) in the Independent Inquiry into Inequalities and Health put it:

'The increasing tendency to out of town supermarkets has lead to the creation of ''food deserts'' (i.e. areas of poor physical access to food shops) *where cheap and varied food is only available to those who have private transport or are able to pay the costs of public transport if this is available'.*

Thus people from low-income areas are left with a stark choice – either shop at the remaining small stores in their area, which as will be shown in later sections can be disproportionately expensive, shop at discount type stores (if available) that have a limited range of foods, in particular fruit and vegetables or to shop at out-of-town superstores which are most accessible by car. However, people from low socio-economic groupings are less likely to have access to a car (Office of Population Censuses and Surveys 1993), which makes accessing the out-of town superstores even more difficult.

In a much-noted study, Guy (1996) explored the effect of the opening of seven out-of-town superstores around Cardiff on the impact of food shopping within Cardiff itself. Using a number of different sources, Guy attempted to look at the change in number of food stores at the time these seven out-of-town superstores were being built (1973 – 1990). He estimated that there was at least a 33% decline in the number of convenience stores, a 44% decline in the number of small food stores and a 17% decline in the number of chain-owned stores. Whilst the closure of many of these stores might not be due directly to the opening per se of the new superstores, it does show the changes in access that people from the city of Cardiff faced in obtaining food.

The influence of car ownership (and thus physical access to many superstores) on shopping habits can be seen if figures from Beaumont et al (1995 – cited in National Food Alliance 1997) are considered. Asked which factors mattered most in determining shopping habits, 94% of people from socio-economic groups A+B (i.e. the highest socio-economic groupings), compared to 66% of socio-economic groups E (the lowest socio-economic grouping) cited easy parking, whilst for low prices the figures were 78% and 94% respectively and for closeness to home 70% and 82% respectively. Therefore, it could be surmised that for lower-income groups the cost of food and easy physical access are much more pertinent issues compared to how easy it is to park a car.

2.3.3 Role of physical access in food shopping

Although supermarkets/superstores have been used as a setting for dietary interventions and health promotion programmes (e.g. Anderson et al 2001, Kristal et al 1997, Light et al 1989, Närhinen et al 1999), they have never been used as the intervention itself. However, decision making for food choices often takes place at the point of choice for example at the supermarket (Kristal et al 1997) and so physical access to a previously inaccessible source of fruit and vegetables may lead to an increase in their consumption. However, what is the evidence that physical access to food stores is a determinant of either food choice or food intake?

Caraher et al (1998) used data from the 1993 Health Education Authority's Health and Lifestyles Survey to explore the issues of income and access (tables 2.13 and 2.14). Although most people use supermarkets/superstores as their main source of shopping, over

11% of people with the lowest incomes are likely to use their local shops compared to 8% of those with higher incomes, a finding that reflects that of Robinson et al (2000) who found that 41% of people from lower socio-economic groups used their local corner shop on a regular basis, although the local supermarket was still used most frequently. This may well be linked to the fact that people in lower income and socio-economic groups are less likely to have access to a car and/or use a car for shopping. Indeed in the Caraher study, 40% of the low-income group did not have access to a car whilst just over 50% used a car to access shops (compared to 82% of the higher income group). This in turn may have further implications in where people shop and what factors limit what is bought. This last detail is emphasised by the fact that 5.5% and 14.5% of the low-income group stated that 'difficulties in getting to shops with children' and 'problems of carrying/transporting foods', limited the food they purchased. Furthermore, Robinson et al (2000) found that whilst superstores and out-of-town supermarkets were visited less regularly by their shoppers, those with access to a car or van were much more likely to shop there. Additionally, some of these issues of access may be further exacerbated in older people who may have limited mobility (Piachaud and Webb 1996, Wylie et al 1999).

Table 2.13: Mode of transport used to access shops by socio-economic status

	Socio-economic groups I+II	Socio-economic groups IV+V
	Transport used to access shops (%)	
Walk	12.6	26.8
Car	84.5	62.1
Bus	2.3	12.0

(Caraher et al 1998)

Table 2.14: Factors affecting shopping by income level

	Income £3000 or less	Income £14000 or more
	Where people shop (%)	
Small local shops	11.1	7.0
Local supermarkets	67.8	65.5
Supermarkets in other towns	29.5	31.5
	Access to car (%)	
No access to car	43.3	7.7
	Transport used to access shops (%)	
Walk	33.4	14.2
Car	51.8	82.1
Bus	13.3	3.9
	Factors limiting choice of food purchased (%)	
Problems of carrying/transporting	14.5	6.6
Difficult to get to shops with children	5.5	0.3

(Caraher et al 1998)

Furthermore, Bostock (2001) in a study of low-income women found that whilst walking was perceived as an inexpensive form of transport and enabled the control of meagre budgets, walking also caused much stress, particularly for those mothers with young children. This often led to journeys of very short duration, especially for food shopping, which in turn had implications for accessing food in areas with poor physical access to food where opportunities to buy food were limited. Indeed, Bromley and Thomas (1993) believe that the changes in retail provision in the UK have bypassed those people without cars creating a large group of disadvantaged consumers.

As part of the 'West of Scotland twenty-07 study: health in the community', Ellaway and Macintyre (2000) investigated food shopping practices and priorities among residents of four socially contrasting neighbourhoods in Glasgow. When asked which factors were very/fairly important when choosing where to buy their food, the most popular choices were, cleanliness (98.4%), quality (97.9%), range of goods stocked (93.5%), location/easy to get to/park (83.1%), service (82.0%) and price (81.5%). However, this distribution disguises some important differences if the sample is split along income and geographical lines (table 2.15).

Table 2.15: Factors influencing choice of shop and buying from corner shop by income and geographical location

	Ratings of factors when choosing where to shop by income and geographical location (%)			Respondents buying food items at corner shop by income and geographical location (%)		
	Price	Location/easy to get to/park	Range of foods	Bread	Grocery goods	Vegetables
Income groups						
5 – highest	58.9	87.5	96.9	9.3	0.8	3.9
4	81.3	86.7	97.7	10.0	3.1	4.6
3	86.0	81.3	94.6	21.9	4.7	3.9
2	90.8	81.5	92.3	26.2	5.4	7.7
1 – lowest	93.0	83.6	90.6	24.8	10.9	12.4
Geographical location						
4 – least deprived	66.3	85.7	96.3	16.2	3.7	4.2
3	81.4	85.9	93.2	16.3	5.1	7.3
2	93.6	74.5	89.4	14.9	6.4	4.3
1 – most deprived	91.2	82.7	93.8	21.6	5.5	6.9

(Ellaway and Macintyre 2000)

For lower income groups in comparison to higher income groups, price was the clearest determinant whilst for higher income groups it was range of food. Location/easy to get to/park was still important but the differences between income groups were not as stark. As for where people shop, it appears that people from lower socio-economic groups were more likely to shop at a corner shop than those from higher socio-economic groups – yet, it is not known if this is due to the greater physical access to corner shops or less physical access to larger shops. These results reflect those of Robinson et al (2000) who found that low-income shoppers who used local cut-price supermarkets or local markets were more likely to mention low prices as a reason for shopping there.

On the other hand, the evidence is inconsistent with regards to physical access to supermarkets by socio-demographic areas, with two studies by Cummins and Macintyre (1999) and Donkin et al (1999, 2000a) showing that physical access to stores in low-income areas were not potentially an issue.

Cummins and Macintyre (1999) mapped the distribution of all supermarkets and a representative sample of all other food premises by postcode district in the Greater Glasgow Health Board area. In turn a deprivation score (Carstairs-Morris DEPCAT) was assigned to each store by matching the deprivation score of the geographical area in which the store was located to the store itself. In this study it was found that the area with the highest deprivation score had the highest density of food stores implying that physical access was not an issue.

However, there are several drawbacks to this study. First of all it is only in one geographical area and so the results are not generalisable. Secondly, there is no indication of the prices within the stores in the different areas or the availability of goods within them, and finally the distances to shops within a postcode district may still be large and not accessible without a car or convenient public transport system.

In a recent study, Donkin et al (1999, 2000a) mapped access to food in two highly deprived wards as assessed by their Carstairs scores. What is different about this study is that it takes a spatial or area perspective to access rather than a household or individual view. To aid the study a data questionnaire was constructed which would allow for the collection of information on food prices and availability within a 2-km radius that encompassed 227 enumeration districts with a mean Carstairs score of 2.62. The questionnaire of 71 foods was devised to allow for a range of foods that could contribute to a healthy diet, although an additional 50 items of confectionary etc. were added when recording availability. Only 83%

of the shops actually stocked items for which price was being collected and no shop stocked more than 61% of the foods.

The 2-km radius was selected, as it would allow for a full range of types of shopping outlet including supermarkets, off licences and garage forecourts. This distance was chosen as it was thought to be a 'reasonable' distance in which to travel. Analysis showed that people were unlikely to have to travel more than 500m to reach some sort of food outlet (median distance 207m) (Donkin et al 1999). When considering 'healthy' food items only the mean distance to a shop that carried a significant number of them increased to 277m and when price was also taken into account (shops which were below the mean shop price) the distance further increased to 323m. However, as part of the same study the authors mapped the availability of the shops selling each food and the Carstairs score for the enumeration district of the store. Whilst for the majority of foods they was no association between a store stocking them and the Carstairs score, for 23 foods including fruit and vegetables there was a positive association between the shop stocking them and a relatively high Carstairs score (Donkin et al 2000b).

Whilst in this sample there is good physical access to food including a healthy diet, it does not necessarily mean that they may be affordable to all residents. Furthermore, the study took place in a large city; in this case London and this situation may not be reflective (as with the Glasgow study by Cummins and Macintyre 1999) of other smaller cities and towns. This last point may be borne out if recent work by Dowler et al (2001) is examined. Using a similar methodology to the survey in London, the Sandwell area of the West Midlands was mapped for access (both economic and physical) to healthy food. The Sandwell work is particularly pertinent as it is a geographical area comparable to the research study area in terms of its high deprivation level. The authors found that accessing food stores was a difficulty for residents, particularly for accessing stores that had a range of fruits and vegetables at an affordable price and was particularly true if residents had to walk in order to access the shops. Indeed, as the authors put it '*it is easier to describe the areas that do have access to shops stocking a reasonable range of reasonably priced foods, than those that do not*' (Dowler et al 2001, p28). Furthermore, as a result of this work, Dowler et al (2001, p9) defined physical access as '*the range and quality of food commodities available in shops people can actually reach, whether by foot, public transport, or, if they have access to one, by car*'.

From the evidence presented in this section of the chapter it might be argued that the existence of areas of poor physical access to fruit and vegetables is not clear-cut. Nonetheless the provision of food stores has changed dramatically over recent times, to the extent that there has never been a larger number of food stores in the UK, but it may be argued that these are not necessarily accessible to all sections of society. Support from studies such as those in Sandwell and of those of people without cars indicate that accessing food stores is a potential problem that needs further exploration.

2.3.4 Physical access as a component of food insecurity

Physical access to food is also relevant to the issues of food security/insecurity, and its growing significance to people in developed countries such as the USA and UK, as well as developing countries where it has been a subject of much concern for many years. Whilst there have been many definitions of food security/insecurity, they have often been global in their perspective and have not focused on the inherent problems faced by people in developed countries in acquiring food. Research in the United States in the late 1980's led to the development of definitions that could be used in developed countries to understand what was meant by food security/insecurity (Anderson 1990, p1559):

Food security: *Access by all people at all times to enough food for an active, healthy life. It includes at a minimum: 1) the ready availability of nutritionally adequate and safe foods, and 2) an assured ability to acquire acceptable foods in acceptable ways.*

Food insecurity: *Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.*

Campbell (1991) argues that for a person to be food secure, they must have the money to buy food at all times but also must have the physical access to places such as supermarkets in order to buy the food (i.e. in socially acceptable ways). Furthermore, the food available should be nutritionally adequate to meet the body's needs, which highlights the issues of quality and quantity of the diet. In taking this work further, Campbell (1991, p410) described the geographical impact on food security *'At a community level the constraints most often included are the availability of food markets, the actual quality and quantity of food present in food markets and the ability of people, both financially (considering price relative to* *individuals' abilities to command resources) and physically (in terms of transportation issues or physical disabilities), to acquire the food that is available'*. Campbell encapsulated these as food availability (type and quantity) and food accessibility (cost and distance).

As has been highlighted the issue of food security is becoming a matter of concern, particularly for low-income families. Low-income families are far more likely to experience food insecurity than other families, and whilst they rarely lead to clinical manifestations of malnutrition (although it does occur), poverty is a significant predictor of hunger and food insecurity (Campbell 1991, Townsend et al 2001). As Riches (1997) suggests hunger must be understood as a function of inequality linked to inequitable access to food and the possible ways in which people have to obtain food (i.e. that is personally undermining and stigmatising).

Whilst there is presently is no published data available for the UK on the number of food insecure households (although work is currently being undertaken – Margetts et al 2002), it is possible to get an indication to the extent of the problem by examining data from the US. Approximately 12% of US homes could be considered food insecure, (which equates to approximately 30 million people) including 4% that could be termed as food insecure with moderate hunger or severe hunger (Carlson et al 1999). However, the realisation that food poverty may be a problem in the UK has led to a Parliamentary Motion being signed by 198 MPs and the formulation of the Food Poverty (Eradication) Bill.

Moreover, studies from the US have shown that people from food insecure households have consistently lower intakes of fruit and vegetables than those people from food secure households (Anonymous 2000, Cristofar and Basiotis 1992, Derrickson et al 2001, Dixon et al 2001). This may be due in part to not having the physical access to the fruit and vegetables

2.3.5 Physical access to food highlighted as a government issue

The potential problem of physical access to food, and its possible implications, particularly with regards to people on low incomes has now become a political issue in the UK. A number of high-profile government reports have highlighted the problems that many 'disadvantaged consumers' now have in accessing food.

Following the publication by the Department of Health of The Health of the Nation in 1992, The Nutrition Task Force was set up in order to help achieve the dietary targets laid out. However, it was recognized that people on low incomes may have particular problems achieving the targets and so the Low Income Project Team (LIPT) was established in order to try and find ways in which people with low-incomes could achieve the targets (Department of Health 1996 and Nelson 1997). As part of its remit, the LIPT was to collate examples of effective coping strategies and to make recommendations concerning the best ways to improve access to healthy diets for low-income households.

Following their recommendations that included the development of a co-ordinated national approach on food and low income, it was recognised that in order to achieve them a number of other steps were needed. This included further research on the effectiveness of different approaches to the problems of food poverty including assessing food provision on medium to long-term health outcomes, and development of indices of food accessibility and cost.

Likewise, Acheson (1998, pp65-66) understanding the need for better physical (and economic access) to food made the following recommendations as part of his Independent Inquiry into Inequalities in Health:

- *We recommended policies which will increase the availability and accessibility of foodstuffs to supply an adequate and affordable diet* (recommendation 20),
- *We recommend the further development of policies which will ensure adequate retail provision of food to those who are disadvantaged* (recommendation 20.1).

As part of the Social Exclusion Unit's research into Neighbourhood Renewal, the subject of physical access to stores was directly examined as part of a larger assessment regarding general access to services in the UK. In order to tackle the issue, a Project Action Team (p28) was set up specifically with the goal of *'developing a strategy to increase access to shopping for people in poor neighbourhoods'*. The work of this team finally resulted in the proposal of three recommendations, namely:

- A questionnaire should be developed which could be used to establish a baseline and, repeated over time, to measure the trends and test the effectiveness of interventions in improving people's shopping access.

- Local authorities and health authorities should jointly conduct Health Impact Assessments on retail provision and plans as a means of monitoring the effectiveness of such interventions on improving the health of the community and its impact on reducing health inequalities.
- Commission research on various issues related to shops in deprived neighbourhoods (Social Exclusion Unit 2000, 2001).

In 1999, The Department of Social Security published a document 'Opportunity for All – Tackling Poverty and Social Exclusion'. Within the document, inequalities in health related to lack of physical access to shops selling good quality food at affordable prices are mentioned explicitly. Their approach is intended to be long term in that it tackles the causes of poverty and social exclusion, not just the symptoms. As the document summarises whilst individuals suffer from poverty and social exclusion this often leads to the same problems for the whole community.

Furthermore, as part of wider investigation into the practices of the main superstore chains, the Competition Commission examined and acknowledged the problems that some consumer groups faced in physical accessing local shops. However, when they considered a range of social and environmental issues related to the growth of superstores, (including their impact on employment, physical access by low income groups, the impact on the viability and stability of town centres, some transport considerations and the emergence of food deserts) they identified problems but did not attribute them to anti-competitive behaviour. Nevertheless, the Commission did also find that many of the superstore chains were persistently selling some frequently purchased products below cost.

Whilst this may seem to have some advantages to those on low income, it does have a knock effect in that it damaged smaller stores and non specific food stores, which tended to be relied upon by elderly or less mobile individuals, including those without a car. This has in turn led government planning ministers amongst others to advocate the building of food stores that are physically accessible to a larger cross-section of the British population (Wrigley et al 2002).

Summary

Dramatic changes have occurred to the shopping patterns of people in the UK due in part to the vast expanse of new superstores in out-of-town locations. However, these stores are not necessarily physical accessible to all, particularly those with no access to a car. A lack of a car is most likely to occur to people from lower socio-economic groupings, who have also seen a reduction in the number of food stores in the residential areas they are most likely to live. Evidence suggests that people in low-income areas are more likely to use the stores that are physically accessible to them.

However, whilst most of these studies have shown that there are differences in the physical access to food stores, particularly between lower and higher income groups, there have been no studies that have investigated the differences in food consumption by different levels of physical access. Therefore, at present it is not possible to say whether changes in physical access will have any affect on fruit and vegetable consumption. However, decision making for food choices often takes place at the point of choice for example the superstore and so it may be hypothesised that physical access to a previously inaccessible source of fruit and vegetables may lead to an increase in their consumption.

2.4 Other components in the framework of fruit and vegetable consumption

As has been put forward previously, physical access to food stores on its own may not be the determinant of food choice, but may be influenced by other factors. These factors may include and outlined here are:

- The availability of foods (in this case fruit and vegetables) in the store accessed,
- The economic capability of affording fruit and vegetables,
- Having the appropriate nutritional knowledge and attitudes to consider buying fruit as well as taking into account lifestyle factors such as smoking,
- Other aspects affecting whether fruit and vegetables will be bought, as well as afterwards, in having the time, preparation and cooking facilities, and family interactions.

2.4.1 Availability

If stores are physically accessible, then in order to purchase fruit and vegetables they must be available within the stores. Therefore, there are issues centring on the foods stocked in shops, particularly with respect to the availability of 'healthy' foods but also foods that meet cultural and social requirements. A number of studies have investigated the availability (as well as cost) of 'healthy' foods in stores, particularly with regards to disparities between different socio-economic areas.

Mooney (1990) explored the availability of two types of shopping baskets, one that would be considered healthy, and the other consisting of foods that should be reduced in line with dietary recommendations. Availability of these foods was surveyed in four supermarkets in an affluent area and five supermarkets in an adjoining deprived area in North London. Overall, Mooney found that whilst all the foods that should be reduced were available in all supermarkets in both areas, more of the healthy items were missing from supermarkets in the deprived areas. These items included low fat mince-meat and burgers, low sugar tinned beans and peaches, and wholemeal pasta, whilst finding semi-skimmed milk and wholemeal flour was restricted in both areas. Likewise, in a similar study in Glasgow, Sooman et al (1993) found that less than 50% of foods from a 'healthy' shopping basket were actually available in deprived areas.

Furthermore, in a study by Barratt (1997) apart from all items not being available in smaller shops, many did not have special offers or very large pack sizes offering economies of scale. Barratt believes that this causes problems for many people on low incomes who are more likely to buy food in small, local shops in order to eliminate travel costs. Moreover, she points to evidence from the Health Education Authority that many people on low incomes avoid the variety of supermarkets since they feel they can not afford to be tempted away from their usual purchases and take the risk of not liking foods and as a result wasting their money.

One of the reasons for the lack of healthy foods may be the change in the geography of shop siting, which has led to an expansion and proliferation of the limited-line discount stores particularly in low-income areas (Cummins and Macintyre 1999, Guy 1996, Wrigley 1994, Wrigley 1998). These are stores that offer a limited variety of product lines, in the range of 1,500 to 3,500 compared with 12,000 or more in a large supermarket (Department of Health

1996). Indeed, as the LIPT alluded to, physical access is not only about the absence of shops but also the presence of the 'wrong' sort *'while some low income areas are not totally deprived of a supermarket or other large grocery store, the choice of retailer or store format may be extremely limited. In some areas the overwhelming majority of grocery stores are discount stores or freezer centres...* ' (Department of Health 1996, p7).

McGoldrick and Andre (1997) citing a previous study, showed that as socio-economic status decreased, the number of visits to discount stores per week statistically increased, as did the percentage of grocery shopping purchased in those stores. Evidence from Dowler and Calvert (1995a, 1995b) in their study of lone parent families, suggests that people who shopped exclusively in discount stores bought a more restricted range of fruits and vegetables, and had in general a much less healthy dietary pattern.

Even if an individual is able to access a supermarket, another area of expansion has been the own brand goods marketed by the major supermarkets. Evidence presented by the National Food Alliance (1997) suggests that whilst own-label goods tend to be less expensive than brand named equivalents there is a stigma attached to them, and that mothers in low-income families might often buy the more expensive version to avoid the stigma. Additionally, the National Food Alliance suggest that the majority of own brand goods tend to be fatty/sugary type processed foods, rather than 'healthier foods' and that their quality is also often questionable. With respect to own brand goods it has been suggested that supermarkets improve the range of economy-line foods on offer (National Food Alliance 1998, Nelson 2000) and to ensure that low-cost fruits and vegetables are regularly available (Dowler and Calvert 1995b, National Heart Forum 1997b, Nelson 2000).

What also underpins this issue is the availability of foods that are socially, culturally and personally appropriate. As Mela (1999) emphasises cultural rules on food choice are often fundamental to what is actually consumed, and may be the most obvious influence on food preference and thus food choice. Studies have shown that different ethnic/racial groups have differences in consumption of foods including fruit and vegetables (e.g. Glanz et al 1998, Krebs-Smith and Kantor 2001, Randall et al 1990).

Different ethnic or cultural groups often have very different food preferences based on historical precedents, ritual belief systems (including religious), as well as community and family structures (Mela 1999) but also moral and ethical considerations (Shepherd 1999). Likewise, such cultural determinants may be the marker to what food aspirations individuals have (Furst et al 1996) and that only foods (including fruit and vegetables) will be consumed provided that they fit with the cultural repertoire of the individual and the community they live in (Barker et al 1995, Forsyth et al 1994, Prevost et al 1997). This is often linked to historical patterns of what people have eaten within each country and the influences it has received in that time from other countries, for example, consider the impact of Indian food on the dietary habits within the UK (Wright et al 2001).

Summary

In order that food such as fruits and vegetables are bought they must be available in the stores people can physically access, and must fit with their cultural identity. However, studies have shown that this is not necessarily true, particularly for individuals living in low-income areas. The evidence is that stores in low-income areas often do not sell as wide a range of healthy foods as is sold in more prosperous areas.

2.4.2 Affordability

According to Dowler et al (2001, p9) affordability or economic access may be defined as *'having sufficient money to buy appropriate healthy food, which depends both on food prices and on how much money can be allocated to food and travel expenditure'*.

Being able to afford any food that is available within a physically accessible store may be the greatest determinant of whether fruit and vegetables for instance are actually bought. This is likely to be particularly true for those people with limited incomes.

As will be shown, cost is often the main driver to buying fruit and vegetables but also there is the issue that for many people a healthy diet is actually more expensive than an unhealthy one. Besides, those people with limited incomes spend significantly more as a percentage of available money on food than higher income groups, and are often more efficient at buying food in terms of the amount of money available to them.

2.4.2.1 The influence of cost

In 1996, a pan European survey of consumer attitudes to food, nutrition and health was conducted on a nationally representative sample of adults in each of the European Union

Member States (Kearney et al 1997). As part of this survey influences that were perceived to be important on food choice were assessed. Across Europe, after quality/freshness, price was found to have second greatest influence on what people bought and was seen to be more important than taste, tying to eat healthily or family preferences, whilst further analysis revealed that for unemployed people price was the most important influence (Lennernäs et al 1997). However, it is not possible to see if what was chosen as an influence actually affected buying or eating habits. Other studies in both the UK and Europe have also shown that cost or lack of money to buy food was a significant barrier to consuming a healthy diet – in particular increased amounts of fruits and vegetables (Anderson et al 1993, Brug et al 1995, Cox et al 1998, Thompson et al 1999, Wandel 1995).

Moreover, as part of the same pan-European study, an analysis of perceived barriers to healthy eating was presented (Lappalainen et al 1997). Somewhat surprisingly, cost of 'healthy' food (19%) was only the fifth most common answer after, lack of time, self-control, resistance to change and food preparation. However, for the UK sample it was the third most commonly perceived barrier (21%) after self-control and lack of time (Kearney and McElhone 1999). In a European study in Germany, Belgium and the Netherlands, those women with low socio-economic status (as defined by educational level) considered cost more often than health when choosing their food (53% versus 50%), and whilst this difference is not very big, for women with high socio-economic level the figures were 28% versus 69%. Additionally, these women were more likely to restrict what their children were eating (Hupkens et al 2000).

In general it may be summarised that cost or lack of money is a major influence on what is bought, particularly for those people with lower socio-economic status, although cost is not necessarily perceived to be a barrier to healthy eating.

2.4.2.2 Relative cost of a healthy diet

In one of the first studies of its type, Mooney (1990) conducted a study in one North London district where costings were taken of two shopping baskets, the first comprising foods recommended in a healthy diet, and the second consisting of foods to be reduced in a healthy diet. Nine supermarkets were visited -four in an affluent area of the district and five in a deprived area of the district. Results showed that healthy basket cost 21% and 17% more than the unhealthy one in the deprived and affluent areas respectively. Although in this study the price in deprived areas was cheaper for both baskets, what it does show is that the healthy basket is considerably more expensive (and less readily available) to people especially those on low incomes and living in the deprived areas. As Mooney states, this is can be a serious obstacle to healthy eating.

To further emphasise this, in the same shops Mooney priced two diets, one as recommended according to the 1986 NACNE Guidelines and the other based on the diet of income group D (low income) in 1985 NFS. The results show that in the affluent areas the recommended NACNE diet was 63% more expensive whilst in the deprived areas it was even more expensive – 73%.

The main drawback of this study is the small sample size, only nine stores in one district were analysed and only a range of 15 products from each of the lists. Furthermore, the only stores visited were supermarkets over 2,500 sq. ft, which means no smaller convenience type stores or 'corner shops' were tested, which may have been even more expensive.

This pattern of disparity in price has been found in other studies in other locations within the UK. A study conducted in 1991 by the National Children's Home found that on average across the UK a 'healthy' shopping basket would cost 17% (range 14% to 22%) more than an 'unhealthy' shopping basket. Sooman et al (1993) suggested that attention be given to the price and availability of healthy foods, particularly in socio-economically deprived areas. To illustrate this, a study was undertaken in two areas of Glasgow – one with a high percentage of households in socio-economic groups I and II (high) and one with a high percentage of households from socio-economic groups IV and V (low).

A 10% sample of shops in the localities were taken which were representative in terms of 1) the hierarchy of retail provision in each locality (strategic centres, major local centres, minor local centres, individual shops); 2) socio-residential characteristics within each locality; and 3) geographical spread within the localities. A shopping basket approach was taken – pricing a list of foods of which people are encouraged to eat more, and a list of foods which people are encouraged to eat less. To conduct a fair price comparison of products between shops, it was necessary to ensure that the items were of the same size, weight etc. The prices were based on the smallest packet because people on low incomes and or living alone may buy on this basis (Mooney 1990).

Whilst the difference in price between the localities for the unhealthy basket was negligible, the healthy basket was 5% more expensive in the locality with high representation from socio-economic groups IV and V than socio-economic groups I and II. What was also seen was that the healthy basket was 10% more expensive in the affluent area and 16% more expensive in the more deprived area than the unhealthy basket.

A drawback is that it does not take into account what people really eat, nor can it examine the cost of eating a diet following current guidelines to increase the consumption of fibre rich carbohydrates and decrease the intake of high fat foods. Additionally the sample size with this study was small and so the results must be treated with some caution.

Barratt (1997) looked at the cost (and availability) of healthy food choices that met agreed nutritional targets and compared the cost with the average weekly amount spent on food as reported in the NFS. Foods were priced in supermarkets and smaller retail outlets in Derbyshire in three different years (1990, 1992, 1994). The cost of the cheapest brand in the most economical pack size was used. Whilst the findings for the study are inconclusive for cost of the whole diet, many items were found to be at least twice as expensive in the smaller shops than in supermarkets.

Travers (1996) as part of a larger study in Canada assessing the social organisation of nutritional inequities, participants were to obtain and record prices of foods listed on a standard grocery list comprising foods from the Agriculture Canada Nutritious Food Basket. The participants with support repeated a pricing comparison exercise between inner city and suburban stores of two major superstore chains. Two of the stores were the only superstores within the neighbourhood where most of the participants lived and shopped and constituted an inner city area, whilst the two other stores were chosen to represent the same store chains but were located in middle-class suburban neighbourhoods. Prices within the inner city stores were approximately 5% to 10% higher than in the suburbs. Furthermore, Travers found that the money available for food through the accessible benefits would not cover the food costs of even a 'thrifty' basket of food.

In general it can be summarised that the economies of scale allow food sold in supermarkets to be cheaper (and to cover a wider range of goods) but there is the paradox that a 'healthy' basket of food including fruit and vegetables is often found to cost more in disadvantaged areas (Acheson 1998). However, it must also be noted that there is evidence that there is also a price variability issue when it comes to food in general – O'Brien and Guy (1985) found that the highest prices were found among the relatively isolated freestanding food shops.

Travers believes that such a pricing strategy compromises the participants' ability to purchase a nutritious diet while shopping in their own neighbourhoods. Further difficulties including time and money for transport are encountered if travelling elsewhere to purchase food is necessitated. The time needed for shopping is an issue that needs to be further explored (Chetthamrongchai and Davies 2000).

Recent work by the Food Commission offers another example of the price differential between a basket of 'healthier' food and a basket of 'regular food' but also highlights the growing discrepancy in price. Based on the selection of 18 items (regular versus healthier version), the healthier basket was 51% more expensive, but compared to the same items in 1988 the regular basket in 2001 was 30% more expensive but the healthier basket was 66% more expensive (Davey/Food Commission 2001). However, a drawback of many of these studies is they have looked at the price and availability of two baskets compared to each other, but do not look at what people actually buy (Davies and Worrall 1998).

Cade et al (1999) as part of the UK Women's Cohort Study also looked at the relative cost of a healthy diet. The analysis was done indirectly by multiplying the amount of food consumed from a previously completed food frequency questionnaire with prices taken from the 1995 NFS and a large superstore chain. In order to establish the 'healthiness' of the diet, a healthy diet indicator was developed based on the WHO recommendations for the prevention of chronic disease. A sub-sample of respondents at the extremes of the healthy diet indicator were interviewed to establish indirect costs, such as where food was purchased, how often, and how they reached the shops.

Women with the healthiest diets spent on average 63% daily more on food than women with the least healthy diets. The characteristics of the healthier women showed that they were more likely to be vegetarian and to have degree level education, they also had a lower body mass index and their total dietary intake in kcals was 56% higher. Analysis of the food groups showed that women with less healthy diets spent a higher percentage of their budget particularly on meat (17% compared to 1%) and much less on vegetables (17% compared to 24%), fruits (12% compared to 25%) and grains/nuts/seeds (3% compared to 6%).

In the sub-group analysis of the two extremes, it emerged that the women with the healthiest diets shopped more frequently than their less healthy counterparts, spent less time reaching the place where they did their main shopping and spent less time overall in shopping and travelling. It may be hypothesised that the women with the healthiest diets had access to a car and thus reaching superstores was relatively simple. However, it must be acknowledged that the women enrolled in the UK Women's Cohort Study are not a representative sample of the women in this country, they are more likely to be vegetarian, be concerned about their eating habits and what type of foods they eat.

By and large, it appears that healthy food constituting a healthy diet including fruits and vegetables is comparatively more expensive than an unhealthy one. Furthermore, there are inequalities in the pricing structure between different neighbourhoods, with higher prices in lower socio-economic areas. This may have an effect towards the differential intake of fruits and vegetables across different groups.

2.4.2.3 Money for food

It has been demonstrated that whilst there are inequalities in dietary intake across the spectrum of socio-economic groups, the unemployed, marginalized and single parent families have consistently been found to have further difficulties in acquiring an adequate diet. These sections of society are also the people who are more likely to live in and around areas of poor physical access to fruit and vegetables (Lang and Caraher 1998, Whitehead 1998), and therefore, their diets will be potentially even more compromised.

To understand the extent of the problem, one has to consider the number of people who are potentially affected by this situation. According to National Statistics, the number of people in the UK living in poverty (as defined as living on less than 50% of the average income after housing costs) rose from 9% in 1979 to 24% in 1994, and may well be continuing to grow (Nelson 2000). Over 6% of the population are unemployed, 18.1% of the population are of pension age and over 7% of all households are lone parents (Office for National Statistics 2001).

With respect to this last point in 1991 there were approximately 1.3million lone parent families – which equates to 19% of families with dependent children. Of these, 59% live in poverty (although 23% of households with two parents also live in poverty). Eighty percent of lone parent families are dependent on income support (Nelson 2000), whilst nearly one in five working age households has no one in work. Fifty percent of lone parents have an income of £150 or less per week (Office for National Statistics 2001). NFS data for 1999 reveals that a lone parent with one or more children spends on average £10.80 per person per week on food, which compares to £17.84 per person per week for an adult couple with no children or £12.68 per person per week for a family comprising two adults and two children. In terms of intake of fruits and vegetables (excluding potatoes and potato products) mean consumption is 2.7 portions per person per day in a lone-parent family, compared to a family of two adults and two children where the figure is 3.0 portions per person per day. The NFS data shows that lone parents and their children have the lowest intake of fruits of any group.

A number of studies have looked at the issues surrounding food choice and intake in marginalized groups. One of the first studies was by Lang et al (1984) who initiated a study entitled 'Jam Tomorrow?' to look at the food circumstances, attitudes and consumption of low-income people, particularly those unemployed, on government training schemes and retired. The timing was pertinent, as at that stage in the mid 1980's Britain was undergoing an economic recession and unemployment levels were the highest since the Second World War.

Across the board, it appeared that when money was tight food was the first thing to be budgeted on, for 26% of the entire sample and 39% of the unemployed. Analysis showed that 37% of unemployed people had had to go without a meal on a number of unspecified occasions in the previous year compared to 10% of employed and 5% of retired people, and that 25% found that they did not have enough money to buy food for all week, compared to 7% and 2% for employed and retired people respectively. Asked, if they had a main meal every day and if not the reason why, the most common answer was because of cost (55% of unemployed, 33% of employed, 30% of retired and 13% of those on Government schemes). The extent of this problem was seen when 48% of unemployed people, 37% of employed people, 25% of retired and 37% of people on Government schemes, did not have all meals (i.e. breakfast, lunch and evening meal) when their diet was assessed, i.e. meals were being skipped. When asked what factors are important in the foods you buy, 76% mentioned good value for money, 53.6% nutritious/good for you, 52.2% satisfying and filling, 30% a nice taste and 22% cheap. This shows that whether a food is good for you or tastes nice may not be as relevant as how much it costs or fulfils satiety.

Overall, this study gives an indication of the hardship that people on a low-income, particularly those who are unemployed, face in eating a nutritionally adequate diet. Missing meals and cutting back were all too common as have been shown in other studies (Cade 1992, Dowler and Calvert 1995a, 1995b), although skipping meals may be a last resort. A study by Maxwell (1996) found that there was a hierarchy of coping strategy when money was inadequate, ranging from eating foods that are less preferred and limiting portion sizes to the extreme of skipping food for a whole day(s).

The study by Lang et al (1984) does have its drawbacks in its design. Whilst the total sample was approximately 1000, the disaggregation into smaller groups often gave very small numbers, and results are only expressed for those people actually responding to any given question. Furthermore, the questionnaire was to be (generally) self-completed which means that some of the people in the worst situations where literacy for example was a problem may have been missed.

However, evidence does suggest that people from lower income groups actually spend a higher percentage of their disposable money on food compared to higher income groups, although in terms of absolute spend the amount was less. Nelson and Peploe (1990) used data from the NFS and FES to explore food purchasing at a household level. It was one of the early studies to show that although there was direct relationship between family income and absolute food expenditure there was an inverse relationship between family income and percentage income spent on food. What the data also showed was that the lowest income groups were the most efficient purchasers (ounces/100 pence) for certain food groups, in particular bread, fats, potatoes and sugar – i.e. 'filler foods', but also for foods groups such as milk, fish and meat. However, they were less efficient at buying fruits and vegetables.

In this study, the authors then looked at the changes that would be needed to be made by a family of two adults and one child (aged 1-4 years) in order to achieve the guidelines for a healthier diet as specified by NACNE/COMA, and what financial impact that these changes would have. It was estimated that significant changes would be particularly necessary for purchasing increased amounts of bread, cereals, potatoes and fish and decreased amounts of meats and fats. However, the new diet would cost 52% of weekly total net income for a family on Income Support, and is likely to be well beyond what would be affordable.

This study has the drawback that it is only theoretical and does not take into account for example the distribution of foods and nutrients between members of the family which has been shown to occur (Nelson 1986). It also makes assumptions about the cost of the healthy diet with respect to back dating the price of the foods bought.

In a much quoted study, Dowler and Calvert (1995a, 1995b) carried out a cross-sectional survey of 200 lone-parent households in Greater London. It showed that after adjustment for household size and composition based on energy requirements, that 21% of mean household income was spent on food each week (32% without adjustment). However, this hides quite strong differences within the population, for example, for those on income support 24% of mean household income was spent on food each week (40% without adjustment), compared to 17% (25% without adjustment) for those not on income support. Additionally, once again, whilst the percentage spend was higher the absolute spend was less in the income support group. Furthermore, those on income support were less likely to have 'variety' in their diets, particularly for fish, fruits and vegetables.

Another problem that faces people particularly from low-income groups is that money intended for food often is eroded by other essential expenditures such as rent (Travers 1996). The food budget is often targeted as it was seen as a way of purchasing less (and therefore spending less) but still being able to partially meet a need. Wynn (1987) using data from American surveys in which households are divided into 'poor' and 'not poor' showed that some households economise on food to the point of malnutrition in favour of spending the money on other things such as rent, clothing or cars. Hanes and MacDonald (1988) in a position paper for the British Dietetic Association stated that for those people on low incomes the money available for food is so restricted that they are unable to afford a healthy diet particularly in light of the other demands on money. Research has shown that if extra money was available to people on low income, that it would not necessarily be spent on food but on other essential items such as children's needs, fuel bills, clothing/shoes and debt repayments (Deep in Debt 1992 cited in National Food Alliance 1997). However, evidence from a survey by the National Children's Home (1991) of low-income families, suggests that people are not ignorant of the type of foods they should be eating. Asked what they would spend an extra £10 of food money on, 60% said they would buy more fruit, 54% more fresh lean meats and 38% more vegetables. This compares to 8% who said more cakes, biscuits etc. and 3% who said meat products such as bacon, sausages and burgers.

In addition, according to recent research covering the period 1994 to 1998, the lowest 10% of household income saw their income rise 77%, compared to 140% for households in the top 10% of household income. However, more importantly the costs of all goods and services rose 83%. Although food costs in this period have risen by 56% it still means that other budgetary needs may take consideration over food. Moreover, prices have not changed uniformly, fruits, vegetables, white fish fillet, and rice rose on average by over 64%, 61%, 116% and 188% respectively, whilst sugar, vegetable oil, frozen fish products and frozen chips rose by 47%, 14%, 69% and 28% respectively (Food Magazine 2000). Furthermore, there is some evidence that there are higher profit margins on fresh produce compared to other types of foods (Sustain 2000).

Anderson and Morris (2000) undertook research looking at the short and long term impact of a change in household income (both increased and decreased) on the amount of money spent on food, their eating habits and preferences. Although the sample size was small (n=150) there were interesting results. On average people lost 31% of their income and this led quickly to a change in the amount spent on food. Moreover, people tended to eat less meat, fish, rice pasta, frozen vegetables and salad but also felt less social pressure to eat a healthy diet. In addition, a decrease in income led to a decrease in both the amount eaten and the variety of foods consumed.

To illustrate the essential cost of a healthy diet, Morris et al (2001) investigated what the minimum income for 'healthy living' would be that incorporated costs for a healthy diet, access to exercise and recreation, safe housing, other costs of living and social integration. For a single healthy male, aged 18 to 30 living on his own, it was estimated that a baseline figure would be £131.86 per week. Of this figure, a healthy diet would account for 22% of the budget, but could increase up to 25% depending on where the person lived. This work has thus far only been carried out for single males but not for other people/groups, for example families or lone parents.

As has been seen when money was tight less money was spent on groceries although parents normally try to ensure that this did not affect their children's intakes, although in some very poor families children do sometimes go to bed hungry for lack of food (Lorenzana and Sanjur 1999). Furthermore, there was a feeling of having to be constantly vigilant over what was being eaten and feeling guilty if money was spent on 'treats'. Often, meals were prepared that would be considered socially devalued or excluding (Crotty et al 1992, McKenzie 1974). It can be summarised that whilst people on low incomes spend less in terms of absolute amount on food, they do spend a greater percentage of their income on food (James et al 1997).

However, it must be taken into consideration how much food costs in terms of the calories available, which is of considerable importance if money is tight. Families must trade off between having enough to eat and being able to eat a 'healthy' diet. Results from the Food Commission show that many less 'healthy' foods are a better source of energy in terms of density. For example, in terms of price per 100 calories, apples and oranges cost 21.9p and 36.2p respectively, plain potatoes 6.5p, hard margarine 1.4p, half fat margarine 6.2p and milk chocolate 9.8p (Food Commission cited in National Food Alliance 1997).

This raises the issue of the balance between (nutritional) quality and (nutritional) quantity of the diet. It is clear that issues related to the affordability, including money available for food and the relative cost of a healthy diet, will have a major impact on the quality of food bought and thus the diet consumed i.e. the macro and micronutrient balance of the foods eaten. This will have a direct affect on the balance of quality and quantity of the diet. Studies from the US on women from food insecure households highlight the issue of balancing quality with quantity of food, which have shown as food insecurity in women increased so did their body mass index/level of obesity. Townsend et al (2001) found that as food insecurity increased in women (excluding the severely insecure), so did the levels of obesity – from 34% in the food secure, to 41% for mild insecurity and 52% for moderately insecure. This was independent of other factors including income, ethnicity, age, education and lifestyle factors. Olson (1999) also found that women who were from insecure households had significantly higher body mass index compared to those from food secure households – 28.2 vs. 25.6kg/m^2 and a higher percentage of obese women 37% vs. 26%. These results coupled with the fact that studies of food insecure people have shown that they having significantly lower intakes of micronutrients (e.g. Cristofar and Basiotis 1992, Dixon et al 2001, Rose 1999, Sun Lee and

Frongillo Jr. 2001, Tarasuk and Beaton 1999), indicates that although the quality of the diet may be poor they are consuming enough energy to become overweight and obese.

These differences in micronutrient intake may be explained by poor consumption of fruit and vegetables. Cristofar and Basiotis (1992) found that women from food secure households ate on average 42g (approximately equivalent to half a portion) more fruit and vegetables per day compared with women from the most insecure households. Furthermore, for children from these respective households it was found that there was a similar pattern with 45g more being eaten per day by food secure children.

Derrickson et al (2001) assessed the vegetable consumption between different household groups using four validated measures of food insecurity. For each measure there was a similar pattern with food secure households consuming significantly more portions of vegetables a day than food insecure households. Similarly, there was a significant consumption gradient with reduced levels of vegetable intake with higher levels of food insecurity, although absolute levels for all households were low (two portions or less a day).

Dixon et al (2001), using data from the third US National Health and Nutrition Examination Survey (NHANES III) compared dietary intakes from food insecure and secure households. Households were divided by respondent into younger adults (20 to 59 years) and older adults (60 or more years). Over a one-month period, younger adults from insecure households in comparison to those from food secure households ate 14 and seven less portions of fruit (including fruit juices) and vegetables respectively. For older adults, those from insecure households also ate these items less but not at a statistically significant level. However, this was the only study of the three highlighted that adjusted intakes for other factors (in this case – gender, age ethnicity, income and geographical residence).

Overall, in a review in the US, it was found that upto 12.6% of people with food security issues had fruit and vegetable intakes of less than one portion per day compared to under 5% of people consuming five or more portions per day (Anonymous 2000). However, it may be postulated that this may be a reflection in the fact that fruits and vegetables are a poor source of dietary energy per unit cost compared to other foods.

A theme that repeatedly appears is that of budgeting, however, Dowler (1997) suggests that for people, particularly for those on low-incomes, budgeting strategies can only work for those people who actually have physical access to shops that sell a range of foods at a price that is 'affordable'. Overall, it is clear that the percentage of disposable income spent on food in lower income units is significantly higher than that spent by those with higher incomes, although the absolute spend is much less. Indeed, there is evidence that the lack of money for food means that skipping of meals by individuals is commonplace. Furthermore, fruits and vegetables are an expensive source of energy in comparison to other products and so may lead to them not being bought.

Summary

The cost of food may be a major determinant of food intake, particularly as has been demonstrated in that a healthy diet is relatively more expensive than an unhealthy diet. Similarly, the cost of food is often found to be disproportionately more expensive in more socially deprived areas. These two factors may have particular implications for those on low-incomes who spend more on food as a percentage of their income, although the absolute spend is less than for those from higher income groups. It may be concluded that even if a store is physically accessible it does not automatically mean that a person may be able to afford the food that it stocks.

2.4.3 Attitude, knowledge, barriers and perceptions to and of a healthy diet

It has been hypothesised that an individual's attitude, knowledge, perceived barriers and perceptions of and towards a healthy diet, including the consumption of fruit and vegetables would partly determine an individuals food choice and thus dietary consumption. Furst et al (1996) claim that attitudes affect long term food habits and thus how individuals go about selecting food, which will in turn affect their acquisition (including the use of superstores), but also their preparation and eventual consumption. However, Parmenter et al (2000) state that for a person to select a healthy diet they must know at a minimum the recommendations for a healthy diet and to understand the necessity to select certain foods in order to meet those recommendations. Additionally, Kearney et al (2001) suggest that in order for people to change their diets they first need to know that they actually need to change them. Furthermore, trying to identify these constraints will help understand why people reject a more health-orientated diet or do not change their food choice (Zunft et al 1997). It is therefore important to assess attitudes towards diet in order to consider whether people who have increased access to fruit and vegetables and buy them have different attitudes to those who do not buy fruit and vegetables.

A number of different approaches have been taken in order to assess the relationship between dietary intake and an individual's attitude, knowledge, and self-perceptions with regards to a healthy diet. The approaches have varied between the use of simple questionnaires to more in-depth conceptual frameworks such as the health belief model, the theory of reasoned action and the theory of planned behaviour, many of which were developed in nutrition by assessing attitudes towards dietary fat (e.g. Lloyd et al 1993, Shepherd and Stockley 1985, Shepherd and Towler 1992).

In the pan-European study on attitudes to food, nutrition and health in nationally representative samples the main perceived barriers to healthy eating were found to be lack of time and self control (both 33%), followed by resistance to change (21%). The issues of lack of knowledge or difficulties in selecting healthy food were not seen as important (both 14%), and 15% indicated they did not want to change their dietary practices. However, there was variation between different demographic groups, where for example lack of time was cited by 42% of 15-34 years olds compared to 15% of over 55 year olds. Moreover there were variations between EU countries. In the UK for example, self-control was cited by 45% of respondents and knowledge by 20%, whilst resistance to change was significantly cited more by males and those who were more poorly educated (Kearney & McElhone 1999, Lappalainen et al 1997).

As part of the same study, Kearney et al (1997) examined the perceived need to alter eating habits. Across Europe, 71% of people (including 62% of UK respondents) agreed with the statement 'I do not need to make changes to the food I eat, as it is already healthy enough', which may lead to the conclusion that the vast majority of people do not believe that dietary guidelines and advice are self-relevant. This may be backed up when it was found that 87% of people in the EU (including 94% of UK respondents) thought that people in general (i.e. other than themselves) should be eating more fruits and vegetables.

Zunft et al (1997) investigating the perceived benefits of healthy eating at both a population level and at an individual level found that 67% and 66% of people thought that at a population level the benefits of healthy eating were staying healthy and disease prevention respectively. However, when asked from a personal point of view these figures were 31% and 24% respectively, which may indicate that healthy eating and its potential benefits may be considered as a theoretical issue without personal relevance (Zunft et al 1997) or without being relevant to their nutritional habits at that time (de Graaf et al 1997). Similarly, in a survey in the UK by Buttriss (1997) personal ill health or ill health of a close friend or family member was perceived by general practitioners and practice nurses as being the key motivator for their patients to change their dietary habits, and that apathy was the main obstacle. Furthermore, this lack of motivation to change dietary habits might highlight issues of self-ambivalence towards eating healthily (Shepherd 1999).

This issue of self-perception of a healthy diet has also been found in other studies in the UK. Margetts et al (1998) found that the majority of people felt that they did not need to change their diets, whilst Anderson et al (1993) and Parmenter et al (2000) both found that over 50% of people who consumed under two/three portions of fruits and vegetables per day believed they were consuming enough. Anderson et al (1994) on a cross-section of the Scottish population, found that 69% claimed to be healthy eaters and that 60% did not want to change their diets. In a study by Griffiths et al (1994), which focused on a highly deprived inner city area of London there was a considerable divergence between dietary intake and perception for men over the age of 45, for example 90.6% of men aged 60 years and over reported they had a healthy diet but only 65.9% had a diet that could be considered healthy or moderate at best. Furthermore, 46.5% said they ate adequate amounts of fruit and vegetables compared to 23.4% who said they didn't. Cox et al (1998) found that 36% of low fruit consumers and 44% of low vegetable consumers perceived that their intakes were high, whilst Kearney et al (2001) in Northern Ireland (as well as the Republic of Ireland) found that those people with the highest intakes of fruit and vegetables were significantly more likely to indicate they make a conscious effort to try and eat a healthy diet compared to those people with the lowest intakes. However 43% of people in the lowest quartile of vegetable intake thought that they were eating the right amount of vegetables, which is in stark contrast to the fact that just 7% of respondents from the lowest quartile of fruit intake believed they ate the right amount of fruit.

In order that an individual understands the need to alter their diet, it is important to comprehend an individual's interpretation of what a healthy diet is. Evidence seems to suggest that most people perceive a healthy diet to include fruit and vegetables. Margetts et al (1997) found that across Europe, fruit and vegetables (42%) was second only to low fat (49%) as perceived components of a healthy diet and that over 80% mentioned either of these, including 91% of UK respondents. Moreover, Povey et al (1998) in the UK found that eating fruit and eating vegetables, along with eating a balanced diet were perceived to be the most important part of healthy eating. Parmenter et al (2000) examined a cross-section of the UK population for their nutrition knowledge related to factors including current dietary recommendations and healthy food choices. Although more than 90% of respondents were aware of the recommendations including to increase fruit and vegetable consumption, 70% did not know that the recommendations actually specified the consumption of at least five portions daily. Furthermore, over 40% of the respondents were unaware of a link between low intake of fruit and vegetables and health problems, whilst a minority of people - 42% and 47% were aware of the link between low fruit and vegetable consumption and cancer and cardiovascular disease risk respectively.

As with many aspects of diet differences in attitudes, knowledge and perceptions have been found between demographic groups. For example, Fagerli and Wandel (1999) clearly showed that women had a greater awareness of nutrition issues such as choosing foods they considered to be healthy, and the health aspects of the foods, compared to men. One theory for this is that women are and have traditionally been the servers and providers of foods to husbands and families, and this has led to increased awareness of related issues (Barker et al 1995), whilst Beardsworth et al (1999) and Dixey (1996) highlight the issue of social pressure for women to conform to weight and body image 'norms' in today's society. Kearney et al (2001), Parmenter et al (2000) and Wardle et al (2000) found that women, those people with higher educational attainment, those with higher socio-economic status and those who were married, had significantly better nutritional knowledge independently of other factors. Similarly Dittus et al (1995), found a similar pattern when exploring the perceived benefits and barriers to consuming more fruit and vegetables.

From the pan-European survey, knowledge was not perceived to be a barrier to healthy eating differently by gender, age or education level, although people with lower levels of education were more likely to be resistant to changes in their diet – a result that was particularly significant in the UK (Kearney and McElhone 1999, Lappalainen et al 1997). In terms of self-perception of diet, as education level increased the percentage of people thinking they did not need to make changes decreased, whilst the opposite was true for increased age. Additionally males and those with low education were less likely to think of the nutritional aspects of the food they ate (Kearney et al 1997).

Whilst these studies have stated that attitudes, knowledge and perceptions were important determinants of diet, what is the evidence that they lead to variations in diet? For studies of fruits and vegetables, the evidence although limited seems to suggest a correlation, although not always to a significant level. For example, Barker et al (1995), Brug et al (1995) and Wardle et al (2000) found that there were was a strong relationship between fruit and vegetable intake and nutrition knowledge. Indeed, in the Wardle study it was found that those people in the highest quintile of knowledge were nearly 24 more times likely to be a higher consumer of fruit and vegetable (at least 2-3 portions of both fruit and vegetables per day). Additionally, Thompson et al (1999) found through regression analysis that low consumers of fruit and vegetables had significantly lower/poorer knowledge and attitudes. However, a study by Dallongeville et al (2000) suggests that whilst those with increased knowledge consumed more fruit and vegetables it was not to a significant level. Furthermore, Gibson et al (1998) found that a mother's nutritional knowledge was significantly associated with their child's fruit consumption but not to their child's fruit juice or vegetable consumption.

In conclusion, the relationship between attitudes, knowledge and consumption is not necessarily as clear-cut as imagined. However, whilst nutrition knowledge and attitudes on their own may not explain food choice they may help in part in explaining the variation in diet that exists. Further to this, barriers to fruit and vegetable consumption such as cost may diminish nutrition behaviours, as suggested by the negative correlation and lower nutrition behaviour scores for low income and education respondents (Dittus et al 1995). Additionally one of the difficulties with many studies is that they attempt to look at attitudes, knowledge and perception as one but they may be very different in their nature. Likewise differences may be observed between different demographic groups, in particular gender, age and income groups, which may have an effect on dietary outcome.

Povey et al (1998) raised the issue that there is often an assumption that there is an unproblematic relationship between knowledge and the decision to do the 'right thing' in terms of a healthy diet. However, the issue of food choice may be due to the prioritisation of an individual's situation in terms of family, time, social pressure and so forth (Connors et al

2001) and that attitudes and knowledge are issues that may be compromised upon. Furthermore, it may be hypothesised that one of the reasons people do not change their behaviour in terms of diet, is that they do not have the physical access (or monetary access) to healthy food to actually change their diet even if they have the 'correct' knowledge and attitudes.

2.4.3.1 Lifestyle factors

Lifestyle factors such as cigarette smoking, alcohol consumption and physical activity levels may also be markers of general attitude including dietary intake. In fact, according to the Government White paper 'Saving Lives: Our Healthier Nation' smoking itself is currently the single most preventable cause of ill health in the UK (Department of Health 1999). Therefore, these aspects are important to understand and assess in order to consider their impact on food choice, particularly after improved physical access to 'healthy' foods such as fruit and vegetables.

Studies have shown a strong relationship between lower socio-economic status and increased cigarette smoking (Billson et al 1999, James et al 1997, Marmot et al 1991, Woodward et al 1994) and physical activity (Dowler 2001, James et al 1997, Margetts et al 1999, Marmot et al 1991), and an inverse relationship with alcohol consumption (Lynch et al 1997, Marmot et al 1991), although according to the NDNS of British Adults, lower socio-economic groups derive more energy from alcohol than those people from higher socio-economic groupings (Gregory et al 1990).

The relationship between cigarette smoking and consumption of fruit and vegetables in particular has been shown to be closely associated. Many studies have repeatedly and consistently shown that smokers are lower consumers of fruit and vegetables (as well as a healthy diet in general) (e.g. Johansson et al 1999, Palaniappan et al 2001, Prevost et al 1997, Subar et al 1990, Thompson et al 1992, Thompson et al 1999). Furthermore, as Woodward et al (1994) showed, those people who smoke appear to be considerably less aware of health issues than non-smokers, and are less likely to have tried to change other lifestyle factors such losing weight, eating less fat/salt and taking more exercise. Analysis by Margetts et al (1998) also found that smokers were less likely to have changed their diets over the previous three years. Another consideration may be that those people from low socio-economic groupings who smoke may not spend as much money on food as they have to put money away for cigarettes, although this is not always the case (Dowler and Calvert 1995b).

Levels of increased physical activity are associated with increased intakes of fruit and vegetables. Johansson et al (1999) showed that on average those people that exercised at least four times a week on average ate a portion of fruit and vegetables more a day than those people not exercising at all and half a portion more than those exercising between one and three times a week. This gradient between activity levels and consumption was also found by Agudo et al (1999) in Spain, a country with high average fruit and vegetable consumption. Indeed, in the UK as well as Europe as a whole, physical activity is not seen as a major influence on health compared to other issues such as smoking, food intake and stress (Kafatos et al 1999). However, as Dowler (2001) points out, those people who have problems accessing fruit and vegetables both in terms of physical and monetary access may also be the people who have the most problems accessing leisure facilities.

Analysis of dietary patterns has often found that those people with higher alcohol intakes are also those with lower fruit and vegetable intakes (Barker et al 1990, Schulze et al 2001), but were also more likely to be smokers (Woodward et al 1994). Lynch et al (1997) showed that those people with the lowest fruit and vegetable intakes were also the ones to be higher consumers of alcohol when its distribution of consumption was divided into quartiles. However, the relationship between fruit and vegetable intake is not always clear-cut. For example, Billson et al (1999) found that those women with the highest fruit and vegetable intake also had a significantly higher intake of alcohol; whilst for men there was no significant difference between higher and lower consumers of fruit and vegetables. Furthermore, Greenwood et al (2000) found that those with a 'health conscious' diet consumed moderate amounts of wine, whilst those who were termed 'monotonous low-quantity omnivores' consumed alcohol in low quantities.

Differences in attitudes, knowledge, perception and lifestyle have been shown to be predictors of differences in the consumption of a healthy diet including fruit and vegetable consumption. It is therefore imperative to assess whether changes in physical access leads to increased consumption only in those who have the required attitudes, knowledge and lifestyle to enable changes in consumption to occur.

2.4.4 Buying and consuming and other barriers to consumption

Various studies have highlighted other issues that may impinge on individuals buying and consuming fruit and vegetables (Anderson et al 1998, Brug et al 1995a and 1995b, Connors et al 2001, Cox et al 1998, Treiman et al 1996). The most pertinent of these include issues of cooking - cooking skills, convenience, time, storage and preparation facilities, social influences and interactions, cultural influences and interactions, as well as matters of personal taste. These concerns are important to consider as they may raise issues of conflicting priorities in consuming fruit and vegetables.

2.4.4.1 Cooking skills, facilities and time to prepare

Women are still the primary source of meal preparation in the UK (Caraher et al 1999, Dixey 1996, Furey et al 2000, Murcott 2000), although it is acknowledged men now play a much more significant role than previously (Davies and Madran 1997). However, a number of these studies as well as others have questioned whether people of either sexes have the cooking skills available to them in order to prepare vegetables in particular but also to avoid having to rely upon convenience or pre-prepared dishes, that may be nutritionally inferior and comparatively expensive.

Review articles by Caraher (Caraher et al 1998, Caraher and Lang 1999, Caraher et al 1999) have highlighted the issue of (lack of) cooking skills and the possible implications. Caraher et al (1998, 1999) using data from the Health Education Authority's 1993 Health and Lifestyle survey showed that whilst overall there were a high percentage of respondents claiming confidence in cooking skills and how to cook foods, there were differences by particular techniques and for particular food groups. Men and women were both less likely to be confident over certain cooking techniques that could be construed as being 'healthy' alternatives, such as steaming, poaching and stir-frying compared to frying or roasting. Most women claimed to be confident cooking vegetables but nearly 25% of men were not confident. Additionally, people with lower incomes were significantly less likely to be confident in cooking vegetables. Allied to this, factors limiting food purchased, particularly for men included, the ability to store food, not knowing how to cook some foods, as well to a lesser extent limited cooking facilities.

Brug et al (1995a, 1995b) found that the perceived skills and time to prepare vegetables in particular was a potential barrier to their consumption, as has been found by numerous other studies (Anderson et al 1994, Treiman et al 1996). Indeed, Treiman et al (1996) found for a group of low-income women that time was a major barrier to increased consumption. Lappalainen et al (1997) found this to be particularly true for people with higher levels of education but may be linked to the fact that they also perceived lack of time to be a major barrier. As Wylie et al (1999) in a study of older people found that although facilities may be present in the household, they may not be suitable if a person was ill or had restricted mobility.

Whilst Caraher expresses the opinion that the case for cooking skills must not be over-emphasised and are only one part of food intake determination, they are important as they give people further options when deciding on foods. If an individual has no skills in cooking then they have restricted options in what they can eat, as there may also be a tendency to rely upon processed and pre-cooked foods (that often have high levels of fat, sugar and salt and are more expensive) but also they will not be as likely to use raw ingredients in their cooking such as fruit but in particular vegetables. Similarly without cooking skills, control over what is purchased and eaten may also be compromised, as there will also be little opportunity to try and diversify the diet to include healthier foods. This may be particularly pertinent when access to foods is improved, as it may be conjectured that foods will not be bought, as the individual will not know how to cook them. Furthermore, cooking and cooking skills are part of the wider framework of food choice involving menu planning, budgeting and purchasing (Furey et al 2000). This may be particularly important where there are limited financial resources, although Roux et al (2000) in a study of low-income families in France found that over 50% did not plan ahead when shopping.

Moreover, the lack of cooking skills may become more of an issue in future as many children will leave school with little or no knowledge of how to cook due to changes in the national curriculum (National Food Alliance 1997, Stitt 1996), particularly as Caraher et al (1999) showed that nearly 50% of women and 15% of men cited cookery classes at school as a source of education on cooking skills.

Conversely, several authors also warn, that as women are often responsible for the cooking of meals, that teaching of such skills does not become a way of shackling women to the kitchen at a time of sexual equality (Caraher and Lang 1999, Dixey 1996, Furey et al 2000).

2.4.4.2 Families, friends and social pressure

Whilst there are differences in the allocation of food within families (Nelson 1986, Wheeler 1991), families and households reportedly provide one of the most important sets of interpersonal relationships influencing food choice (Furst et al 1996, Stratton and Bromley 1999). This may be as food is often a focal point for families to sit down together when they might otherwise not do so. As Thompson et al (1999) found, those people who were single, widowed or divorced were statistically more likely to be a low fruit and vegetable consumer than a person who was married or living with a partner.

Often the food prepared for the family is a conglomerate of the different personal influences, needs, and wants of each family member, but also the type of family functioning that occurs i.e. conflicting or cohesive (Cullen et al 2000). However, in many cases there is a high level of reliance on mothers for food choices particularly for fruit and vegetable consumption, although other family members may be an influence (Brug et al 1995a and 1995b, Stratton and Bromley 1999). Indeed, a reason cited why consuming fruits and vegetables at meals were important was trying to set a good example for children (Cullen et al 2000, Treiman et al 1996).

This parent-child interaction is often a major determinant of food choice and intake (Cullen et al 2001). However, children (and partners) are sometimes seen as a barrier because they do not like or are not willing to try fruits and vegetables (Anderson et al 1994), but also children will learn from their parents and if certain foods are avoided this will be picked up by children (Baxter and Schröder 1997).

Nevertheless, acceptance of changes in the diet, for example consuming more fruit and vegetables, may be determined by the approval of family members. Furthermore, an individual's intake may be compromised by trying to fit in with what is going on around them or the inability to have different food if money or food is limited, as often is the case in low-income families (Dowler and Calvert 1995b). However, Dowler and Calvert (1995b) found that in low-income families the amount of fruit and vegetables eaten by parents increased if they did not buy food simply because their children would eat it.

2.4.4.3 Taste

Intake of certain foods may be limited by sensory perceptions and perceived aversions including taste (Furst et al 1996) and may be a major influence on intake as was found by Lennemäs et al (1997) as part of the pan-European study on food, nutrition and health. Indeed, in the UK it was the second most cited factor with 49% mentioning it, whilst in a study in the US by Glanz et al (1998) it was the most important factor in food choice ahead of cost, convenience, nutrition or weight control but also a major determinant of fruit and vegetable consumption.

Not surprisingly, Brug et al (1995) found that only those people who liked the taste of fruit and vegetables were eating them, whilst liking them were a major motivation for their consumption, findings which were also found by Treiman et al (1996). Furthermore, people may profess to prefer other foods instead of fruit and vegetables (Wandel 1995). However, Drewnoski et al (1999) argues that taste preferences are shaped by exposure and that most will come to like a food if they are exposed to it enough and with if it is placed in a positive social context. Equally, Baxter and Schröder (1997) contend that a reason that there is often a low intake of vegetables is due to lack of exposure at young age.

Summary

Even once fruit and vegetables have been purchased, there may be factors that impose upon the ability to consume. These in particular are likely to be issues of having the time, facilities and cooking skills to prepare fruit and vegetables, family acceptance and issues of individual taste.

2.5 Justification of research question

As has been established through the literature review, there are wide differences in fruit and vegetable consumption in the UK. These are underpinned by a framework of factors and decisions that affect an individual's ability to consume fruit and vegetables, and include the question of physical access to fruit and vegetables.

The changes in the geography of food retailing in the UK has led to the emergence of a group of 'disadvantaged' consumers. However, there is no evidence at present that an increase in the physical accessibility to a food store selling fruit and vegetables will actually contribute to there being an increase in consumption. This study sets out to test this theory, by investigating the changes in consumption after the opening of a locally accessible food store, but also by placing it in the context of availability, affordability, attitude and buying of fruit and vegetables which will affect the level of consumption.

Hence, the aim of this research is specifically to 'determine whether an increase in physical access to fruit and vegetables through the opening of a locally accessible superstore in an area of low fruit and vegetable consumption will lead to increased consumption of fruits and vegetables'.

Moreover, the hypothesis to be tested is 'people with poor physical access to fruit and vegetables, who have an increase in physical access to fruit and vegetables as a result of the opening of a superstore (exposure) will increase their consumption of fruit and vegetables by 20%, from an average of 2.88 portions per person per day to 3.46 portions per person per day (outcome)'.

The hypothesis constructed for this study was based on an increase of fruit and vegetable consumption of 20% (or at least 0.5) portions per day. Previous literature has shown that an increase of at least 0.5 portions per day is achievable (e.g. Ammerman et al 2002, Beresford et al 2001) and would have a significant effect on health (Joffe and Robertson 2001).

3 METHODOLOGY

The study was an uncontrolled intervention study. The intervention was the opening of a superstore in a geographical area of poor fruit and vegetable access and consumption.

3.1 The study area

The study was conducted in two contiguous wards in Leeds, namely Seacroft and Whinmoor, which are approximately 6km north east of the city centre. The area is divided by the main arterial ring road (A6120) that splits the area into two unequal parts – the larger western region is known as Seacroft, whilst the eastern side is further divided by the A64 (York Road) and has Whinmoor to the north and Stanks/Swarcliffe to the south (figures 3.1 and 3.2).

In the pre-intervention period, with the exception of an Asda superstore on the southern fringe of the study area and a small Netto discount store, there were very few food retail outlets in the area and those that existed sold a highly restricted range of fresh or frozen fruit and vegetables. A detailed observation of the study area and the immediate vicinity revealed only four 'green retailers' (those retail outlets selling a wide range of fresh fruit and vegetables) were located within the study area with another 'green retailer' within 500m of the study area boundary. These stores comprised three greengrocers (although all three sold other items alongside their fresh produce), the Netto discount store and the Asda superstore. Figure 3.2 shows the distribution of these 'green retailers' located disproportionately in the southern part of the Seacroft estate. Residents in both the northern region of the Seacroft estate and in the Stanks/Swarcliffe estates had no local 'green retailers'.

In the pre-intervention period the nearest superstore for the majority of residents in the study area was Asda at Killingbeck, a store situated within a retail park just off the busy A64 road to the south of the Seacroft estate. The nearest large cluster of retail outlets in the pre-intervention period (including several independent food shops, a small Tesco and a Kwik Save) was located at Cross Gates (Whelan et al 2002).

As a city, Leeds is the 40th most deprived local authority district in the UK, although some areas of the city have undergone a significant economic revitalisation in the last decade, although the study area does not appear to be one (Wrigley et al 2002). According to the

1991 census, the combined population of the two wards was approximately 38,000, the vast majority of whom were white, highly deprived and living in local authority housing (table 3.1).

Figure 3.1: Map of study area within the city of Leeds

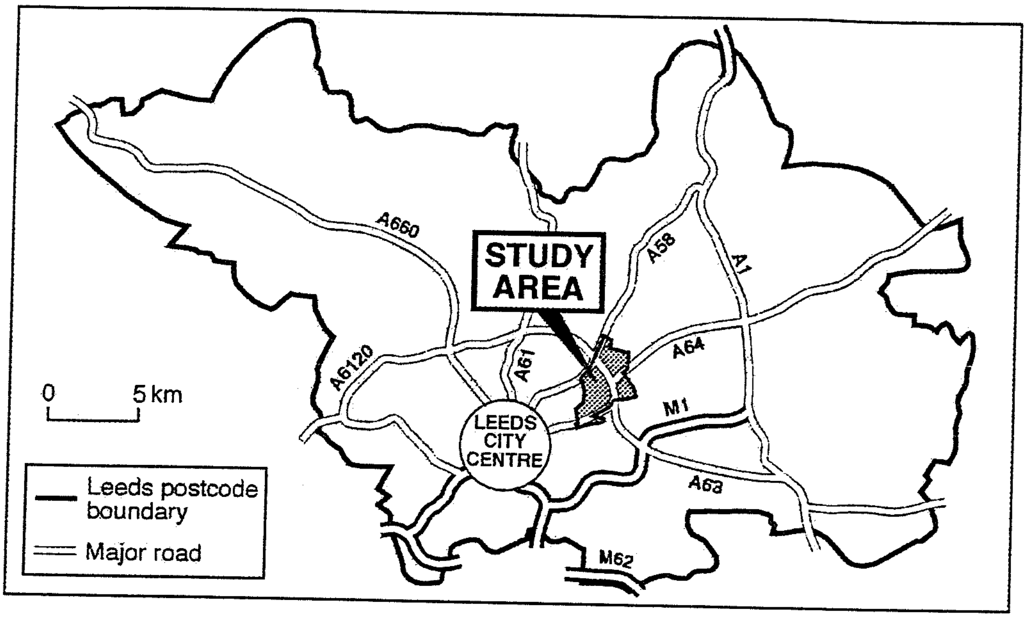
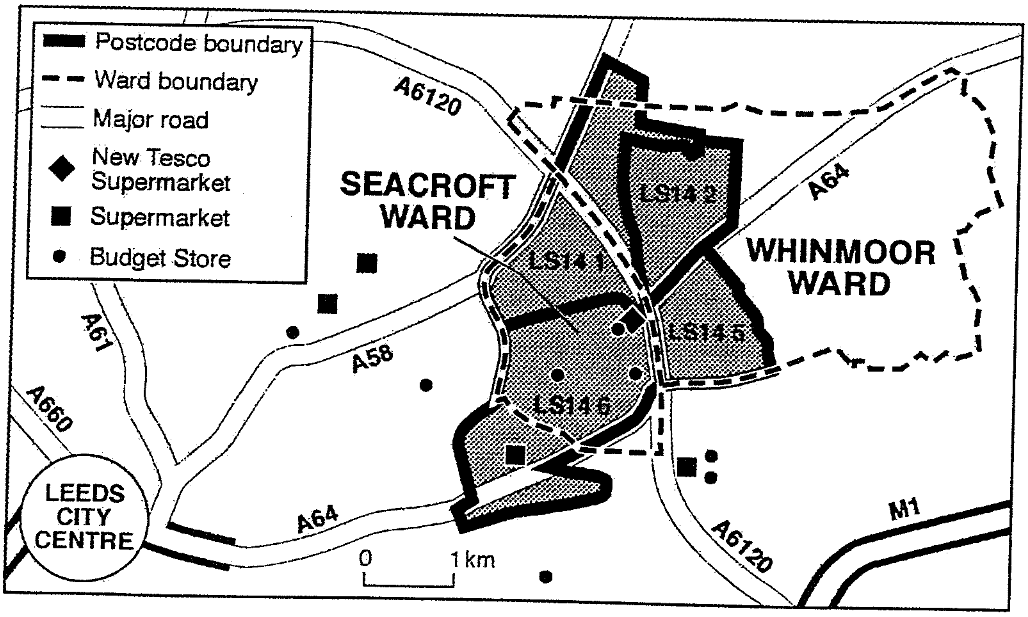


Figure 3.2: Map of study area



(Source of figures - Wrigley et al 2002)

Table 3.1: Social characteristics of research area*					
	Owner-occupied households (%)	No car households (%)	Lone parent households (%)	Male unemployment (%)	White (%)
Great Britain	66.4	33.4	3.8	9.8	94.5
Leeds	61.4	41.3	4.1	10.1	94.2
Seacroft ward	27.5	61.1	8.9	18.9	98.4
Whinmoor ward	49.8	43.2	5.2	9.8	97.7

*According to 1991 Census data (Office for Population Censuses and Surveys 1993)

A recent Department of Environment, Transport & the Regions commissioned report (2000) has produced a ward level deprivation ranking for all wards in England for a number of different summary measures (domains). Overall, Seacroft and Whinmoor were ranked 338th and 1948th out of 8414 wards, meaning that they were ranked within the top 5% and 25% respectively of deprived wards in England (table 3.2).

Table 3.2: Ward level index of multiple deprivation*			
	Seacroft	Whinmoor	Leeds
Overall	388	1948	-
Income domain	217	1486	4
Employment domain	452	1828	4
Health domain	663	1526	-
Education domain	900	3066	-
Housing domain	1216	2958	-
Access domain	6087	6263	-

*According to the Department of the Environment, Transport and the Regions (2000)
At ward level (i.e. Seacroft/Whinmoor) - 1 is most deprived ward, 8414 is least deprived ward. At district level (i.e. Leeds) - 1 is most deprived district, 354 is least deprived district.

According to table 3.2, Seacroft and Whinmoor appear to have 'good geographical access' to services, including a post-office, food shopping, a general practitioner and a primary school. However, it is not possible to disaggregate the components of the domain, and whether each component has equal waiting. Therefore, from this index it is not possible to say whether these wards have good access to food shops alone or not.

3.2 Study design

The study area was selected on the basis that there were few food retail outlets within easy physical access for the majority of people living within the wards (Clarke et al 2002, Whelan et al 2002). The area had a clearly defined postcode boundary that enabled easier enumeration of the target population. The postcode sectors included in the study were LS14

1, LS14 2, LS14 5 and LS14 6 (figures 3.1 and 3.2). Further to this, the study area was opportunistic, as it was known that a major superstore was to open within the area.

Participants to be studied were drawn from the LS14 1, LS14 2, LS14 5 and LS14 6 postcodes and were interviewed twice – once before the opening of the superstore (wave one/baseline) and once after the opening of the superstore (wave two/follow-up). Additionally, at the same time participants were to complete a self-administered prospective seven-day food checklist. The superstore opened in November 2000 whilst waves one and two data collection took place between the last weeks of May to the last week of July 2000 and 2001 respectively. The data collection was carried out at the same time of year in order to avoid the issue of seasonality of foods – i.e. because some foods are only available at certain times of the year and because dietary patterns change according to the time of the year (see chapter 7.1).

3.2.1 Wave one

Participants willing to participate in the study were asked to sign a consent form. They then completed a interviewer administered questionnaire including questions on age, gender, household size, number of children under 16 in the household, housing tenure, mobility issues, access to a car, education and employment, receipt of benefits, as well as their shopping practices and patterns.

Additionally, participants were asked to complete over the next week a prospective seven-day food checklist of all foods they consumed. The checklist contained 71 foods in 10 broad food groups – drinks, cereals/breads, eggs/dairy products/margarine/fats, jams/spreads, fruits, meat/fish/other main-food/soup, potatoes/rice/pasta/baked beans, vegetables (not including potatoes), desserts/sweet snacks/confectionery, and savoury snacks.

Subjects were asked to tick whether they ate each food at four meal events each day – at breakfast time, at lunchtime, at teatime/evening meal and at another time. Furthermore, within each meal the subject could indicate whether their serving size was small, medium or large. The checklist was self-completed, but checked by the interviewer when collected at the end of the seven-day period.

Along with the checklist, participants were asked to self-complete questions on factors affecting and limiting their food choices when shopping, their height and weight, smoking status, alcohol consumption and physical activity patterns.

3.2.2 Wave two

Interviewers returned to the household of each respondent from wave one of the study for recruitment into wave two. Wave two respondents had to be the person within the household who completed wave one of data collection. Participants willing to take part further in the study were then asked to sign another consent form. Participants then completed another interviewer led questionnaire based on the first questionnaire but with some changes intended to further explore use/non use of the new superstore. Additionally, the respondents were given the same seven-day checklist to complete which was once again self-completed but checked by the interviewer when collected at the end of the seven-day period.

Along with the checklist, participants were asked to self-complete questions on factors affecting and limiting their food choices when shopping, but also any reasons why their food intake may have changed over the previous twelve months, their perceived health over the previous twelve months and their own perceived changes in intake of certain food groups, including fruits and vegetables, over the previous twelve months.

3.3 Study recruitment

3.3.1 Wave one - Selection of potential households for study

According to the 1991 census, the type of housing, age of residents, and economic status within and between the two wards of Seacroft and Whinmoor were not homogeneous. In order to recruit a representative sample of the population and to allow for stratification of the sample for analysis (e.g. by age, economic status and physical access to shops) a sampling strategy was devised to reflect the diversity of the population.

A local geographer in Leeds with considerable experience in mapping postcode level information gave advice in order to fully define the study area and its boundaries. The sample was to be drawn from specified postcodes sectors, namely LS14 1, LS14 2, LS14 5 and LS14 6 that make up the majority of the wards in question (figure 3.2). To further define the sampling frame, use was made of a small area postcode file, which is a list of the first six digits of all postcodes within the sectors. There are approximately 140 addresses within each small postcode area. The file was used to define 100 randomly chosen sampling points.

The aim was to recruit 14 addresses (approximately a 1 in 10 sample) within each sampling point, starting at a randomly selected, but predetermined address. The objective was to continue recruiting until at least 1000 subjects completed all aspects of data collection (interviewer administered questionnaire and a self-completed seven-day checklist, plus self-administered questions).

3.3.1.1 Recruitment of individuals from households into study

Interviewers from a large international market research company undertook study recruitment and data collection. With advice from the research team, all were carefully trained according to common standards to carry out the different aspects of data collection. All aspects of recruitment were in line with local ethical approval granted for the study by the Leeds Health Authority/St James's and Seacroft University Hospitals Clinical Research Ethics Committee.

In-line with ethical considerations, participants were told the general nature of the project at the point of initial recruitment. However, at this point they were not told of the specific analysis of fruit and vegetable consumption, as this was one of many areas of analysis to be undertaken as part of the larger project from which this thesis was derived. At each stage (i.e. at both waves one and two) a voucher incentive was offered to the participant. However, this was not rewarded until after the collection of the seven-day food checklist by the interviewer, in order to avoid any potential biases. Furthermore, the voucher (for the Kingfisher group including the B&Q, Comet, MVC, Woolworth and Superdrug stores) was not redeemable for food, and was to the value of £5 at each wave of data collection. A further voucher of £2 was offered to those people approached and agreeing to participate in the repeatability study.

Recruitment of individuals was subject to a number of inclusion and exclusion criteria. The person to be recruited needed to be 17 years or older and to be the person principally responsible for domestic arrangements in the household. Furthermore, the new superstore in conjunction with the local family learning centre had set up a series of adult education classes in order to prepare people for employment in the new superstore. Therefore, anybody attending these classes was excluded as they were thought to be unrepresentative of the population.

Using their predetermined starting points, interviewers approached each household to initiate recruitment. If the household was vacant or nobody was at home, the interviewer moved onto the next household. When contact was made, the interviewer asked for the person in the household aged 17 years or over who was the person principally responsible for domestic arrangements (man or woman) – as in accordance with the National Food Survey. The rationale being that this person would have the greatest knowledge of the households' food shopping patterns and constraints. If the person was not available, enquires were made to establish when an appropriate time to call back would be.

If and when the appropriate person was contacted, the general nature of the study and what would be expected of them was explained. However, the interviewer did not indicate that the study was investigating the effect on food patterns due to the opening of the new superstore. If the person did not wish to take part, the interviewer left immediately. However, if the individual agreed to participate, the interviewer gave further details of the information to be collected and a time was made to conduct the interviewer-administered questionnaire. Only once the questionnaire had been completed were the methods required for the completion of the self-completed seven-day checklist described.

One week after the seven-day checklist were placed, the interviewer returned to collect it but only after it was checked over for completeness. This was intended to allow a degree of quality control within the fieldwork. Once the interviewers had collected the data, both the questionnaire and checklist were returned to the market research company for data entry. Data entry was performed by means of scanning, and so negated the issue of transcription errors or the need for double-checking. This method was also used for wave two data collection.

3.3.2 Wave two

The aim was to recruit all respondents from wave one of the study into wave two of the study. However, it was expected that due to loss at follow up (people moving away, non contact at house and people refusing to participate further) only approximately a 60%

response rate would be achieved. With respect to this, the sample size calculation of the number of respondents required was estimated on the number of people that needed to be recruited into wave two in order to assess differences in fruit and vegetable consumption, but bearing in mind that there would be approximately a 40% non-response rate in wave two.

Starting with a list of all households involved in wave one of the study, interviewers from the same market research company returned to all households in order to recruit the same individual who completed wave one of the study into wave two of the study. If no contact was made with the required respondent, interviewers returned to the house on a number of occasions in order to recruit them.

If and when the appropriate person was contacted, they were reminded of the general nature of the study and what would be expected. If the person did not wish to take part further, the interviewer left immediately. However, if the individual agreed to participate, the interviewer gave further details of the information to be collected and a time was made to conduct the interviewer-administered questionnaire. Only once the questionnaire had been completed were the respondents supplied with the seven-day checklist. One week after the seven-day checklist were placed, the interviewer returned to collect it but only after it was checked over for completeness.

3.4 Research tools

The information from respondents was gathered by means of an interviewer led questionnaire and a respondent self-completed (but interviewer checked) seven-day food checklist and questionnaire.

3.4.1 Questionnaire and food checklist development

The development of the questionnaire and food checklist was led by a public health nutritionist but aided by the study management team, which comprised public health nutritionists, geographers, town planners, representatives of the food retail industry and the market research company undertaking the fieldwork. Several meetings and correspondence were undertaken in order to work out any problems that had arisen during development and to ensure the relevance of the questions, readability, and ease of response, as well as limiting any possible ambiguities.

As time and resources were limited, where possible the questionnaire was based on questions from previous large-scale and well-known nationally representative studies of food and nutrition habits in the UK, such as the Health Education Authority's Health and Lifestyle survey. This approach was envisaged to overcome potential problems of respondent understanding of questions. Furthermore, the market research company involved in the fieldwork have been responsible for administering the Family Food Panel survey (Taylor Nelson Sofres 2002) to a nationally representative sample of UK residents, and advised us on wording and structural issues aimed at improving respondent understanding and response rates.

The seven-day food checklist was based on the food frequency questionnaire developed by the Health Education Authority (HEA3) which members of the study team had been previously involved in validating for use by general practitioners (Little et al 1999). However, for the purposes of the study there was alteration of some of the food groups in order that changes perceived to be important could be assessed before and after the opening of the superstore. This was once again done under the guidance of the study management team. The validity of the tool in this population was not assessed but its repeatability was (for rationale see chapter 7).

At first it had been hoped that the questionnaire and food-checklist could be administered by post. In order to test this assumption, the market research company mailed 120 questionnaires and checklists out to a random sample of residents in the study area. A response rate of 6% was achieved, whilst 2.5% of forms were returned as undeliverable. In order to establish what had happened, 16 of those respondents who had not returned their forms were contacted. Six respondents claimed not to have received them although crosschecking showed that they had been named and addressed correctly. The remainder said that they had received the forms but decided not to fill them out, whilst two people commented that they might have filled the forms in if there had been a substantial cash incentive.

Following the postal administration and respondent feedback, as well as subsequent discussions with the study management team, it was decided that in order to achieve the numbers required for the study an alternative approach was required. It was therefore decided that an interviewer-based approach was needed. In order to assess this approach a period of pilot testing was entered into. Interviewers entered the study area in mid-April 2000 and questioned 119 respondents (although seven households were approached for every successful placement), who were also left the seven-day checklist for completion. Of these 119 checklists, 105 (88%) had been completed on collection by the interviewer.

Interviewer feedback was positive and largely in agreement that respondents found no significant problems in filling out either the questionnaire or checklist. Therefore, it was felt that no amendments were needed to either tool, and that their full administration to the study population could begin.

3.4.2 Specific measures within questionnaire and checklist

In order to assess the links in the framework as described in chapter 1.3 used to study the relationship between changes in physical access to fruit and vegetables (the exposure), and their consumption (the outcome), it is necessary to highlight the measures within the questionnaire and checklist that enable this relationship to be examined.

1. Changes in access to fruit and vegetables (exposure)

Questionnaire:

Store used for main shopping

Store used for fruit and vegetable shopping

2. Availability of fruit and vegetables

Questionnaire:

Assessment of availability, range and quality of fresh fruits and vegetables

3. Affordability of fruit and vegetables

Questionnaire:

Household income level

Housing tenure

Employment status of respondent

Unemployment in household

State benefit receivership

4. Attitudes towards fruit and vegetables

Questionnaire:

Assessment of attitude statements

5. Factors impinging on the buying and consumption of fruit and vegetables

Questionnaire:

Factors affecting and limiting the choice of foods bought

6. The buying and consumption of fruit and vegetables (outcome measure)

Seven-day food checklist:

Consumption of fruit and vegetables

Fruit and vegetable consumption were assessed by means of a seven day food checklist (Appendix 1) with opportunity to select for different times of the day – breakfast time, lunch time, teatime/evening meal, all other times, and portion size – small, medium or large, although subsequent advice has been not to differentiate between portion sizes (Cade – personal communication). Interviewers gave the checklist to respondents consenting to participate in the study and the interviewer collected the checklists one week later. Detailed oral and written instructions with an example of how to fill the checklist in were given. The interviewer checked each diary at the time of submission for completeness. They were all analysed at a later date, including those received during the pilot phase.

According to the National Heart Forum (1997) there is no clear definition of what a fruit and/or a vegetable may be defined as other than in biological terms or as accepted by common sense. For the purposes of this thesis, composite or mixed dishes were not included, nor were potatoes and other starchy staples, non-fruit juices, or nuts. Fruits were defined as real (100%) fruit juices (upto a maximum of one portion per day), apples/pears, oranges/tangerines/lemons, bananas, peaches, dried fruit, other fruit, whilst vegetables were defined as carrots, peas/beans, broccoli/cauliflower/cabbage, tomatoes, salad/raw vegetables, processed vegetables, other vegetables, and baked beans, and all were counted regardless of presentation (i.e. fresh, frozen or tinned).

All intakes subsequently quoted in this thesis were expressed as portions per day, and were calculated by summing the number of times each fruit and vegetable was marked on the checklist and dividing by seven.

7. Other measures

Questionnaire:

Gender of respondent

Age of respondent

Household size

Number of children in house under the age of 16 years

Car access

Education level of respondent

Mode of transport used to access main store

Mode of transport used to access fruit and vegetable store (wave two only)

Factors affecting and limiting food choice

Smoking status of respondent

Height of respondent (wave one only)

Weight of respondent (wave one only)

Alcohol consumption of respondent (wave one only)

Physical activity patterns of respondent (wave one only)

Reasons why new superstore used/not used (wave two only)

Reasons why food consumption of respondent may have changed between wave one and wave two (wave two only)

Self-perceived changes in food group consumption of respondent, including fruits and vegetables between wave one and wave two (wave two only)

3.5 Dietary assessment methodology

There is a range of dietary assessment methodologies available for research purposes, although the method chosen must be 'fit for purpose' in that it must fulfil the requirements needed to meet the research objectives. This study required a dietary assessment methodology that allowed for assessment of fruit and vegetable consumption at two points in time, and to assess the differences between them (i.e. the change in consumption). Additionally, it was important to assess both within person day-to-day changes in consumption and within person changes between the two waves of data collection. Furthermore, the group under assessment may lead to constraints on the type of methodology used, and so for these reasons a checklist approach was chosen after consideration of other methods.

Whilst weighed records are often referred to as the gold standard of dietary assessment methodologies, it is generally acknowledged that they are difficult to undertake and can be labour intensive, which may lead to a lower response rate (Bingham 1988). Furthermore, in a large sample such as this one, the feasibility of using such a method is difficult, and therefore this method was rejected. This was also felt to be true of unweighed or estimated records.

Food frequency questionnaires were not used as it is difficult to assess within person variations in diet with them and they do not allow easy assessment of day-to-day changes in consumption. Furthermore, it can be difficult to use this method to assess trends over time (Cade et al 2001). Like food frequency questionnaires, single 24-hour recalls do not allow for day-to-day variations in diet to be determined (Nelson and Bingham 1998), whilst multiple 24-recalls do allow for such comparisons to be assessed but are expensive and not easily feasible in large samples. Additionally, these methods are both retrospective in nature and it was necessary to have a prospective methodology that did not rely on memory and could be filled out on a daily basis.

Checklists have the advantages of being prospective in nature, may be self-administered, are easy to complete (only requiring the ticking off of any foods eaten), and allow the assessment of multiple days of consumption as well as between day variations. Checklists have been shown to compare well with other dietary assessment methodologies. In studies by Bingham et al (1994, 1995) a checklist when compared to 16 days of weighed records showed good agreement for both daily food consumption values and daily nutrients intakes, although there was a significant difference in the estimation of vegetable intake by which the checklist may have underestimated intake. Bingham and colleagues also demonstrated that for nutrient intakes the classification in fourths obtained from the checklist compared to 16 days of weighed records ranged from 45% for starch to 76% for alcohol, whilst misclassification into the extreme fourths of the distribution were all under 4% (Bingham et al 1994). Unfortunately there are no figures to show how well individuals were classified across the distribution for different food groups.

In the 1995 study, Bingham and colleagues collected 24-hour urine samples to assess nitrogen excretion and therefore energy balance. When correlations were made between nitrogen as derived from the diet and the urine collections, the checklist was outperformed by only 16 days of weighed records and a 7 day estimated diary, with an overall correlation of 0.38.

In a further study, Little et al (1999, 2000) assessed the relative validity for a range of dietary assessment tools including a seven-day checklist against seven-day weighed records, in 111 patients seen in Primary Care. This study presented the agreement for nutrients and also food groups, including fruits and vegetables. The authors suggest that the checklist may slightly over-estimate the intake of fruit and vegetables but in general had a good correlation (coefficient) between itself and the seven-day weighed record, meaning that there is good agreement between the fruit and vegetable consumption as assessed by the two dietary assessment methodologies. This statistic is important as it shows that the measure of fruit and vegetable consumption by the checklist is likely to be a true reflection of what is actually being consumed by the respondents. Additionally, the authors also showed that the checklist had good sensitivity (the measure of correctly identifying exposure) and specificity (the measure of correctly identifying non-exposure) (Little et al 2000).

The rationale for using seven-days was to allow for variation over the period of the week to be examined. It has been shown that food intake including fruit and vegetable consumption differs over a week, for example at the weekend compared to weekdays. Bingham (1988) estimates that for group levels of intake, three to four days are required, but that for assessment of within-person differences more days may be needed.

Using the equation $k=\%cv^2/(\%se)^2$ (Bingham 1988), where k is the number of days required, cv is the coefficient of variation (where cv=(standard deviation/mean)*100) and se is the standard error, it is possible to calculate the number of days needed to assess fruit and vegetables consumption. If it is assumed that mean average is three portions per person per day (i.e. the national average according to Gregory et al 1990), that the within-person variance (variation) in consumption from the mean is three portions per person per day (based on wave one consumption figures) and that the standard error of consumption is 0.75

portions per day (based on wave one consumption figures), then how many days are required can be calculated using the stated calculation (figure 3.3)

Therefore, it is estimated that seven-days will be sufficient to calculate fruit and vegetable consumption in wave one of the study. This will be the same for wave two, assuming that there is an increase in consumption but the variance and standard error structures do not change. However, once the results have been analysed it will be possible to work back through the calculation in order to see if seven-days were sufficient or not.

Figure 3.3: Calculation of the number of days required for checklist

Step 1: calculate the coefficient of variation (cv)
cv = (√variance/mean) x 100
cv = (√3/3) x 100
cv = 0.58 x 100
cv = 58.0

Step 2: calculate the percentage standard error (se)
%se = (se/mean) x 100
%se = (0.75/3.0) x 100
%se = 0.25 x 100
%se = 25.0

Step 3: calculate k
k = $(58.0)^2/(25.0)^2$
k = 3364/625
k = 5.4days

3.6 Validation and repeatability of the seven-day food checklist

It is important to have a true measure of consumption in order that it can be shown that any changes in consumption are due to changes in exposure and are not a reporting error of the instrument used, i.e. the checklist, therefore the validity of the checklist is vital. Validity is the degree to which a measurement is a true and accurate measure of what it purports to measure (Nelson 1997). For a tool to be properly validated it must be administered in the same population in which it is to be used. Although the checklist has been previously validated (Little et al 1999, 2000) it was not in the same population as for this study, which is an acknowledged limitation of the study. Furthermore, the lack of a potentially valid tool does have serious implications for this study. If the checklist has not been validated then it is not possible to be sure with any degree of accuracy that the tool actually measures what it sets out to measure (i.e. fruit and vegetable consumption). In an ideal situation, the checklist would be measured against another dietary assessment instrument (a standard) such as a seven-day weighed record (or a biological marker if appropriate) in order to test how 'well' the checklist measured fruit and vegetable consumption – i.e. to assess the degree of agreement between the two measures. Consequently, the underlying issue here is whether the data derived from the checklist can be believed or not, and therefore in this study it can only be assumed that results are an accurate representation of what is actually consumed (see chapter 7.2).

However, as the results derived in this study are not for comparison with other studies but for within-person and within-group changes of fruit and vegetable consumption due to a change in physical access within the study group only, the issue of repeatability it may be argued is much more pertinent (see chapter 4). Repeatability is the extent to which a dietary assessment tool is capable of producing the same result when used repeatedly in the same circumstances. The study tool, i.e. the checklist, must be able to pick up differences in fruit and vegetable consumption between the two waves of data collection. If the tool does not allow for repeatability, it is not possible with any degree of certainty to be sure that any difference found between the two waves of data collection are a true variation in consumption rather than measurement error inherent in the tool. Therefore, a repeatability study on the seven-day checklist was performed (see chapter 4).

In order to interpret the results of this study it is important to have some confidence in the accuracy of the measure of fruit and vegetable intake. Although the checklist had been previously validated, the population for that previous validation were likely to have been better educated and more motivated than the sample used in the present study. The construct validity of the checklist was established before the study began, but not the relative validity in this population, such that there may be either over or under reporting of intake. The potential error introduced by the use of the checklist may have attenuated the true effect, and reduced the power of the study.

The use of self-administered dietary assessment methodologies such as the seven-day checklist employed in this study needs to be carefully considered, particularly with respect to use in low-income populations. Issues that are particularly pertinent are those of literacy levels, language barriers and compliance, whereby people may be excluded unnecessarily or the qualities of the data returned are poor.

3.7 Sample size calculation

The aim of this study is to explore the changes in fruit and vegetable intake by changes in physical access to fruit and vegetables. However, as the framework indicated in section 1.2 shows, it is important to analyse the data by differences in accessibility, affordability, attitudes and consumption. Additionally, it will be important to stratify each variable by socio-demographic characteristics such as age, gender and socio-economic status. Therefore, it is important to calculate how many subjects would be required in order to determine any relationship with any degree of certainty (i.e. the results are not due to chance but to a true relationship) and in order to do this it is necessary to calculate the sample size. In general the more subjects in the sample the less likely that a result is due to chance, although a very large sample may not be feasible.

Two factors in any sample size calculation that need to be addressed are level of significance and power. Significance is the level to which the results found are not due to chance, whilst power is the probability that a negative result is actually true. Depending on the type of analysis that will be undertaken, different calculations are required in order to correctly calculate the sample size.

3.7.1 Calculation of continuous variables

To calculate the sample size for continuous variables such as fruit and vegetable consumption, the following formula may be used (Cole 1997):

$$n=2\frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2}{(d^*/\sigma)^2}$$

Where:

n is the total number of subjects

d^* is the difference between the groups to be detected – in this case the number of portions of fruit and vegetables consumed per day,

σ is the standard deviation of fruit and vegetable consumption per day,

Z_1-α is the significance level,

Z_1 -ß is the power.

In order to show the variation in possible group size (i.e. the minimum number per group), table 3.3 shows the results of a number of sample size calculations based on different expected changes in fruit and vegetable consumption (d*) between the two waves of data collection, differences in the level of power and statistical significance $(Z_{1-\alpha/2} + Z_{1-\beta})^2$ and variations in the standard deviation of fruit and vegetable consumption (σ). As can be seen depending on the level of power and significance, the numbers required in these examples can vary between 12 and 458 respondents per group. An example of the workings of the calculation is given below in figure 3.4. Note the value of the term $(Z_{1-\alpha/2} + Z_{1-\beta})^2$ will depend on the level of significance and power required, for example for 95% level of significance and 80% power the figure is 7.8, whilst for 99% significance and 90% power the figure is 14.9 (Cole 1997).

Table 3.3: Number of people needed per group for continuous variables

Standard deviation of fruit and vegetable consumption (σ)	Power & statistical significance $(Z_{1-\alpha/2} + Z_{1-\beta})^2$	Change in consumption of fruit and vegetables - portions per day (d*)		
		0.5	1.0	1.5
1.96	80% and 5%	240	60	26
	80% and 1%	360	90	40
	90% and 5%	323	81	36
	90% and 1%	458	115	51
1.30	80% and 5%	104	26	12
	80% and 1%	156	40	18
	90% and 5%	140	36	16
	90% and 1%	199	51	22

Figure 3.4: Example of power calculation for continuous variables

Based on an increase of 1.0 portions of fruit and vegetables per day (d*), with a standard deviation of 1.96 portions per day (σ), and with 80% power and 5% statistical significance $(Z_{1-\alpha/2} + Z_{1-\beta})^2$.

$$n=2\frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2}{(d^*/\sigma)^2}$$

From Cole (1997) it is known that $(Z_{1-\alpha/2} + Z_{1-\beta})^2$ for 80% power and 5% statistical significance is 7.8.

Therefore the calculation is

$$n= 2\frac{(7.8)}{(1.0/1.96)^2}$$

n=60

However, it is necessary to multiply this figure by the number of different groups that the data will be analysed by. For example, if gender (2 groups) and age (5 groups) are examined, the total number needed would be 60 x (2 x 5) = 600 respondents in total.

3.7.2 Calculation of proportions

Apart from group changes in fruit and vegetable consumption, in this study it is important to investigate proportion of respondents affected by either the exposure (i.e. changes in physical access) or the outcome (changes in fruit and vegetable consumption). In order to calculate how many respondents will be within each proportion, it important to assess how many respondents will be needed in total. Therefore, as before it is necessary to perform a sample size calculation.

For this type of analyses, the sample size calculation as derived by Cole (1997) is,

$p_0 = p(1+r)/(RR+r)$

Where:

p_0 is the number of people without physical access to fruits and vegetables,

r is the proportion of people e.g. with higher intake of fruit and vegetables,

RR is the relative risk of the exposure/outcome i.e. of being a higher consumer of fruit and vegetables.

As can be seen in these examples, depending on the level of power and significance, as well as the other terms, the number of people in the sample required can vary between 90 and 3770 respondents (table 3.4).

Table 3.4: Number of people needed in sample for proportions

r	p_o	Power & statistical significance $(Z_{1-\alpha/2} + Z_{1-\beta})^2$	Size of relative risk (RR)		
			1.5	2.0	2.5
9:1	0.1	80% and 5%	3770	1106	578
4:1	0.1	80% and 5%	2165	622	325
2:1	0.1	80% and 5%	1560	448	234
9:1	0.2	80% and 5%	794	486	222
4:1	0.2	80% and 5%	447	271	125
2:1	0.2	80% and 5%	322	231	90

Note as previously shown the value of the term $(Z_{1-\alpha/2} + Z_{1-\beta})^2$ will depend on the level of significance and power required, for example for 95% level of significance and 80% power the figure is 7.8, whilst for 99% significance and 90% power the figure is 14.9 (Cole 1997).

Figure 3.5: Example of power calculation for proportions

Based on an assumption that p_o (the number of people without physical access to fruit and vegetables) is 0.2 (or 20%), that the relative risk (RR) of being a higher consumer of fruit and vegetables is 2.0, that r (the proportion of people with higher intakes) is 9:1 and with 80% power and 5% statistical significance $(Z_{1-\alpha/2} + Z_{1-\beta})^2$.

$p_0 = p(1+r)/(RR+r)$

$p_1 = p_0 \times RR$
$p_1=0.2 \times 2$
$p_1=0.4$
Where p_1 is the remaining number of people (i.e. with physical access)

$p=(p_0 + p_1)/2$
$p=(0.2 + 0.4)/2$
$p=0.3$

$d^*= p_1 - p_0$
$d^*=0.4 - 0.2$
$d^*=0.2$
Where d* is the is the change in fruit and vegetable consumption

$f=d^*/(\sqrt{p}(1-p)$
$f=0.2/(\sqrt{0.3}\ (1-0.3)$
$f=0.43$
Where f is a fraction of the standard deviation of d*

$n=(r+1/2r) \times 2((Z_{1-\alpha/2} + Z_{1-\beta})^2/f^2)$
$n=(10/18) \times 2\ (7.8/0.18)$
$n=48.6$
Where n is the number of people required

but total sample size is n(1+r)
= 48.6 (1+9)
= 486 people in total.

Therefore based on the calculation presented in figure 3.5, it was estimated that at least 486 people would be required in the final sample in order to assess potential changes in the proportion of respondents classified as either lower or higher intake consumers between the two waves of data collection.

3.8 Statistical analysis

The baseline (wave one) outcome i.e. fruit and vegetable consumption before the opening of the superstore has been compared with the follow-up (wave two) outcome after the opening of the superstore in order to assess changes in fruit and vegetable consumption due to changes in physical access.

Data obtained for each respondent was entered into a statistical spreadsheet (SPSS for Windows Version 10.0). The normality of the data were tested against normal distribution using a number of different procedures (e.g. one sample Kolmogorov-Smirnov test, plots of histograms against a normal curve) and showed that absolute intakes at waves one and two were skewed with 'long-tails' for high intake respondents, but that change in consumption was normally distributed. At an individual level, people who were self-reported high intake consumers at wave one, also tended to be high reporters at wave two, hence the normality for the distribution of change. Where ranking was used to categorise people, the wave one and two consumption levels were transformed using logs but were still skewed. Sub-set analyses were undertaken with those with the highest levels of consumption removed; this made little difference to the average effects such that potential outliers did not influence group ranking. However, because of the large sample and the fact that the change in consumption was normally distributed, parametric tests were used to analyse changes in fruit and vegetable consumption levels.

In order to explore the overall hypothesis of the study and the factors within the proposed framework of consumption ANOVA, chi-square, paired and independent sample t-tests were used to assess differences in consumption levels and proportions within variables, as well as to explore the general nature of the data. However, once these simpler techniques had been used it was necessary to employ more sophisticated tests such as regression analysis (both logistic and multivariate) to explore the factors that influenced overall/absolute changes in consumption levels.

The data at each level of the framework of consumption was stratified by the same set of variables found at baseline to be significant predictors of higher and lower fruit and vegetable consumption, namely; age, smoking status, educational attainment, attitude towards healthy eating, household deprivation marker score and the number of children in the household under the age 16 years. In addition, consumption changes were stratified by levels of wave one fruit and vegetable consumption.

4 REPEATABILITY STUDY

This chapter reviews the repeatability study performed on the (respondent) self-administered prospective seven-day checklist.

4.1 Rationale for repeatability study

Repeatability (sometimes referred to as reliability or reproducibility) refers to the consistency with which a *'measure of exposure measures that exposure'* (Margetts and Nelson 1997, p242) and thus may be defined as the degree to which a method yields similar results on two different occasions (i.e. a dietary assessment measure should be capable of producing the same result when used repeatedly in the same circumstances). This study was designed to assess fruit and vegetable consumption on two separate occasions approximately one year apart using a prospective self-administered seven-day checklist, thus the repeatability of the study tool is pertinent.

The study tool (i.e. the seven-day checklist) must be able to pick up differences in fruit and vegetable consumption between the two waves of data collection. If the checklist does not allow for repeatability, it is not possible with any degree of certainty to be sure that any difference found between the two waves of data collection are a true variation in consumption rather than measurement error inherent in the tool, i.e. it can not be valid (Margetts and Nelson 1997, Willett 1998). Therefore, a repeatability study on the seven-day checklist was performed.

4.2 Methodology for repeatability study

In order to perform the repeatability study of the seven-day checklist, it is important to make sure that it measures fruit and vegetable intake as accurately in the low consumers as it does in the high consumers in order that stratified analyses may be undertaken. Therefore, to undertake a repeatability study it was necessary to select respondents who are at the extremes of fruit and vegetable intake.

As resources to undertake such a study were limited, the findings from wave one of data collection were used to inform the repeatability study. Results from wave one showed that age was one of the strongest predictors of fruit and vegetable intake in this population – in adjusted analysis those people aged 45 years and over had on average 1.4 more portions per day of fruit and vegetables than those aged 44 years and under. Therefore, in order to target effectively the higher and lower consumers of fruit and vegetables i.e. those at the extremes of intake, age was used to select respondents for the repeatability study. High consumers of fruit and vegetables were those aged 45 years and over, whilst low consumers were those aged 44 years and under.

It was estimated that to assess repeatability it would be necessary to have approximately 50 people in each of the two groups (44 years and under and 45 years and over) i.e. 100 in total. It was estimated that a 50% response rate could be obtained if the process of recruitment was done efficiently, therefore approximately 200 would need to be placed with potential respondents. The placement of checklists for the repeatability study utilised the existing interviewers from the market research company who were in place for wave two of data collection in the main study. As the interviewers collected the seven- day checklist from wave two, they inquired if the respondent (if they fitted the inclusion criteria of age – 45 years and over or 44 years and under) if they wished to complete a repeatability seven-day checklist. If they agreed to take part, they were supplied with a further checklist and a prepaid envelope addressed to the market research company in order to return it for data entry.

4.2.1 Subject recruitment

There were 51 sampling points to be used in wave 2 of data collection, and so it was proposed that the interviewers distribute the repeatability checklists to the first two respondents of each age group (44 years and under and 45 years and over) within each of these 51 sampling points. This would potentially give 204 checklists 'placed' with the same person who has completed a wave two questionnaire and checklist.

4.3 Results for repeatability study

4.3.1 Response rate and sample profile

The total number of checklists placed as described in chapter 4.2 is unknown but could not exceed 204. However 143 completed questionnaires were returned, but three were omitted due to incompleteness, representing a minimum of response rate of 69% (figure 4.1). No information is available on non-responders.

Table 4.1 shows the sample profile of the respondents completing the repeatability study and comparing them to the sample from which they were drawn (i.e. those completing wave two of data collection, n=615). Overall, the repeatability sample is statistically representative of the sample from which it was drawn i.e. those completing wave two of data collection, although the young (44 years and under), those with children and smokers are slightly over-represented but not to a statistically significant level.

Figure 4.1: Recruitment and response rate for repeatability data collection

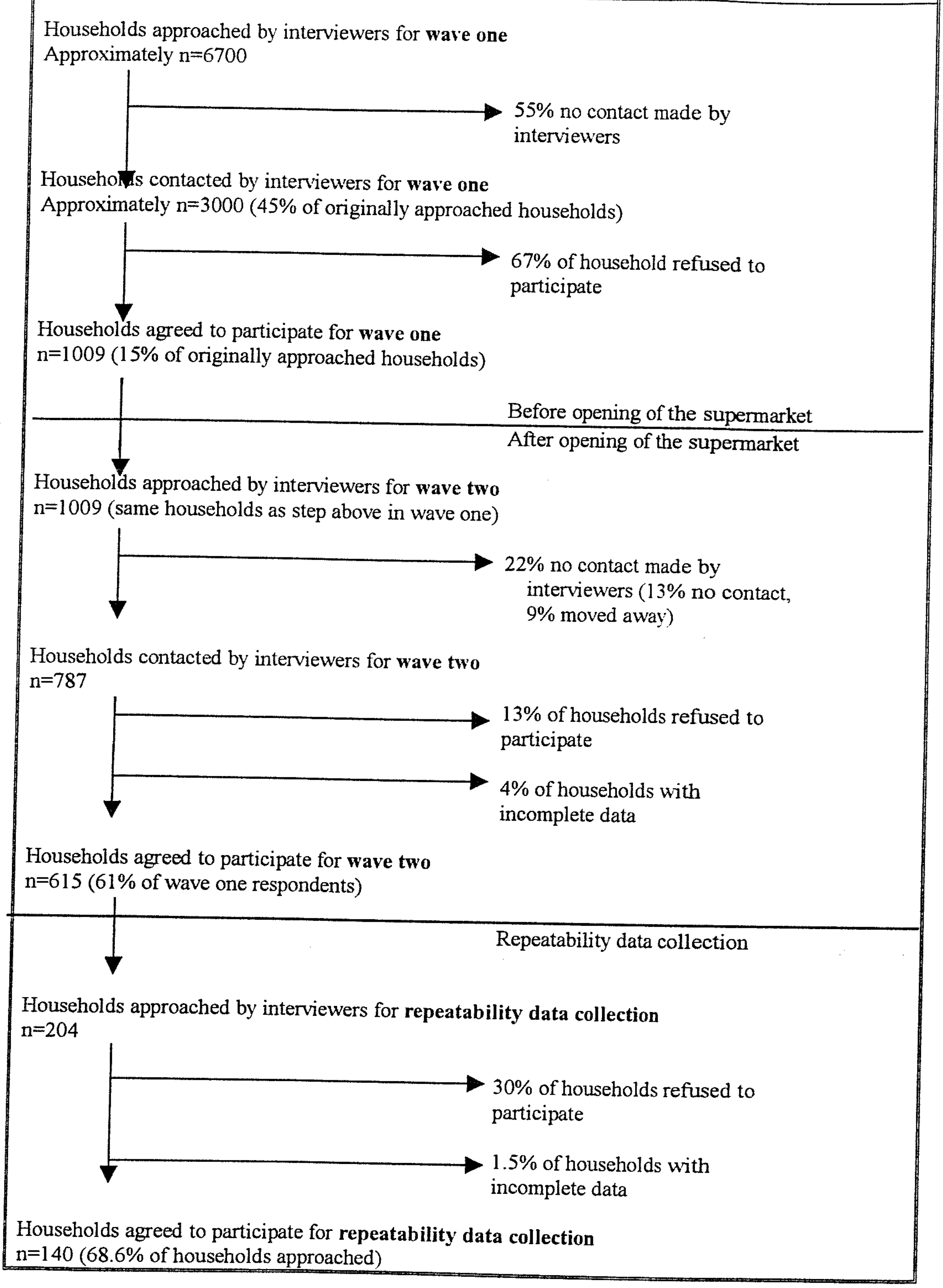


Table 4.1: Sample profile by individual and household socio-demographic variables for repeatability study			
Variable	Repeatability study - number (percentage) n=140	Full sample - number (percentage) n=615	Chi-square test
Gender			
Female	124 (88.6)	519 (84.4)	χ^2=2.406 p=0.121
Age			
17-44 years	77 (55.0)	304 (49.4)	χ^2=2.249 p=0.134
45+ years	63 (45.0)	311 (50.6)	
Employment status			
Full-time/part-time work	51 (36.4)	243 (39.6)	χ^2=3.825 p=0.575
Unemployed	8 (5.7)	28 (4.6)	
Retired	36 (25.7)	175 (28.5)	
Full-time education	2 (1.4)	13 (2.1)	
Housewife/husband	42 (30.0)	154 (25.0)	
Educational attainment			
GCSE (or equivalent) and below	110 (78.6)	500 (81.3)	χ^2=0.002 p=0.960
Benefit levels			
No benefits	43 (30.7)	188 (30.6)	χ^2=0.005 p=0.998
On benefits for less than one year	9 (6.4)	39 (6.3)	
On benefits for more than one year	88 (62.9)	388 (63.1)	
Smoking status			
Non smokers	71 (50.7)	343 (55.8)	χ^2=1.950 p=0.163
Smokers	69 (49.3)	271 (44.1)	
Number of children in household aged under 16 years			
0	75 (53.6)	376 (61.1)	χ^2=6.001 p=0.050
1-2	56 (40.0)	194 (31.5)	
3 plus	9 (6.4)	45 (7.4)	
Number of people in household (all ages)			
1	23 (16.4)	113 (18.4)	χ^2=5.634 p=0.228
2	38 (27.1)	187 (30.4)	
3	40 (28.6)	136 (22.1)	
4	26 (18.6)	106 (17.2)	
5 plus	14 (10.0)	73 (11.9)	
Housing tenure			
Own out-right/paying mortgage	61 (43.6)	255 (41.4)	χ^2=0.039 p=0.578
Rent	77 (55.0)	350 (56.9)	
Car/van access			
Yes	78 (55.7)	363 (59.0)	χ^2=0.975 p=0.324
No	62 (44.3)	249 (40.5)	
Annual household income			
Refused	16 (11.4)	109 (17.7)	χ^2=7.338 p=0.197
Under £5000	25 (17.9)	96 (15.6)	
£5000 – £9999	43 (30.7)	167 (27.2)	
£10,000 - £14,999	25 (17.9)	90 (14.6)	
£15,000 - £19,999	13 (9.3)	66 (10.7)	
£20,000 plus	18 (12.9)	87 (14.1)	
Household deprivation score			
0 (least deprived)	41 (29.3)	163 (26.5)	χ^2=3.358 p=0.500
1	34 (24.3)	180 (29.3)	
2	45 (32.1)	188 (30.6)	
3	16 (11.4)	58 (9.4)	
4 (most deprived)	2 (1.4)	13 (2.1)	

(Pearson) Chi square statistical test: Statistical difference between groups ***p<0.001, **p<0.01, *p<0.5

4.3.2 Results from seven-day checklist

Overall, as demonstrated in table 4.2 the difference in fruit and vegetable consumption between wave two of data collection and the repeatability measure was 0.10 portions per day, with a difference of 0.06 and 0.04 for fruits and vegetables respectively. Furthermore, 42.8% of the sample had a mean difference of within ±half a portion of fruits and vegetables per day.

For both fruits and vegetables the median figure did not change although for fruits and vegetables combined it fell from 2.57 portions per day to 2.43 portions per day (the same as wave one fruit and vegetable median intake), whilst the 95% confidence intervals were all similar for fruits, vegetables and fruits and vegetables.

Table 4.2: Fruit and vegetable consumption (portions per day) for repeatability study

	Wave one	Wave two	Repeatability
Fruit			
Mean ± sd	1.27±1.17	1.28±1.13	1.34±1.40
95% CI	1.07-1.47	1.09-1.47	1.10-1.58
Median	1.00	1.00	1.00
Mode	0.00 (n=15)	0.00 (n=17)	0.00 (n=20)
Range	0.00–5.71	0.00–5.00	0.00–8.00
Vegetables			
Mean ± sd	1.52±0.93	1.59±0.87	1.63±1.14
95% CI	1.36-1.68	1.44-1.74	1.44-1.82
Median	1.29	1.43	1.43
Mode	1.14 (n=18)	1.29 (n=17)	1.00 (n=16)
Range	0.14–5.71	0.14–4.29	0.00–10.57
Fruit and vegetables			
Mean ± sd	2.79±1.83	2.87±1.76	2.97±2.27
95% CI	2.48-3.10	2.57-3.17	2.59-3.35
Median	2.43	2.57	2.43
Mode	1.86 (n=11)	1.86 (n=9)	1.57, 1.71 (n=8)
Range	0.29–11.29	0.14–8.43	0.00–18.29

Table 4.3 shows the distribution of consumption for fruits, vegetables and fruits and vegetables. As can be seen, in general the distributions across the levels of consumption are similar between wave two and the repeatability measure.

Table 4.3: Distribution of fruit and vegetable consumption for repeatability study			
Consumption	Wave one	Wave two	Repeatability
Fruit			
<1.0 portions per day	48.6	47.1	46.4
≥1.0 and <2.0 portions per day	22.1	30.0	32.9
≥2.0 and <3.0 portions per day	20.7	14.3	9.3
≥3.0 and <4.0 portions per day	5.7	4.3	5.7
≥4.0 and <5.0 portions per day	1.5	2.9	2.8
≥5.0 portions per day	1.4	1.4	2.9
Vegetables			
<1.0 portions per day	22.9	19.3	20.0
≥1.0 and <2.0 portions per day	50.7	53.6	50.7
≥2.0 and <3.0 portions per day	18.5	16.4	21.4
≥3.0 and <4.0 portions per day	5.8	10.0	5.0
≥4.0 and <5.0 portions per day	0.7	0.7	2.2
≥5.0 portions per day	1.4	0.0	0.7
Fruit and vegetables			
<1.0 portions per day	9.3	9.3	7.1
≥1.0 and <2.0 portions per day	32.1	27.8	30.8
≥2.0 and <3.0 portions per day	19.3	19.3	21.4
≥3.0 and <4.0 portions per day	17.9	22.2	17.8
≥4.0 and <5.0 portions per day	11.4	10.0	10.0
≥5.0 portions per day	10.0	11.4	12.9

4.3.2.1 Correlations between measures

Tables 4.4 to 4.7 and figure 4.2 show the correlation of the intake of fruits and vegetables between the test measure (the repeatability measure) and the reference measure (wave two measure).

As can be seen fruits, vegetables and fruits and vegetables were all highly correlated ($p<0.001$) when assessed overall (using bi-variate analysis of Pearson, Spearman rho and Kappa correlations), and also when stratified by age (17 to 44 years and 45 years plus) and smoking status (non-smokers and smokers). This indicates that there is no differential reporting overall nor by age and smoking status. However, when the sample was divided into levels of consumption (≤2.0 portions per day, >2.0 to ≤4.0 portions per day, >4.0 portions per day), differences did appear. For respondents consuming over 2 portions per day the measures were significantly correlated, but for those consuming ≤2.0 portions per day the correlations were significant but not as strong. This may indicate that there is a differential bias for the lowest consumers of fruits and vegetables, a factor that must be taken into consideration in the wider analysis of fruit and vegetables consumption in the study.

However, using a correlation does have its disadvantages, as it does not measure the agreement between the two administrations of the checklist but the degree to which the two are related. Therefore, another technique, which may be used, is the Bland-Altman method (1986) that assesses the agreement between the methods across the whole range of intakes. It also provides a method of assessing whether the difference between the measures is the same across the range of intakes, and whether the extent of agreement differs for low intakes compared to high intakes. Bland-Altman plots are the difference between the two measures plotted against the mean of the two measures.

Figure 4.3 shows the Bland-Altman plot for the repeatability study. The negative gradient indicates that those respondents with higher intakes of fruits, vegetables and fruits and vegetables combined are likely to show a larger estimation in the repeatability study compared to the measure achieved in wave two of data collection. If there were the same agreement across the range of intakes, then it would be expected to see a straight-line through the origin.

However, subsequent robustness testing of the data whereby those with very high intakes of fruits and vegetables were excluded (n=4; id numbers 473, 901, 971, 1075) showed that there was a significant shift in the slope of the line (figure 4.4).

Table 4.4: Overall correlations between measures for repeatability study

	R-square	Pearson correlation coefficient	Spearman rank correlation coefficient	Kendall rank correlation coefficient
Fruit	0.62	0.786 $p<0.001$***	0.778 $p<0.001$***	0.624 $p<0.001$***
Vegetables	0.42	0.647 $p<0.001$***	0.642 $p<0.001$***	0.500 $p<0.001$***
Fruit and vegetables	0.56	0.750 $p<0.001$***	0.765 $p<0.001$***	0.600 $p<0.001$***

Correlation coefficients between measures ***$p<0.001$, **$p<0.01$, *$p<0.05$

Table 4.5: Correlation between measures as stratified by age for repeatability study

		17 to 44 years (n=77)	45 years plus (n=63)
Fruits	Pearson correlation coefficient	0.692 p<0.001***	0.815 p<0.001***
	Spearman rank correlation coefficient	0.697 p<0.001***	0.831 p<0.001***
	Kendall rank correlation coefficient	0.556 p<0.001***	0.673 p<0.001***
Vegetables	Pearson correlation coefficient	0.678 p<0.001***	0.624 p<0.001***
	Spearman rank correlation coefficient	0.632 p<0.001***	0.593 p<0.001***
	Kendall rank correlation coefficient	0.498 p<0.001***	0.463 p<0.001***
Fruits and vegetables	Pearson correlation coefficient	0.678 p<0.001***	0.758 p<0.001***
	Spearman rank correlation coefficient	0.692 p<0.001***	0.744 p<0.001***
	Kendall rank correlation coefficient	0.539 p<0.001***	0.615 p<0.001***

Correlation coefficients between measures ***p<0.001, **p<0.01, *p<0.05

Table 4.6: Correlation between measures as stratified by smoking status for repeatability study

		Non-smokers (n=71)	Smokers (n=69)
Fruits	Pearson correlation coefficient	0.817 p<0.001***	0.735 p<0.001***
	Spearman rank correlation coefficient	0.813 p<0.001***	0.720 p<0.001***
	Kendall rank correlation coefficient	0.649 p<0.001***	0.582 p<0.001***
Vegetables	Pearson correlation coefficient	0.682 p<0.001***	0.644 p<0.001***
	Spearman rank correlation coefficient	0.677 p<0.001***	0.594 p<0.001***
	Kendall rank correlation coefficient	0.536 p<0.001***	0.460 p<0.001***
Fruits and vegetables	Pearson correlation coefficient	0.777 p<0.001***	0.729 p<0.001***
	Spearman rank correlation coefficient	0.783 p<0.001***	0.684 p<0.001***
	Kendall rank correlation coefficient	0.609 p<0.001***	0.535 p<0.001***

Correlation coefficients between measures ***p<0.001, **p<0.01, *p<0.05

Table 4.7: Correlation between measures as stratified by wave two fruit and vegetable consumption for repeatability study

		≤2.0 portions per day (n=58)	>2.0 to ≤4.0 portions per day (n=54)	>4.0 portions per day (n=28)
Fruits	Pearson correlation coefficient	0.202 p=0.128	0.639 p<0.001***	0.767 p<0.001***
	Spearman rank correlation coefficient	0.344 p=0.008**	0.711 p<0.001***	0.733 p<0.001***
	Kendall rank correlation coefficient	0.280 p=0.006**	0.539 p<0.001***	0.580 p<0.001***
Vegetables	Pearson correlation coefficient	0.468 p<0.001***	0.495 p<0.001***	0.474 p=0.011*
	Spearman rank correlation coefficient	0.446 p<0.001***	0.413 p=0.002**	0.538 p=0.003**
	Kendall rank correlation coefficient	0.346 p<0.001***	0.310 p=0.002**	0.417 p=0.003**
Fruits and vegetables	Pearson correlation coefficient	0.176 p=0.186	0.497 p<0.001***	0.675 p<0.001***
	Spearman rank correlation coefficient	0.314 p=0.016*	0.549 p<0.001***	0.547 p=0.003**
	Kendall rank correlation coefficient	0.223 p=0.020*	0.405 p<0.001***	0.428 p=0.002**

Correlation coefficients between measures ***p<0.001, **p<0.01, *p<0.05

Table 4.8: Mean difference against absolute difference for repeatability study		
	All respondents (n=140)	Robust sample (n=136)
Fruits	Pearson correlation = -0.321 p<0.001***	Pearson correlation = -0.103 p=0.234
Vegetables	Pearson correlation = -0.344 p<0.001***	Pearson correlation =0.210 p=0.811
Fruits and vegetables	Pearson correlation = -0.368 p<0.001***	Pearson correlation = -0.012 p=0.891

Correlation coefficients between measures ***p<0.001, **p<0.01, *p<0.05

Figure 4.2

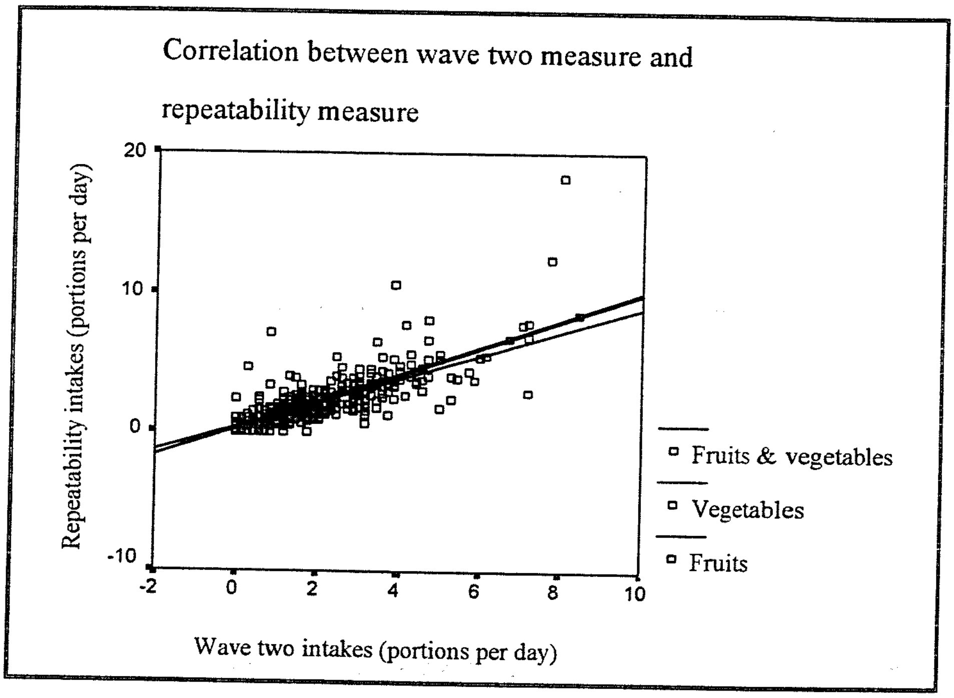


Figure 4.3: Mean of wave two measure and repeatability measure of fruit and/or vegetable consumption against difference between wave two measure and repeatability measure of fruit and/or vegetable consumption.

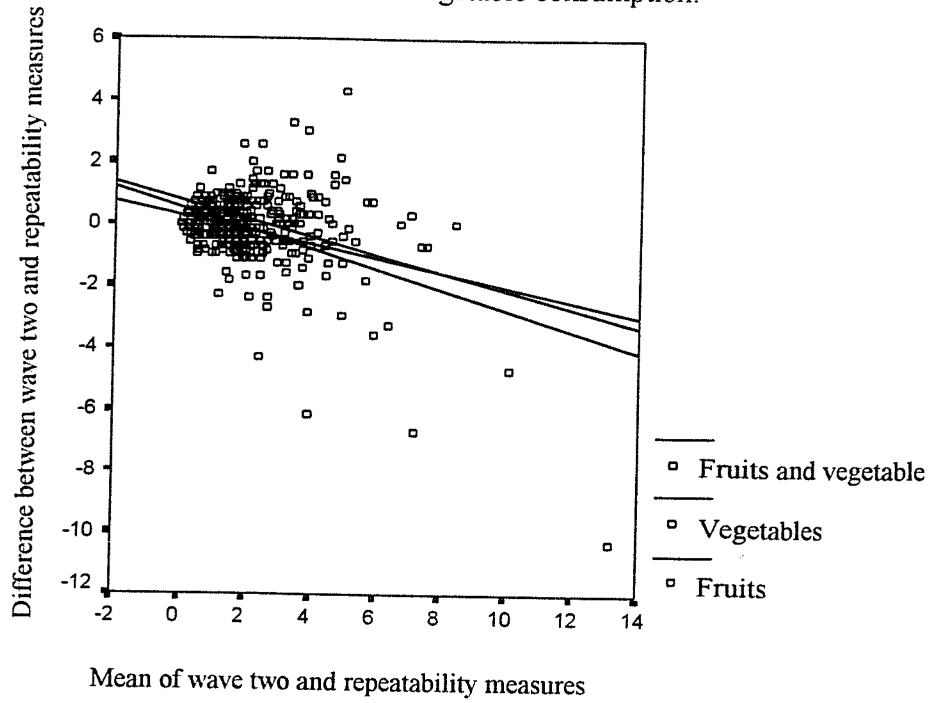
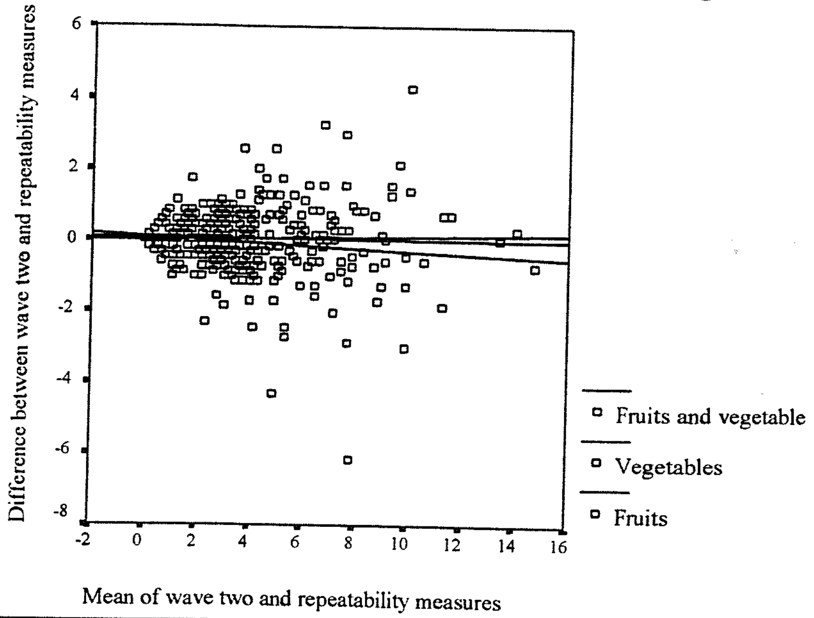


Figure 4.4: Mean of wave two measure and repeatability measure of fruit and/or vegetable consumption against difference between wave two measure and repeatability measure of fruit and/or vegetable consumption using a robust sample.



Figures are produced using the Bland-Altman method (Bland and Altman 1986)

4.3.3.2 Classification

Fruit, vegetable, as well as fruit and vegetable consumption was divided into thirds of the distribution in order to establish whether those who were consuming low, medium or high levels during wave two of data collection were also consuming low, medium or high during repeatability data collection (tables 4.9 to 4.11). The results show that for fruit, vegetable, and fruit and vegetable consumption, there was correct classification into the same thirds of 67.9% (n=95), 57.1% (n=80) and 65.0% (n=91) respectively, whilst the figures for gross misclassification into opposite thirds were 2.1% (n=3), 6.4% (n=9) and 2.1% (n=3) respectively. This shows that respondents did not change their levels of consumption greatly, as can be seen by the low levels of gross misclassification. Furthermore, the Kappa statistics for agreement between the thirds were highly significant (p<0.001) for fruits, vegetables, and fruits and vegetables.

Table 4.9: Classification of fruit consumption between wave two measure and repeat measure for repeatability study (percentages)

	Thirds of fruit consumption from wave two		
Thirds of fruit consumption from repeat measure	Low	Medium	High
Low	26.4 (n=37)	9.3 (n=13)	0.7 (n=1)
Medium	6.4 (n=9)	15.7 (n=22)	7.9 (n=11)
High	1.4 (n=2)	6.4 (n=9)	25.7 (n=36)

Kappa statistic: 0.517 (p<0.001***)

Table 4.10: Classification of vegetable consumption between wave two measure and repeat measure for repeatability study (percentages)

	Thirds of vegetable consumption from wave two		
Thirds of vegetable consumption from repeat measure	Low	Medium	High
Low	20.0 (n=28)	10.0 (n=14)	1.4 (n=2)
Medium	12.1 (n=17)	15.0 (n=21)	8.6 (n=12)
High	5.0 (n=7)	5.7 (n=8)	22.1 (n=31)

Kappa statistic: 0.358 (p<0.001***)

Table 4.11: Classification of fruit and vegetable consumption between wave two measure and repeat measure for repeatability study (percentages)

	Thirds of fruit and vegetable consumption from wave two		
Thirds of fruit and vegetable consumption from repeat measure	Low	Medium	High
Low	21.4 (n=30)	11.4‡ (n=16)	0.7‡ (n=1)
Medium	7.9† (n=11)	19.3 (n=27)	7.9‡ (n=11)
High	1.4† (n=2)	5.7† (n=8)	24.3 (n=34)

Kappa statistic: 0.475 (p<0.001***)

† - signifies over-reporters in comparison to wave two measure

‡ - signifies under-reporters in comparison to wave two measure

Whilst the agreement between thirds is highly statistical, for fruit and vegetable consumption, 28 respondents (20.0%) could be considered to be under-reporters of fruits and vegetables, i.e. their repeat measure were in a lower third than their wave two measure. In addition, 21 respondents (15.0%) could be considered to be over-reporters of fruits and vegetables, i.e. their repeat measure were in a higher third than their wave two measure. In order to assess if under and over-reporters were different their characteristics were examined as shown in table 4.12. As can be seen under and over-reporters were not different, which indicates that there is not likely to be differential bias between the groups.

Table 4.12: Sample profile by over and under reporters with respect to wave two measure for repeatability study			
Variable	Under-reporters (percentage) n=21	Over-reporters (percentage) n=28	Chi-square test
Gender			
Female	95.2	85.7	χ^2=1.128 p=0.276
Age			
17-44 years	66.7	53.6	χ^2=0.852 p=0.356
45+ years	33.3	46.4	
Employment status			
Full-time/part-time work	38.1	39.3	χ^2=0.007 p=0.933
Not in work	61.9	60.7	
Educational attainment			
GCSE (or equivalent) and below	85.7	85.2	χ^2=0.003 p=0.959
Benefit levels			
No benefits	28.6	35.7	χ^2=0.278 p=0.598
On benefits	71.4	64.3	
Smoking status			
Non smokers	52.4	42.9	χ^2=0.437 p=0.509
Smokers	47.6	57.1	
Number of children in household aged under 16 years			
0	47.6	64.3	χ^2=2.333 p=0.311
1-2	47.6	35.7	
3 plus	4.8	0.0	
Number of people in household (all ages)			
1	14.3	7.1	χ^2=1.782 p=0.410
2-3	57.1	75.0	
4 plus	28.6	17.9	
Housing tenure			
Own out-right/paying mortgage	45.0	42.9	χ^2=0.022 p=0.883
Rent	55.0	57.1	
Car/van access			
Yes	47.6	57.1	χ^2=0.437 p=0.509
No	52.4	42.9	
Annual household income			
Refused	9.5	10.7	χ^2=0.879 p=0830.
Under £9,999	47.6	57.1	
£10,000 - £19,999	33.3	21.4	
£20,000 plus	9.5	10.7	
Household deprivation score			
0 (least deprived)	20.0	28.6	χ^2=2.177 p=0.536
1	45.0	25.0	
2	25.0	35.7	
3	10.0	10.7	
4 (most deprived)	0.0	0.0	

(Pearson) Chi square statistical test: Statistical difference between groups ***p<0.001, **p<0.01, *p<0.5

4.4 Results from self-administered questionnaire – sensitivity and specificity analysis

As well as completing the self-administered seven-day checklist, respondents were asked to repeat the self-administered questions contained at the back of the seven-day checklist (Appendix 5). It is therefore possible to establish the repeatability of these questions and thus gain information on how repeatable the questionnaires are.

In order to establish the repeatability of these questions, it is possible to measure the sensitivity and specificity of the questions. Sensitivity is the proportion of respondents who are truly exposed and are classified as such – in this case those respondents who answered yes to a question in both the reference measure (here assumed to be wave two) and the test measure (here assumed to be the repeatability measure). Specificity is the proportion of respondents who are truly not exposed and are classified as such – in this case those respondents who answered no to a question in both the reference measure (here assumed to be wave two) and the test measure (here assumed to be the repeatability measure). As Margetts and Nelson (1997) argue a measure cannot be valid unless it is both specific and sensitive. The method to calculate sensitivity and specificity is shown in figure 4.5 (adapted from Margetts and Nelson 1997).

Figure 4.5: Definition of sensitivity and specificity used for questionnaire

	True status (assume to be results from wave two data collection)			
Measured status (assume to be results from repeatability data collection		*Yes*	*No*	*Total*
	Yes	a	b	a+b
	No	c	d	c+d
	Total	a+c	b+d	a+b+c+d

Sensitivity – a true yes answer is a/a+c
Specificity – a true no answer is d/b+d

The sensitivity and specificity of a number of questions from the self-administered questions were calculated where appropriate – 'when you go shopping ,which of these affects the choice of foods you buy?'; 'other than cost, what limits the choice of food you buy?'; 'have any of the following caused you to change what foods you buy over the last 12 months?'; 'do you have to watch what you eat because of any of the following?' (table 4.13).

The results generated tend to indicate that the questionnaire appeared to be highly specific illustrating that most respondents who answered no in wave two were also likely to answer no in the repeat measure. The degree of specificity ranged from 60% to 99%, but for most questions it was over 90%. In broad terms, this may indicate that there is good consistency for this group, their answers are unlikely to change and that any subsequent analysis of this group is likely to be robust as the respondents answers are truly no for each measure.

However, the degree of sensitivity was not as high suggesting that people who answered yes in wave two did not necessarily answer yes for the repeat measure. Whilst the sensitivity is high for many questions – upto 100% in some cases, there are number of questions where the sensitivity falls dramatically to the extent that for a number of questions the sensitivity is zero. This is particularly true where a small number of people were answering yes in either measure. The difficulty here is that it might indicate that people saying that they are, for example, affected or limited in their choice of food may not be truly affected, which in turn may have repercussions for the framework for change (see chapter 7), as their answer are liable to change.

Table 4.13: Sensitivity and specificity of questions for repeatability study		
Question	Sensitivity	Specificity
Question one – when you go food shopping, which of these affects the choice of foods you buy?		
The costs of food/my food budget	92/104 =88%	24/36 =67%
Not eating certain foods because advised not to by health professionals	13/24 =54%	112/116 =97%
What my spouse/partner will eat	55/69 =80%	66/71 =93%
What my child/children will eat	64/74 =86%	59/66 =89%
Trying to eat a healthy balanced diet	63/79 =80%	47/61 =77%
The kinds of food I like eating	71/103 =69%	27/37 =73%
Convenience	40/55 =73%	75/85 =88%
Whether my spouse/partner is with me	16/24 =66%	100/116 =86%
Whether my child/children are with me	22/30 =73%	98/110 =89%
Packaging/display	3/10 =30%	125/130 =96%
Food advertising	8/13 =62%	123/127 =97%
Programmes/news items in the media	4/13 =31%	119/127 =94%
The kinds of food my friends buy	0/1 =0%	137/139 =99%
The kinds of foods my relatives buy	2/4 =50%	134/136 =99%
Whether I'm hungry or not	24/40 =60%	86/100 =86%
Special offers	78/100 =78%	24/40 =60%
Personal beliefs (e.g. religous/cultural/vegeteranism)	4/7 =57%	131/133 =98%
Question two – other than cost, what limits the choice of food you buy?		
What is available is the store that I can get to	59/72 =82%	44/68 =65%
Not much space to store food at home	13/17 =76%	118/123 =96%
Small or no fridge	7/10 =70%	126/130 =97%
Limited cooking facilities	0/3 =0%	136/137 =99%
Don't know how to cook some foods	13/16 =81%	117/124 =94%
Ability to carry and transport foods home	30/41 =73%	85/99 =86%
Food goes off before its eaten	45/56 =80%	77/84 =92%
Difficult to get to shops with children	7/12 =58%	121/128 =95%
Difficult to get to shops because of age or disability	8/8 =100%	124/132 =94%
Question three - have any of the following caused you to change what foods you buy over the last 12 months?		
Illness	11/20 =55%	115/120 =96%
Difficulty walking	10/15 =66%	123/125 =98%
Acquired a household car/van	1/1 =100%	136/139 =98%
Loss of household car/van	2/3 =66%	136/137 =99%
Less money to spend	35/44 =80%	86/96 =90%
More money to spend	8/13 =62%	118/127 =93%
Got married/new (live in) partner	1/1 =100%	138/139 =99%
Separated from spouse/partner	4/4 =100%	133/136 =98%
New baby	4/4 =100%	134/136 =99%
Kid(s) moved out	3/4 =75%	133/136 =98%
Other reasons	8/26 =31%	105/114 =92%
Question five – do you have to watch what you eat because of any of the following?		
No	54/80 =68%	50/60 =83%
Yes – illness/allergy	16/20 =80%	113/120 =94%
Yes – trying to lose weight	34/46 =74%	88/94 =94%
Yes – pregnancy	1/3 =33%	134/137 =98%
Yes – personal beliefs (e.g. religous/cultural/vegeteranism)	3/4 =75%	133/136 =98%
Yes – other reason(s)	0/5 =0%	132/135 =98%

4.5 Discussion and implications of repeatability study

The repeatability of the self-administered checklist and questions used in the study was assessed in 140 respondents who completed wave two of data collection, representing a minimum response rate of 69%. The sub-sample used to assess repeatability was representative of the larger sample from which it was drawn.

The results in general show that the seven-day checklist is extremely repeatable, with high correlations ($p<0.001$ using bi-variate analysis) achieved. These correlations were also achieved when the sample was stratified by age (17-44 years, 45 years plus) and smoking status (non-smokers, smokers). However, when the sample was stratified by fruit and vegetable intake (≤2.0 portions per day, >2.0 to ≤4.0 portions per day, >4.0 portions per day), the correlations achieved by the lowest consumers (≤2.0 portions per day) whilst in the main were significant, they were not as strong as for the other levels of consumption (those consuming >2.0 to ≤4.0 portions per day, >4.0 portions per day). This may indicate that there may be some small degree of differential reporting at the lower levels of consumption and that this will have implications for the study. Another issue that needs to be addressed is that of regression to the mean, in that the two measures achieved for each respondent may be different, but their means may be in line with the sample mean.

However, the Bland-Altman method of assessment of the agreement across the range of intakes showed that those respondents with the very highest intakes of fruits and vegetables may have the largest differential in consumption, although as demonstrated if these are removed, then the difference across the range of intakes is minimal.

The differences ascribed between the repeatability measure and the reference measure (wave two intakes) may be due to either true subject variation but also may be due to measurement error. With respect to subject variation, this may be systematic or random but is difficult to distinguish (Margetts and Nelson 1997). However, this highlights the complications associated with repeatability studies, particularly as in the true sense of the word, a repeatability study can never be undertaken in exactly the same circumstances, as there is always genuine variation in the diet. Nelson (1997) further explains by stating that the concept of the 'same circumstances' cannot exist when trying to assess the repeatability.

Other issues also impinge on the level of repeatability include the time-period between administrations of the research tool. As Willett (1998) argues, to undertake repeatability study can be difficult, because if the time between the administrations is too short there can be a learning effect, but if the period is too long then there can be genuine changes in eating behaviour and intakes of some respondents. In a systematic review of food frequency questionnaires, Cade et al (2002) found that correlation coefficients of repeat administrations at one month or less tended to give higher figures than those for repeat measures further apart in time. This may be due in part to seasonal variations in consumption patterns (Klaver et al 1988), which will also be likely to affect what is present in food stores, particularly those with a limited range of fruits and vegetables. However, Burema et al (1988) argue that to assess repeatability two (or more) measurements are needed relating to periods in time that are as similar as possible.

The issue of a short time period between administrations of the self-completed seven-day checklist used in this study may be relevant. Subjects were asked to complete the repeat measure within a few days of completing their wave two measure, which may have led to respondents remembering their previous responses, and thus leading to an over-estimation of the repeatability of the measure. Willett (1998) also acknowledges that whilst repeatability studies are generally quick, cheap and convenient they are an appropriate part of dietary assessment evaluation but are not a substitute for validity studies.

With respect to other studies, Willett (1998) indicates that many studies have investigated repeatability with respect to nutrient levels rather than specific food groups such as fruits or vegetables. Evidence from other studies found in the literature indicates that the reproducibility of measures for fruits and vegetables are widely variable. For example after six-months Ocke et al (1997) found the reproducibility to be 0.80 and 0.70 for men (for vegetables and fruit respectively) and 0.61 and 0.77 for women (for vegetables and fruits respectively), whilst in the Health Professionals Follow-up study, for fruit the correlation was 0.71 and for cruciferous vegetables 0.61 (Hu et al 1999). Riboli et al (1997) found the short-term reproducibility (two to three months) of fruits and vegetables were 0.77 and 0.65 respectively.

5 WAVE ONE (BASELINE) RESULTS

This chapter examines wave one (baseline) data collected on study participants before the opening of the superstore. Self-reported fruit and vegetable intakes were examined within the framework of consumption as described in chapter 1.3. The data were obtained through interviewer-administered and self-completed questionnaires and a self-completed seven-day food checklist as described in chapter 3.4.

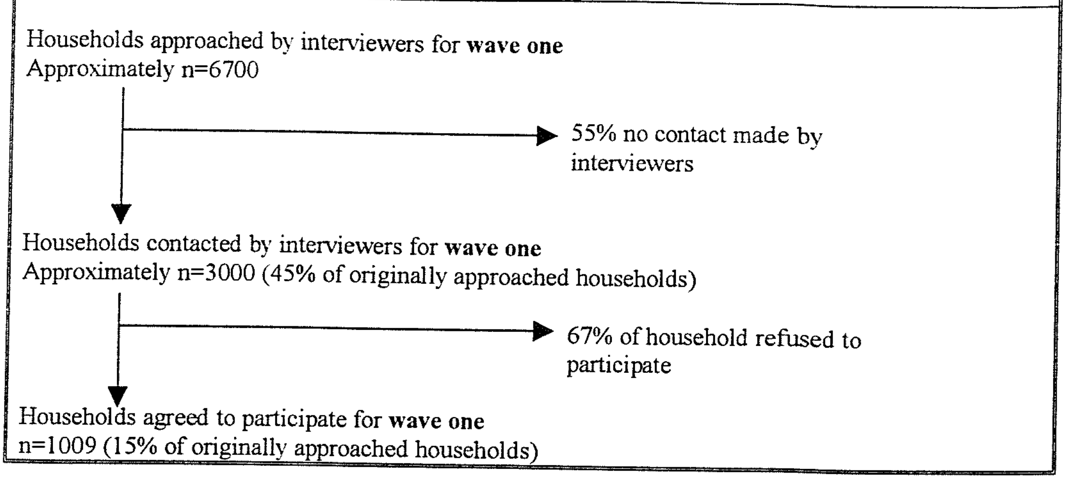
5.1 Recruitment of respondents and response rate

The aim of the study was to determine whether an increase in physical access to fruit and vegetables through the opening of a locally accessible superstore in an area of low fruit and vegetable consumption would lead to increased consumption of fruits and vegetables.

Data are presented for both the 1009 respondents who completed wave one of the study and a sub-set of 615 respondents who subsequently completed both waves of the study (i.e. before and after the opening of the superstore). The respondent was the person in the household principally responsible for domestic arrangements and only one person per household was able to participate. All intakes of fruits and vegetables were measured as portions per day, vegetable consumption excluded all potatoes and potato products but included baked beans, whilst fruit intake included fruit juice upto a maximum of one portion per day as in accordance with National Heart Forum guidelines (1997).

The recruitment of the 1009 respondents into wave one is shown in figure 5.1. In order to recruit 1009 respondents, approximately 6700 households were initially approached. Of these 6700 households, approximately 55% had no contact made (i.e. nobody was at home or the property was vacant when the interviewer called). Of the remaining 45% of households (i.e. where interviewer contact was made) approximately 33% of households agreed to participate (i.e. 15% of original 6700 households). No information was available on non-responders.

Figure 5.1: Recruitment and response rate for wave one of data collection



5.2 Sample profile

This section of the chapter gives an overview of the study sample for baseline socio-demographic factors at both the individual and household level.

Table 5.1 shows the socio-demographic profile of the study sample at the individual level of the respondent. The majority of the sample was female (81.9% when n=1009; 84.1% when n=615), tended to be older which was reflected in the fact that nearly 28% of the sample classified themselves as retired, were poorly educated with approximately 72% of the samples achieving qualifications at GCSE (or equivalent) at most, with approximately 20% in full employment (20.0% when n=1009; 18.9% when n=615 worked full time) and collected some sort of state benefit (including pensions).

Table 5.1: Baseline sample profile by individual socio-demographic variables		
Variable	Number (Percentage) n=1009 – for all respondents in wave one	Number (Percentage) n=615 – for respondents completing waves one and two
Gender		
Male	183 (18.1)	98 (15.9)
Female	826 (81.9)	517 (84.1)
Age		
17-24 years	91 (9.0)	51 (8.3)
25-34 years	200 (19.8)	119 (19.3)
35-44 years	227 (22.5)	145 (23.6)
45-64 years	270 (26.8)	165 (26.8)
65+ years	221 (21.9)	135 (22.0)
Employment status		
Full-time work	202 (20.0)	116 (18.9)
Part-time work	189 (18.7)	119 (19.3)
Unemployed	55 (5.5)	33 (5.4)
Retired	279 (27.7)	171 (27.8)
Full-time education	11 (1.1)	6 (1.0)
Housewife/husband	249 (24.7)	157 (25.5)
Educational attainment		
GCSE (or equivalent) and below	732 (72.5)	441 (71.7)
Above GCSE (or equivalent)	277 (27.5)	174 (28.3)
Receipt of benefit levels		
No benefits	326 (32.3)	188 (30.6)
On benefits for less than one year	67 (6.6)	39 (6.3)
On benefits for more than one year	616 (61.1)	388 (63.1)

Table 5.2 shows the socio-demographic profile of the study sample at the household level of the respondent. Most people rented their properties (59.2% when n=1009; 56.9% when n=615), had access to a car or van (58.3% when n=1009; 57.2% when n=615), did not have children under the age of 16 years in the household, had relatively poor household incomes - at least 55% of households had an annual income of under £15,000 and were materially deprived.

The household deprivation marker score was based on the Townsend index (Townsend 1987) and comprised four components, namely: car/van ownership/access, housing tenure, household unemployment and overcrowding (more than one person per room excluding couples) - the more deprived the household, the higher the score (range zero to four). Nearly 75% of households had some degree of material deprivation, with nearly 14% being highly deprived with a score of three or four.

Table 5.2: Baseline sample profile by household socio-demographic variables		
Variable	Number (Percentage) n=1009 – for all respondents in wave one	Number (Percentage) n=615 – for respondents completing waves one and two
Children aged under 16 years		
Yes	434 (43.0)	280 (45.5)
No	534 (52.9)	314 (51.1)
Number of children in household aged under 16 years		
0	569 (56.4)	332 (54.0)
1	171 (16.9)	112 (18.2)
2	164 (16.3)	109 (17.7)
3	74 (7.3)	42 (6.8)
4	16 (1.6)	6 (1.0)
5	12 (1.2)	11 (1.8)
6	3 (0.3)	3 (0.5)
Number of people in household (all ages)		
1	190 (18.8)	103 (16.7)
2	325 (32.2)	192 (31.2)
3	192 (19.0)	130 (21.1)
4	189 (18.7)	121 (19.7)
5	78 (7.7)	45 (7.3)
6	17 (1.7)	9 (1.5)
7	13 (1.3)	10 (1.6)
8	5 (0.5)	5 (0.8)
Housing tenure		
Own out-right	166 (16.5)	117 (19.0)
Own – paying mortgage	228 (22.6)	138 (22.4)
Rent	597 (59.2)	350 (56.9)
Car/van access		
Yes	588 (58.3)	352 (57.2)
No	421 (41.7)	263 (42.8)
Annual household income		
Refused	177 (17.5)	104 (16.9)
Under £5000	166 (16.5)	101 (16.4)
£5000 – £9999	249 (24.7)	145 (23.6)
£10,000 - £14,999	139 (13.8)	93 (15.1)
£15,000 - £19,999	105 (10.4)	67 (10.9)
£20,000 plus	131 (13.0)	80 (13.0)
Household deprivation marker score		
0 (least deprived)	257 (25.5)	159 (25.9)
1	297 (29.4)	185 (30.1)
2	305 (30.2)	181 (29.4)
3	120 (11.9)	75 (12.2)
4 (most deprived)	15 (1.5)	9 (1.5)

5.2.1 Comparison of sample data to ward level data

In the process of respondent recruitment 15% of the households approached completed wave one of data collection. It was necessary to compare sample characteristics with data available on the area from which the sample was drawn – in this case the Seacroft and Whinmoor wards of Leeds, in order to establish how representative the sample was of the population from which it was drawn. This will help establish the external validity (i.e. the generalisability) of the results, which will depend on the distribution of the respondents with regard to socio-demographic background (Johansson et al 1999). Due to the timing of this study, the 1991 census is the last ward level data available for many of the sample characteristics (table 5.3.)

Table 5.3: Comparison of sample profile with 1991 Census data

Variable	Sample n=1009	Sample n=615	Seacroft Ward*	Whinmoor Ward*	Leeds*
Population	2.7Φ	1.6Φ	18,983	19,010	680,722
65 years plus	21.9	22.0	20.8	18.1	18.8
Unemployed	5.5	5.4	18.0	9.1	9.4
Long-term illness	14.0	14.5	17.2	13.6	14.2
Single adult households	18.8	16.7	30.1	26.0	29.5
More than one adult households (no children)	37.6	37.2	38.3	44.1	43.5
Three or more dependent children	10.4	10.1	7.8	5.5	5.0
Lone parent	10.8	11.1	8.9	5.5	4.3
Households with pensioners only	18.5	19.5	28.4	24.1	25.4
No car available	41.7	42.8	61.1	43.2	41.3
Owner-occupiers	40.8	43.1	27.5	49.8	61.3
Over-crowded	16.7	17.6	2.9	1.8	1.9

*According to 1991 Census, ΦPercentage of total population of Seacroft and Whinmoor wards

As can be seen from the table (5.3), whilst there were differences between the sample and the ward level characteristics, for most variables these differences were small. The unemployed, single adult households and households with pensioners only were under-represented with respect to the ward level data. However, two points should be made regarding this; firstly, in the sample the percentage of people, particularly men who classified themselves as housewives/husbands was very high and may be due to the respondent not wanting to admit they were unemployed; secondly, whilst households with pensioners only living in them was low, those people aged 65 years plus were the largest of the age groups in the sample and are shown to be representative of the number living in the wards, therefore it may be concluded that it is possible to make assumptions regarding this age group. Households with more dependent children and lone –parent households were over-represented in the survey, however, as has been shown in chapter two, these groups of people may be some of the most disadvantaged in terms of money and shopping, and thus it is important to consider them. Data from the Health Education Authority's 1993 Health and Lifestyle Survey found that 22.7% of all households and 43.3% of the lowest income households had no access to a car, a finding that reflects the percentage having access to a car in this sample (Caraher et al 1998).

Summary

At an individual level, the study respondents were mainly female, older, not working in full time employment, had poor educational attainment and were receiving state benefit(s). At the household level, most people rented their properties, had access to a car or van, did not have children under the age of 16 in the house, had low incomes and were materially deprived. With reference to existing data the study sample appears to be representative of the wider population from which they were drawn.

5.3 Wave one fruit and vegetable intake

This part of the chapter examines self-reported fruit and vegetable consumption by the sample population in wave one (i.e. before the opening of the superstore). All intakes were measured as portions per day, and are reported for all 1009 respondents interviewed in wave one and for the sub-set of 615 respondents who were subsequently followed-up for wave two of the research.

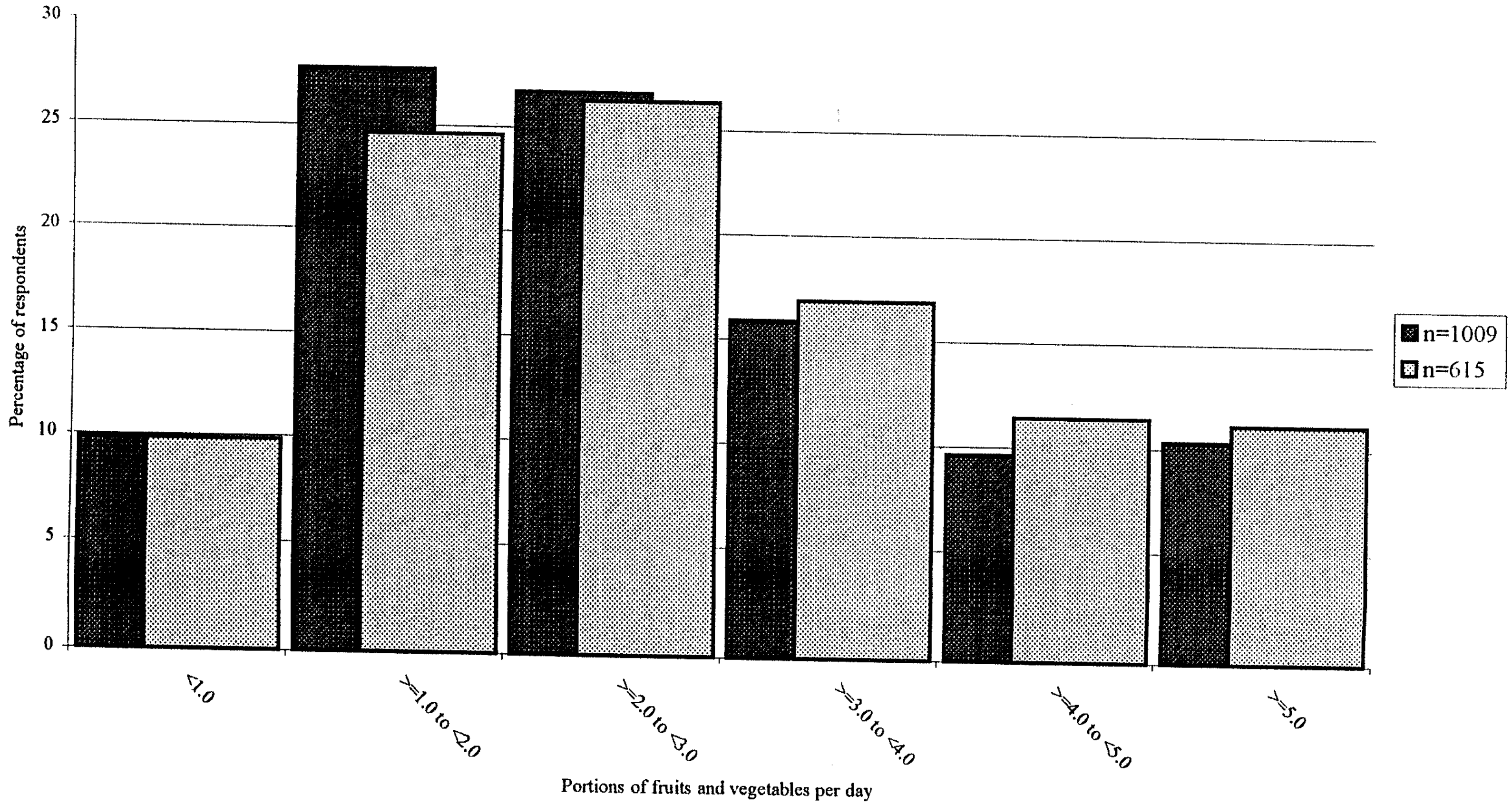
Overall the mean self-reported fruit and vegetable consumption as assessed by the seven-day food checklist was 2.77 portions per person per day, and was comprised of 1.23 and 1.54 portions of fruit and vegetables per person per day respectively. The range was wide from 0 to nearly 20 portions per person per day, whilst the median and modal figures were both 2.43 portions per person per day (table 5.4). However, for those respondents subsequently completing wave two of data collection (n=615), the mean self-reported fruit and vegetable consumption was 2.88 portions per person per day, and was comprised of 1.30 and 1.58 portions of fruit and vegetables per person per day respectively. The range, the median and modal figures remained unchanged (table 5.4). The issues of the relative validity and repeatability of the checklist were examined elsewhere (chapters seven and four respectively).

Table 5.4: Baseline fruit and vegetable consumption (portions per day)		
	Wave one (n=1009)	Wave one (n=615)
Fruit		
Mean ± sd	1.23±1.16	1.30±1.17
95% CI	1.16-1.30	1.21-1.39
Median	1.29	1.00
Mode	0.0 (n=109)	0.0 (n=67)
Range	0.0–10.85	0.0-8.43
Vegetables		
Mean ± sd	1.54±1.02	1.58±1.07
95% CI	1.48-1.61	1.49-1.67
Median	1.43	1.43
Mode	1.0 (n=97)	1.0 (n=62)
Range	0.0-11.29	0.0-11.29
Fruit and vegetables		
Mean ± sd	2.77±1.96	2.88±2.00
95% CI	2.65-2.90	2.72-3.04
Median	2.43	2.43
Mode	2.43 (n=56)	2.43 (n=39)
Range	0.0-19.57	0.0-19.57

Table 5.5: Distribution of wave one fruit and vegetable consumption		
Consumption	Wave one (n=1009) Percentage	Wave one (n=615) Percentage
Fruit		
<1.0 portions per day	48.8	44.6
≥1.0 and <2.0 portions per day	29.9	31.3
≥2.0 and <3.0 portions per day	12.7	15.3
≥3.0 and <4.0 portions per day	5.7	5.7
≥4.0 and <5.0 portions per day	1.9	2.1
≥5.0 portions per day	1.0	1.0
Vegetables		
<1.0 portions per day	23.8	22.9
≥1.0 and <2.0 portions per day	52.1	50.3
≥2.0 and <3.0 portions per day	16.9	18.8
≥3.0 and <4.0 portions per day	5.1	5.7
≥4.0 and <5.0 portions per day	0.9	1.0
≥5.0 portions per day	1.2	1.3
Fruit and vegetables		
<1.0 portions per day	9.9	9.8
≥1.0 and <2.0 portions per day	27.7	24.5
≥2.0 and <3.0 portions per day	26.6	26.4
≥3.0 and <4.0 portions per day	15.9	16.9
≥4.0 and <5.0 portions per day	9.6	11.3
≥5.0 portions per day	10.3	11.1

The majority of the sample ate less than one portion of fruit per day (48.8% when n=1009; 44.6% when n=615), whilst 23 to 24% ate less than one portion of vegetables per day. For total fruit and vegetable consumption, compared to the national average of three portions per day (Gregory et al 1990), 35.8% (when n=1009) and 39.3% (when n=615) of the sample met or exceeded this, whilst 10.3% and 11.1% (when n=1009; n=615% respectively) met the national target of at least five portions per day. At the other extreme just under 10% of the sample ate less than one portion of fruit and vegetables a day in total (table 5.5). The distribution of total fruit and vegetable intake is shown in Figure 5.2.

Figure 5.2: Distribution of fruit and vegetable consumption in wave one



5.3.1 Variations in fruit and vegetable consumption by basic individual and household socio-demographic variables

Table 5.6 shows that using ANOVA analysis there were statistically significant differences ($p<0.001$ for statistically significant variables) within socio-demographic groups using individual and household level variables. One of the most striking differences was that associated with age, with respondents from the oldest age group (65 years and over) eating twice as much fruit and vegetables as those respondents from the youngest age group (17-24 years). Indeed there was a strong age gradient, with increasing consumption as age increased.

Those respondents living in houses that did not have any children under the age of 16 in them, had significantly higher intakes of fruit and vegetables, upto 1.13 portions more per person per day. Furthermore, as the number of children under the age of 16 in the household increased the amount of fruit and vegetables consumed by the respondent steadily decreased. This was also reflected in the gradient of number of people in the household with fruit and vegetable consumption, where single person household respondents had statistically the highest level of fruit and vegetable consumption. However there were no statistical differences in consumption within gender and educational attainment.

Table 5.6: Baseline fruit and vegetable consumption by individual and household socio-demographic variables

Variable	Wave one (n=1009) n	Mean±sd (95%CI)	ANOVA value	Wave one (n=615) n	Mean±sd (95%CI)	ANOVA value
Gender						
Male	183	2.82±1.76 2.56-3.07	F=0.124 p=0.725	98	2.95±1.77 2.59-3.30	F=0.142 p=0.707
Female	826	2.76±2.00 2.63-2.90		517	2.87±2.04 2.69-3.04	
Age						
17-24 years	91	1.72±0.99 1.52-2.44	F=27.765 p<0.001***	51	1.73±1.03 1.44-2.02	F=23.890 p<0.001***
25-34 years	200	2.19±1.80 1.94-2.44		119	2.10±1.33 1.86-2.34	
35-44 years	227	2.40±1.48 2.21-2.60		145	2.42±1.42 2.19-2.66	
45-64 years	270	3.30±2.08 3.04-3.55		165	3.49±2.18 3.15-3.82	
65+ years	221	3.49±2.22 3.18-3.77		135	3.75±2.43 3.33-4.16	
Educational attainment						
GCSE (or equivalent) and below	732	2.78±2.07 2.63-2.93	F=0.065 p=0.799	441	2.86±2.13 2.66-3.06	F=0.095 p=0.758
Above GCSE (or equivalent)	277	2.75±1.61 2.56-2.94		174	2.92±1.63 2.67-3.16	
Children under the age of 16 years						
Yes	434	2.27±1.64 2.12-2.42	F=53.028 p<0.001***	280	2.29±1.48 2.11-2.46	F=50.972 p<0.001***
No	534	3.17±2.12 2.99-3.35		314	3.42±2.26 3.17-3.68	
Number of children in household (under the age of 16 years)						
0	569	3.14±2.09 2.97-3.31	F=24.473 p<0.001***	332	3.36±2.25 3.11-3.60	F=22.300 p<0.001***
1-2	335	2.35±1.72 2.16-2.53		221	2.37±1.46 2.17-2.56	
3 plus	105	2.15±1.43 1.87-2.42		62	2.15±1.52 1.77-2.54	
Number of people in household (all ages)						
1	190	3.20±2.27 2.87-3.52	F=8.248 p<0.001***	103	3.37±2.50 2.89-3.86	F=7.831 p<0.001***
2	325	3.04±1.94 2.83-3.25		192	3.31±2.08 3.02-3.61	
3	192	2.58±2.11 2.28-2.88		130	2.55±1.73 2.25-2.85	
4	189	2.39±1.59 2.17-2.62		121	2.46±1.66 2.16-2.76	
5 plus	113	2.26±1.43 1.99-2.52		69	2.30±1.51 1.94-2.66	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

5.3.2 Variations in fruit and vegetable consumption by cigarette smoking

As described in chapter 1.3 a framework of consumption was developed in order to gain further insights into the role of increased physical access to fruits and vegetables in their consumption. However, it may be important to stratify by key variables such as age and smoking status, tables 5.7 and 5.8 show the mean intake of fruit and vegetables when stratified by smoking status, and by age and smoking status.

Table 5.7: Baseline fruit and vegetable consumption by smoking status

Variable	Wave one (n=1009) n	Mean±sd (95%CI)	ANOVA value	Wave one (n=615) n	Mean±sd (95%CI)	ANOVA value
Smoking status						
Never smoker	302	3.26±2.34 2.99-3.52	F=17.120 p<0.001***	195	3.21±2.22 2.90-3.52	F=6.492 p<0.001***
Ex-smoker	235	3.07±1.91 2.82-3.31		141	3.20±1.99 2.87-3.53	
Light smoker (upto 12 cigarettes per day)	178	2.44±1.44 2.22-2.65		109	2.50±1.48 2.22-2.79	
Heavy smoker (more than 12 cigarettes per day)	279	2.24±1.68 2.05-2.44		161	2.48±1.95 2.17-2.79	
Smoking status						
All never and ex-smokers	537	3.18±2.16 2.99-3.36	F=48.961 p<0.001***	336	3.21±2.12 2.98-3.43	F=19.530 p<0.001***
All smokers (light and heavy)	457	2.32±1.59 2.17-2.47		270	2.49±1.78 2.28-2.70	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.7 shows that there was an inverse gradient between smoking status and fruit and vegetable intake, with heavy smokers consuming in the region of a portion of fruit and vegetables less a day than never smokers. Indeed, when all smokers were grouped together (i.e. light and heavy smokers) they consumed between 0.72 and 0.86 portions a day less than non-smokers (never and ex-smokers) (p<0.001).

Table 5.8 shows that when fruit and vegetable consumption was stratified by both age and smoking status that never and ex-smokers consistently consumed more fruits and vegetables than smokers, irrespective of age. However, the strong age gradient in fruit and vegetable consumption as indicated in table 5.8 continues, with non-smokers and smokers aged 65 years plus consuming double the amount of fruit and vegetables a day compared to non smokers and smokers aged 17-24 years respectively (both p<0.001). Overall, the lowest and highest daily consumption of fruit and vegetables was found in those smokers aged 17-24 years and non-smokers aged 65 years plus respectively.

Table 5.8: Baseline fruit and vegetable consumption stratified by age and smoking status

Age (years)	Smoking status	Wave one (n=1009) Mean±sd (95%CI)	Wave one (n=615) Mean±sd (95%CI)
17-24	Never and ex-smokers	1.81±1.12 1.46-2.16	1.85±1.23 1.35-2.35
	All smokers	1.61±0.85 1.37-1.85	1.55±0.75 1.26-1.84
	Within age group ANOVA value	F=1.023 p=0.315	F=1.080 p=0.304
25-34	Never and ex-smokers	2.66±2.28 2.19-3.13	2.42±1.47 2.02-2.82
	All smokers	1.78±1.12 1.56-2.00	1.85±1.16 1.57-2.13
	Within age group ANOVA value	F=12.637 p<0.001***	F=5.687 p=0.019*
35-44	Never and ex-smokers	2.84±1.55 2.55-3.13	2.71±1.41 2.39-3.03
	All smokers	2.01±1.31 1.77-2.25	2.13±1.40 1.79-2.59
	Within age group ANOVA value	F=18.807 p<0.001***	F=6.057 p=0.015*
45-64	Never and ex-smokers	3.64±2.31 3.27-4.01	3.75±2.32 3.27-4.23
	All smokers	2.91±1.70 2.62-3.20	3.18±1.94 2.72-3.64
	Within age group ANOVA value	F=8.396 p=0.004**	F=2.701 p=0.102
65 plus	Never and ex-smokers	3.64±2.29 3.27-4.01	3.85±2.49 3.33-4.37
	All smokers	3.20±2.10 2.69-3.71	3.62±2.36 2.88-4.36
	Within age group ANOVA value	F=1.804 p=0.181	F=0.251 p=0.617
All ages	Within never and ex-smokers ANOVA value	F=9.936 p<0.001***	F=9.764 p<0.001***
All ages	Within all smokers ANOVA value	F=18.305 p<0.001***	F=13.307 p<0.001***

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Summary

The mean level of fruit and vegetable consumption before the opening of the superstore, ranged between 2.77 (when n=1009) and 2.88 (when n=615) portions per person per day. Nearly 40% percent of the sample was eating three or more portions per day, which is estimated to be the national average (Gregory et al 1990), although 10% of respondents ate less than one portion per day.

Higher intake consumers of fruits and vegetables were statistically found to be those who did not have children under the age of 16 years in the household, and those with smaller households. The most striking differences in fruit and vegetable consumption were found for age and smoking status, with older people and non-smokers having statistically the higher intakes of fruits and vegetables.

5.4 Factors in the framework of consumption

As has been described fully in chapter 1.3, it is important to examine whether changes in physical access to fruit and vegetables leads to an increased intake within a framework, that allows other factors to be examined. These factors were namely, physical access to fruit and vegetables, availability of fruit and vegetables, affordability of fruit and vegetables, attitude towards healthy eating, and the buying and consumption of fruit and vegetables. Within this section, each of these factors was examined for their wave one characteristics and their effect on fruit and vegetable consumption.

5.4.1 Physical access to fruit and vegetables

Physical access to fruit and vegetables was examined by where fruit and vegetables were bought (i.e. shopping practices), the distance travelled to procure them and what transport was used. In order to aid in the analysis of shopping practices, the stores used for food shopping were divided into two, namely; the mainstream multiple high street stores such as Tesco, Asda and Sainsbury (Wrigley 1998) – referred to here as 'big' stores and the limited range/low cost stores such as Lidl, Netto and Kwik-Save (Bromley and Thomas 1993), referred to here as 'budget' stores.

To enable investigation of the current physical access to fruit and vegetables, straight-line distances were calculated between the postcode of the respondent and the store used to buy fruit and vegetables. However, for wave one data, these distances were only available for respondents who bought their fruit and vegetables in the same store used to buy their 'main' household food shopping. Caution must also be noted as the straight-line distances may have an error of ±0.1km due to the nature of the calculation.

Table 5.9 indicates that over 60% of respondents bought their fruit and vegetables in what would be considered a 'big' store and that most of these respondents did so from one particular store (Asda), whilst a minority of respondents bought their fruit and vegetables from a 'budget' store (10 to 11%). Furthermore, a sizeable percentage also bought their fruit and vegetables from other sources such as markets and greengrocers.

Table 5.9: Stores used to buy fruits and vegetables at baseline

Name of food store	Wave one (n=1009) (%)	Wave one (n=615) (%)
All 'big' stores	62.5	60.6
All 'budget' stores	11.1	10.4
Other stores (not specified)	5.8	6.2
Other sources (market, greengrocers etc.)	16.7	19.0

Table 5.10: Straight-line distances travelled to fruit and vegetable store at baseline

	All store shoppers		Big store shoppers		Budget store shoppers	
	n=1009	n=615	n=1009	n=615	n=1009	n=615
Mean±sd (km)	2.50±1.89	2.57±2.04	2.64±1.96	2.71±2.11	1.55±0.84	1.53±0.93
Range (km)	0.10-12.33	0.10-12.33	0.36-12.33	0.61-12.33	0.10-3.70	0.10-3.70
Distance radii (%)						
≤0.5km	1.8	1.5	0.9	0.0	8.0	12.2
>0.5-≤1.0km	10.9	11.5	9.4	9.9	20.7	22.5
>1.0-≤1.5km	15.3	16.8	13.2	15.4	28.8	26.5
>1.5km	72.0	70.2	76.5	74.7	42.5	38.8

The straight-line distances travelled by respondents to the store used to purchase fruits and vegetables is explored in table 5.10 and shows the distance travelled was on average approximately 2.5km, with a range from 0.10km to 12.33km. In general respondents using 'big' stores had to travel considerably further compared to those using 'budget' stores, with under 1.0% of 'big' store shoppers living within 500m of the store used.

Furthermore, as table 5.11 suggests, those people who travel to and used 'big' stores consumed more fruits and vegetables than 'budget' store shoppers. However, those respondents who used other sources such as greengrocers and markets to purchase their fruits and vegetables had the highest mean intakes of fruits and vegetables (statistically significant when n=1009).

Table 5.11: Consumption of fruit and vegetables by baseline fruit and vegetable store type						
	Wave one (n=1009)			Wave one (n=615)		
Store type	Number	Mean±sd 95%CI	ANOVA value	Number	Mean±sd 95%CI	ANOVA value
Big store shoppers	631	2.78±1.88 2.64-2.93	F=5.614 p=0.001**	373	2.89±1.96 2.69-3.09	F=1.805 p=0.145
Budget store shoppers	112	2.21±1.36 1.95-2.46		64	2.44±1.52 2.05-2.82	
Other stores (not specified)	59	2.77±1.85 2.29-3.25		38	2.92±1.87 2.30-3.53	
Other sources	169	3.18±2.54 2.80-3.57		117	3.16±2.40 2.72-3.60	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

5.4.1.1 Transportation issues

Approximately 60% of the sample had regular access to a car or van, but as the results indicate there was no difference in fruit and vegetable consumption figures between those with or without access to a car or van (table 5.12).

Table 5.12: Baseline fruit and vegetable consumption by regular access to a car or van						
	Wave one (n=1009)			Wave one (n=615)		
Access to a car or van	Number	Mean±sd 95%CI	ANOVA value	Number	Mean±sd 95%CI	ANOVA value
Yes	588	2.74±1.70 2.60-2.87	F=0.499 p=0.480	352	2.87±1.80 2.68-3.06	F=0.024 p=0.878
No	421	2.82±2.27 2.61-3.04		263	2.89±2.25 2.62-3.16	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.13 reveals that a car was the most used mode of transport used for fruits and vegetables shopping, although approximately 25% of the sample had to take a taxi, a bus or walk to the stores. However, those respondents who used a bus to access the stores had a mean daily intake of over half a portion of fruits and vegetables more than those using a car. Respondents using a 'store' bus had the highest intakes, but with such a small number this result needs to be considered carefully.

Table 5.13: Baseline consumption of fruit and vegetables by transportation used to access store[Φ]						
	Wave one (n=1009)			Wave one (n=615)		
Transportation	Number	Mean±sd 95%CI	ANOVA value	Number	Mean±sd 95%CI	ANOVA value
Household's own car	403	2.71±1.67 2.54-2.87	F=3.105 p=0.009**	239	2.79±1.68 2.58-3.01	F=2.428 p=0.035*
Lift in somebody else's car	72	2.74±1.89 2.30-3.18		42	3.03±2.20 2.34-3.71	
Taxi	39	2.06±1.61 1.54-2.58		20	2.16±1.99 1.23-3.10	
Scheduled bus	63	3.21±2.92 2.48-3.95		36	3.47±3.09 2.43-4.52	
Store bus	9	4.27±2.48 2.37-6.17		6	4.71±2.94 1.63-7.80	
Walk	35	2.64±1.63 2.08-3.20		22	3.12±1.71 2.36-3.87	

[Φ]where fruit and vegetable store is the main store for shopping. ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Summary

In terms of physical access to fruits and vegetables, the majority of the sample used the 'big' multiple high street stores such as Asda or Tesco to buy their fruits and vegetables, although a considerable number used markets and greengrocers. Furthermore, the respondents who did use markets and greengrocers had the highest mean intakes of fruits and vegetables, and those using a 'big' store consumed considerably more than those using a 'budget' store.

The distances travelled to the fruits and vegetables stores were large, particularly for those accessing 'big' stores, with the majority living over 1.5km away from the store used. A car was the favoured mode of transport to access the stores, although those people who used a bus had the highest intakes of fruits and vegetables.

5.4.2 Availability of fruit and vegetables

In order to assess the availability of fruits and vegetables in the store used by the respondents, proxy measures were employed centring on the respondents attitude towards the store they used compared to other local stores with regards to the availability of fresh fruits and vegetables, the range of fresh fruits and vegetables, and the quality of fresh fruits and vegetables in store.

Analysis of the respondent attitudes showed that most respondents thought that the store they used was 'better' or the same as other stores. However, when the sample was divided into 'big' store and 'budget' store shoppers, significant differences appear. 'Big' store shoppers were consistently found to statistically rate their store of choice 'better' than 'budget store' shoppers for each of the variables measured, namely availability, range and quality (all $p<0.001$) (table 5.14). However, those people who rated their store 'better' did not have statistically higher fruit and vegetable consumption compared to those who rated it the same, worse or don't know (table 5.15). Furthermore, there was no statistical difference in consumption depending on the number of 'better' statements respondents agreed to (table 5.16).

As seen in table 5.17 the number of statements agreed to within each age band has no significant effect on fruit and vegetable consumption except for the oldest age group. However, within each number of statements agreed to, there was a strong age gradient with those aged 65 years plus eating significantly higher amounts of fruits and vegetables. For smoking status (table 5.18), non-smokers were more likely to have agreed to a higher number of 'better' statements than smokers, although within smoking status there was no significant effect on fruit and vegetable consumption. However, non-smokers within each number of agreed statements were likely to consume higher quantities of fruits and vegetables than smokers.

Summary

'Big' store shoppers were more likely to perceive their store as having a 'better' availability, range and quality of fresh fruits and vegetables than 'budget' store shoppers. However, within these groupings of store shoppers, there were no statistical differences in fruit and vegetable consumption. Age does not appear to influence the number of 'better' statements agreed to, but non-smokers were more likely to agree to 'better' statements than smokers.

Table 5.14: Attitude towards main store against other local stores with regards to fruits and vegetables at baseline (where main store is where fruits and vegetables are bought)

	Wave one (n=1009)				Wave one (n=615)			
	Overall (%)	Big store shoppers (%) (n=582)	Budget store shoppers (%) (n=87)	Chi-square value between 'better' for big store and budget store shoppers	Overall (%)	Big store shoppers (%) (n=344)	Budget store shoppers (%) (n=49)	Chi-square value between 'better' for big store and budget store shoppers
Availability of fresh fruit and vegetables								
Better	40.8	49.3	11.5	χ^2=43.851 p<0.001***	39.3	48.3	14.3	χ^2=20.085 p<0.001***
The same	45.5	41.2	74.7		47.6	43.6	73.5	
Worse	6.2	3.6	9.2		6.8	6.8	10.2	
Don't know	7.4	5.8	4.6		6.2	6.2	2.0	
The range of fresh fruit and vegetables								
Better	42.3	50.9	11.5	χ^2=47.256 p<0.001***	41.3	50.3	12.2	χ^2=25.032 p<0.001***
The same	42.9	39.0	64.4		44.1	40.1	61.2	
Worse	7.4	3.6	17.2		7.8	3.2	20.4	
Don't know	7.3	6.5	6.9		6.8	6.4	6.1	
The quality of fresh fruit and vegetables								
Better	41.5	48.3	10.3	χ^2=44.356 p<0.001***	40.5	49.1	8.1	χ^2=29.208 p<0.001***
The same	44.4	40.7	80.5		46.0	41.0	83.7	
Worse	5.7	4.1	4.6		6.0	3.8	4.1	
Don't know	8.3	6.9	4.6		7.5	6.1	4.1	

Chi square statistical test: Statistical difference between groups ***p<0.001, **p<0.01, *p<0.05

Table 5.15: Baseline fruit and vegetable consumption by attitude towards store used to buy fruits and vegetables

	Wave one (n=1009)		Wave one (n=615)	
	Mean±sd 95%CI	ANOVA Value	Mean±sd 95%CI	ANOVA Value
Availability of fruit and vegetables				
Better	2.88±2.04 2.68-3.08	F=2.093 p=0.148	2.94±1.92 2.69-3.18	F=0.324 p=0.569
All other (same, worse, don't know)	2.70±1.90 2.55-2.85		2.84±2.05 2.63-3.05	
Range of fruit and vegetables				
Better	2.83±2.02 2.64-3.03	F=0.710 p=0.400	2.86±1.89 2.63-3.09	F=0.033 p=0.855
All other (same, worse, don't know)	2.73±1.92 2.57-2.88		2.89±2.08 2.68-3.11	
Quality of fruit and vegetables				
Better	2.92±2.18 2.71-3.13	F=4.134 p=0.042*	3.00±2.15 2.73-3.26	F=1.414 p=0.235
All other (same, worse, don't know)	2.67±1.78 2.52-2.81		2.80±1.89 2.61-2.99	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.16: Baseline fruit and vegetable consumption by number of 'better' statements agreed with

Number of 'better' statements	Wave one (n=1009)			Wave one (n=615)		
	n	Mean±sd 95%CI	ANOVA Value	n	Mean±sd 95%CI	ANOVA Value
0	515	2.71±1.82 2.55-2.87	F=1.297 p=0.274	316	2.86±1.92 2.65-3.07	F=0.734 p=0.532
1	72	2.58±2.46 2.01-3.16		50	2.85±2.87 2.03-3.66	
2	80	2.64±1.43 2.32-2.96		52	2.55±1.50 2.14-2.97	
3	342	2.94±2.13 2.71-3.16		197	3.00±1.98 2.73-3.28	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.17: Distribution of 'better' statements by age (years) (percentage of row total) and baseline fruit and vegetable consumption						
Age in years	n	Number of 'better' statements (% of row total) Fruit and vegetable consumption (mean±sd)				
		0	1	2	3	Within row ANOVA value
17-24	1009	45.1 1.74±1.06	11.0 1.57±1.00	7.7 1.39±0.72	36.3 1.82±0.96	F=0.444 p=0.772
	615	52.9 1.84±1.17	15.7 1.59±1.05	7.8 1.29±0.71	23.5 1.73±0.77	F=0.391 p=0.760
25-34	1009	50.5 2.12±1.34	8.0 1.90±0.84	9.0 2.80±1.39	32.5 2.19±2.53	F=0.879 p=0.453
	615	49.6 2.10±1.31	8.4 1.91±0.88	10.9 2.91±1.58	31.1 1.87±1.30	F=2.115 p=0.102
35-44	1009	49.8 2.35±1.43	7.9 2.12±1.11	11.0 2.17±1.05	31.3 2.64±1.74	F=1.105 p=0.348
	615	51.7 2.44±1.48	9.0 2.32±1.17	12.4 1.96±0.99	26.9 2.64±1.54	F=0.95 p=0.416
45-64	1009	52.6 3.35±2.35	6.3 2.92±1.61	5.9 3.08±1.21	35.2 3.32±1.84	F=0.273 p=0.845
	615	53.3 3.76±2.60	7.9 3.13±1.75	5.5 2.65±1.01	33.3 3.27±1.55	F=1.203 p=0.311
65 plus	1009	53.4 3.14±1.59	5.0 4.73±5.23	6.3 3.41±1.95	35.3 3.83±2.34	F=2.824 p=0.040*
	615	49.6 3.23±1.36	4.4 6.60±6.71	5.9 3.82±2.09	40.0 4.06±2.54	F=4.369 p=0.006**
Within column ANOVA value	1009	F=14.062 p<0.001***	F=3.676 p=0.059	F=0.177 p=0.675	F=14.695 p<0.001***	
	615	F=20.253 p<0.001***	F=1.100 p=0.300	F=0.008 p=0.929	F=2.543 p=0.112	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.18: Distribution of 'better' statements by smoking status (percentage of row total) and baseline fruit and vegetable consumption						
Smoking status	n	Number of 'better' statements (% of row total) Fruit and vegetable consumption (mean±sd)				
		0	1	2	3	Within row ANOVA value
Never and ex-smokers	1009	45.4 3.20±2.00	6.7 3.14±3.26	9.1 2.59±1.20	38.7 3.29±2.28	F=1.407 p=0.240
	615	46.1 3.35±2.06	8.6 3.23±3.62	9.5 2.57±1.26	35.7 3.18±1.89	F=1.224 p=0.300
All smokers (light and heavy)	1009	57.3 2.28±1.53	7.4 2.02±0.98	6.8 2.73±1.76	28.4 2.39±1.78	F=1.221 p=0.302
	615	57.4 2.40±1.67	7.0 2.33±1.12	7.4 2.53±1.84	28.1 2.72±2.09	F=0.622 p=0.601
Within column ANOVA value	1009	F=34.486 p<0.001***	F=3.676 p=0.059	F=0.177 p=0.675	F=14.695 p<0.001***	
	615	F=20.253 p<0.001***	F=1.100 p=0.300	F=0.008 p=0.929	F=2.543 p=0.112	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

5.4.3 Affordability of fruits and vegetables

Fruit and vegetable consumption was measured by a number of economic factors, including employment status, receipt of state benefits, annual household income, and household deprivation (composed of housing tenure, household car/van access, household overcrowding and unemployment in the household), in order to assess whether economic factors and constraints affected consumption levels.

Results showed that employment status was a strong predictor of fruit and vegetable consumption, with those retired respondents having the highest intakes of fruits and vegetables. However, as has been previously shown those people from older age groups were most likely to have the highest intakes, and it is likely that in many cases these were the same people. There was no difference in intake between levels of state benefit receipt, whilst for annual household income the pattern was very unclear with those in the lowest and highest income bands having the highest intakes of fruits and vegetables (table 5.19).

Table 5.19: Baseline fruit and vegetable consumption by economic markers						
	Wave one (n=1009)			Wave one (n=615)		
Variable	n	mean±sd 95% CI	ANOVA value	n	mean±sd 95% CI	ANOVA value
Employment status						
Full-time work	202	2.60±1.58 2.38-2.82	F=12.273 p<0.001***	116	2.70±1.67 2.39-3.01	F=11.790 p<0.001***
Part-time work	189	2.49±1.58 1.87-2.71		119	2.57±1.63 2.27-2.87	
Unemployed	55	2.30±1.59 1.87-2.73		33	2.40±1.71 1.80-3.01	
Retired	279	3.52±2.26 3.25-3.78		171	3.79±2.50 3.41-4.17	
Full-time education	11	2.27±1.85 1.03-3.51		6	2.38±2.23 0-4.72	
Housewife/husband	249	2.41±2.00 2.16-2.66		157	2.32±1.51 2.08-2.56	
Receipt of benefit levels						
No benefits	326	2.73±1.98 2.52-2.95	F=0.284 p=0.753	188	2.81±1.86 2.54-3.08	F=0.580 p=0.560
Under one year	67	2.73±1.61 2.54-3.32		388	2.88±2.10 2.67-3.09	
More than one year	616	2.78±1.98 2.69-2.93		39	3.19±1.62 2.66-3.72	
Annual household income						
Refused	177	2.90±2.00 2.60-3.20	F=2.362 p=0.038*	104	3.06±2.25 2.62-3.50	F=1.756 p=0.120
Under £5000	166	2.96±2.24 2.62-3.31		101	3.08±2.53 2.58-3.58	
£5000 - £9999	249	2.68±2.02 2.43-2.93		145	2.86±2.09 2.51-3.20	
£10,000 - £14,999	139	2.48±1.38 2.25-2.71		93	2.59±1.46 2.30-3.90	
£15,000 - £19,999	105	2.38±1.42 2.11-2.66		67	2.36±1.30 2.05-2.68	
£20,000 plus	131	2.94±1.80 2.63-3.25		80	3.07±1.84 2.66-3.48	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

5.4.3.1 Household deprivation marker score

The household deprivation marker score based on the Townsend index (Townsend 1987) was composed of four indices, namely, housing tenure, household car/van access, household overcrowding, and unemployment in the household. Respondents from households in which a value of zero was achieved were the least deprived, whilst those respondents from households in which a value of four was achieved were the most deprived. Table 5.20 shows there were significant differences in fruit and vegetable for all indices except car/van access. Furthermore, the respondents from the most deprived households consumed in excess of a portion of fruit and vegetables less per day than those respondents from the least deprived households.

Table 5.20: Baseline fruit and vegetable consumption by household deprivation markers						
	Wave one (n=1009)			Wave one (n=615)		
Variable	n	mean±sd 95% CI	ANOVA value	n	mean±sd 95% CI	ANOVA value
Housing tenure						
Own out-right/paying mortgage (score of 0)	394	3.06±1.92 2.87-3.25	F=14.441 p<0.001***	255	3.20±2.04 2.94-3.45	F=11.122 p=0.001**
Rent (score of 1)	615	2.59±1.96 2.43-2.74		360	2.65±1.94 2.45-2.86	
Car/van access in household						
Access in household (score of 0)	589	2.74±1.71 2.60-2.88	F=0.414 p=0.520	353	2.87±1.80 2.69-3.06	F=0.006 p=0.937
No access in household (score of 1)	420	2.82±2.27 2.60-3.04		262	2.89±2.25 2.61-3.16	
Household overcrowding						
No overcrowding (score of 0)	834	2.92±2.03 2.78-3.06	F=27.443 p<0.001***	504	3.06±2.07 2.87-3.24	F=21.798 p<0.001***
Overcrowding (score of 1)	169	2.07±1.37 1.86-2.27		108	2.08±1.38 1.82-2.34	
Unemployment in household						
No unemployment (score of 0)	862	2.83±1.97 2.69-2.96	F=3.997 p=0.046*	530	2.93±2.00 2.77-3.11	F=2.870 p=0.091
Unemployment present (score of 1)	138	2.47±1.88 2.15-2.78		82	2.53±1.98 2.10-2.97	
Total household deprivation marker score						
0 (least deprived)	257	3.03±1.79 2.81-3.25	F=5.071 p<0.001***	159	3.19±1.90 2.89-3.49	F=4.120 p=0.003**
1	297	2.88±1.94 2.66-3.10		185	3.07±2.05 2.78-3.37	
2	305	2.76±2.16 2.52-3.00		181	2.76±2.04 2.46-3.06	
3	120	2.18±1.82 1.85-2.50		75	2.20±1.91 1.76-2.64	
4 (most deprived)	15	1.81±1.35 1.06-2.56		9	2.11±1.42 1.02-3.20	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Furthermore, as is demonstrated in table 5.21, within each age band, those respondents from households with no deprivation consistently had the highest intakes of fruits and vegetables (although not to statistically significant levels), whilst those from households with highest deprivation had the lowest intakes of fruits and vegetables. In general those aged 65 years plus within each level of housing deprivation had the highest intakes of fruits and vegetables (statistically significant except when household deprivation marker score was four, but note the very small sample number).

Smokers were less likely to come from a household with no deprivation, with 16.8 to 19.5% of smokers coming from a house with no deprivation compared to 31.4 to 33.7% of non-smokers. At each level of deprivation score, non-smokers without fail had higher fruit and vegetable intakes (statistically significant for household deprivation marker scores of two and under) (table 5.22).

Table 5.21: Distribution of household deprivation marker score by age (years) (percentage of row total) and baseline fruit and vegetable consumption

Age in years	n	Household deprivation marker score (% of row total) Fruit and vegetable consumption (mean±sd) 0	1	2	3	4	Within row ANOVA value
17-24	1009	12.2 1.86±1.25	21.1 1.53±0.74	35.6 1.57±0.87	25.6 2.07±1.20	5.6 1.31±0.46	F=1.386 p=0.246
	615	11.8 1.50±0.69	15.7 1.32±0.68	41.2 1.59±0.96	25.5 2.40±1.30	5.9 1.43±0.43	F=2.096 p=0.097
25-34	1009	18.9 2.66±1.52	26.0 2.33±1.42	28.6 2.32±2.56	24.0 1.59±1.13	2.6 1.66±1.59	F=2.235 p=0.067
	615	17.6 2.67±1.71	27.7 2.58±1.54	27.7 1.77±0.85	24.4 1.49±0.75	2.5 2.33±1.82	F=4.526 p=0.002**
35-44	1009	29.5 2.59±1.53	25.0 2.47±1.58	29.5 2.16±1.19	15.2 2.49±1.75	0.9 1.14±0.40	F=1.140 p=0.338
	615	31.0 2.61±1.40	24.6 2.84±1.54	29.6 2.07±1.28	14.1 2.11±1.41	0.7 1.43	F=1.965 p=0.103
45-64	1009	38.6 3.31±2.06	31.1 3.17±1.72	23.5 3.48±2.30	5.7 3.37±3.38	1.1 3.33±1.61	F=0.202 p=0.937
	615	37.7 3.64±2.25	30.2 3.29±1.86	23.5 3.54±1.96	7.4 3.73±3.70	1.2 3.14±2.22	F=0.217 p=0.929
65 plus	1009	18.6 3.69±1.44	40.5 3.48±2.44	40.5 3.41±2.31	0.5 3.43	0.0	F=0.147 p=0.931
	615	20.0 3.88±1.51	44.4 3.54±2.59	34.8 3.94±2.68	0.7 3.43	0.0	F=0.277 p=0.842
Within column ANOVA value	1009	F=4.847 p=0.001**	F=7.038 p<0.001***	F=8.862 p<0.001***	F=3.518 p=0.010*	F=2.069 p=0.163	
	615	F=4.773 p=0.001**	F=3.124 p=0.016**	F=12.826 p<0.001***	F=3.473 p=0.012*	F=0.578 p=0.654	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.22: Distribution of household deprivation marker score by smoking status (percentage of row total) and baseline fruit and vegetable consumption							
Smoking status	n	Household deprivation marker score (% of row total) Fruit and vegetable consumption (mean±sd)					
		0	1	2	3	4	Within row ANOVA value
Never and ex-smokers	1009	31.4 3.37±1.93	32.3 3.20±2.17	27.0 3.24±2.48	8.3 2.44±1.91	0.9 2.43±1.68	F=1.771 p=0.133
	615	33.7 3.48±1.99	32.8 3.31±2.32	23.8 3.12±2.11	8.4 2.22±1.81	1.2 2.11±1.76	F=2.346 p=0.054
All smokers	1009	19.5 2.42±1.31	27.1 2.47±1.49	34.6 2.33±1.75	16.6 2.04±1.76	2.2 1.50±1.12	F=1.590 p=0.176
	615	16.8 2.53±1.50	27.2 2.77±1.54	36.9 2.43±1.97	17.2 2.23±1.98	1.9 2.11±1.31	F=0.782 p=0.538
Within column ANOVA value	1009	F=17.380 p<0.001***	F=10.181 p=0.002**	F=13.570 p<0.001***	F=1.365 p=0.245	F=1.652 p=0.221	
	615	F=8.307 p=0.005**	F=3.064 p=0.082	F=5.041 p=0.026*	F=0.000 p=0.987	F=0.000 p=0.995	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Summary

Economic factors including employment and annual household income, as well as markers of household deprivation (housing tenure, household unemployment and household overcrowding) appeared to be predictors of fruit and vegetable intake. Those respondents from households with no household deprivation consumed over a portion of fruits and vegetable a day more than those respondents from households that were the most deprived.

5.4.4 Attitudes towards healthy eating

Respondents who claimed to have a positive attitude towards healthy eating had statistically significant higher consumption of fruits and vegetables than those who did not (table 5.23). In particular those respondents agreeing with the statement 'I mostly eat a healthy diet nowadays' and disagreeing with the statement 'I don't really care what I eat' had the highest intakes of fruits and vegetables (p<0.001). Furthermore, those respondents with the most positive attitude towards healthy eating based on the answers to three attitude questions, had statistically the highest fruit and vegetable intake – well over a portion a day more than those respondents with the least positive attitude towards healthy eating (p<0.001) (table 5.24).

Table 5.23: Baseline fruit and vegetable consumption by attitudes towards healthy eating			
Statement	Attitude	Wave one (n=1009) mean±sd (n)	Wave one (n=615) mean±sd (n)
Healthy eating is just another fashion	Agree	2.69±1.96 (n=287)	2.86±2.13 (n=189)
	Disagree	2.87±1.84 (n=572)	3.01±1.98 (n=336)
	Don't know/neither agree or disagree	2.54±2.33 (n=150)	2.43±1.72 (n=90)
	Within group ANOVA	F=2.040 p=0.131	F=3.035 p=0.049*
I mostly eat a healthy diet nowadays	Agree	3.08±2.01 (n=695)	3.18±2.01 (n=435)
	Disagree	1.93±1.41 (n=218)	1.93±1.46 (n=128)
	Don't know/neither agree or disagree	2.49±2.02 (n=96)	2.66±2.34 (n=52)
	Within group ANOVA	F=31.507 p<0.001***	F=20.951 p<0.001***
I don't really care what I eat	Agree	2.28±1.62 (n=255)	2.36±1.71 (n=152)
	Disagree	3.01±2.02 (n=689)	3.10±2.02 (n=423)
	Don't know/neither agree or disagree	2.16±2.04 (n=65)	2.49±2.44 (n=40)
	Within group ANOVA	F=17.017 p<0.001***	F=8.823 p<0.001***

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.24: Baseline fruit and vegetable consumption by overall attitude towards healthy eating		
Number of 'positive' attitudes	Wave one (n=1009) mean±sd (n)	Wave one (n=615) mean±sd (n)
0 (respondents with least positive attitude towards healthy eating)	2.04±1.48 (129)	1.97±1.31 (75)
1	2.26±1.81 (184)	2.58±2.19 (109)
2	2.90±2.23 (316)	2.87±2.09 (207)
3 (respondents with most positive attitude towards healthy eating)	3.17±1.80 (380)	3.33±1.89 (224)
Within group ANOVA value	F=16.676 p<0.001***	F=10.262 p<0.001***

Positive attitudes based on: Healthy eating is just another fashion – disagree; I mostly eat a healthy diet nowadays – agree; I don't really care what I eat – disagree
ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Stratification of positive attitudes by age, smoking status, as well as age and smoking status combined are presented in tables 5.25 to 5.26. Within each age band (other than for 17-24 year olds) those with the highest number of positive attitudes towards healthy eating had the highest fruit and vegetable intake, although not always to statistically significant levels (table 5.25). However, within each band of number of positive attitudes, those aged 65 years plus had statistically the highest intakes of fruits and vegetables. Likewise within both non-smokers and smokers, those with more positive attitude towards healthy eating had higher intakes of fruits and vegetables (table 5.26). Overall, those people who were older, did not smoke and had more positive attitudes towards health had the highest consumption levels for fruits and vegetables (table 5.27), although the interactions between attitudes, smoking status, and age are complex as the differentials in fruit and vegetable intake are not constant. For example at lower age groups for each attitude group the difference between smokers and non-smokers is small for fruit and vegetable consumption, whereas at older age groups for most attitude groups, non-smokers consume higher intakes of fruits and vegetables than smokers.

Table 5.25: Distribution of positive attitude by age (years) (percentage of row total) and baseline fruit and vegetable consumption

Age in years	n	Number of positive attitudes (% of row total) Fruit and vegetable consumption (mean±sd)				
		0	1	2	3	Within row ANOVA value
17-24	1009	25.3 1.45±0.81	26.4 1.49±0.66	25.3 2.26±1.44	23.1 1.68±0.65	F=3.577 p=0.017*
	615	27.5 1.63±0.89	25.5 1.32±0.66	25.5 2.21±1.51	21.6 1.78±0.67	F=1.765 p=0.167
25-34	1009	16.0 1.48±0.88	24.0 1.79±1.10	27.0 2.48±2.73	33.0 2.58±1.41	F=4.153 p=0.007**
	615	17.6 1.62±0.94	22.7 1.98±1.21	28.6 2.10±1.36	31.1 2.46±1.51	F=1.960 p=0.124
35-44	1009	10.6 1.54±1.61	16.7 1.80±0.81	30.0 2.50±1.73	42.7 2.78±1.32	F=7.634 p<0.001***
	615	10.3 1.38±0.87	15.2 1.92±0.78	34.5 2.53±1.71	40.0 2.79±1.29	F=5.441 p=0.001**
45-64	1009	11.5 2.65±1.56	14.4 2.70±2.44	33.0 3.25±2.19	41.1 3.73±1.90	F=3.805 p=0.011*
	615	9.7 2.46±1.61	13.3 3.29±3.10	36.4 3.22±2.03	40.6 4.04±1.96	F=3.146 p=0.027*
65 plus	1009	8.6 3.32±1.51	15.8 3.42±2.40	37.1 3.32±2.37	38.5 3.69±2.14	F=0.451 p=0.717
	615	7.4 3.31±1.42	17.8 3.92±2.68	37.0 3.50±2.73	37.8 3.98±2.16	F=0.474 p=0.701
Within column ANOVA value	1009	F=9.670 p<0.001***	F=7.619 p<0.001***	F=2.800 p=0.026*	F=12.282 p<0.001***	
	615	F=5.816 p<0.001***	F=5.763 p<0.001***	F=3.564 p=0.008**	F= p<0.001***	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.26: Distribution of positive attitude by smoking status (percentage of row total) and baseline fruit and vegetable consumption

Smoking status	n	Number of positive attitudes (% of row total) Fruit and vegetable consumption (mean±sd)				
		0	1	2	3	Within row ANOVA value
Never and ex-smokers	1009	7.6 2.29±1.66	16.4 2.50±1.89	31.1 3.32±2.62	44.9 3.47±1.88	F=5.522 p=0.001**
	615	6.8 2.04±1.36	16.4 2.82±2.24	32.1 3.12±2.30	44.6 3.59±1.96	F=2.692 p=0.047*
All smokers (light and heavy)	1009	19.0 1.90±1.38	20.4 2.03±1.72	31.3 2.44±1.60	29.3 2.67±1.53	F=1.991 p=0.116
	615	19.3 1.92±1.28	18.9 2.35±2.15	35.6 2.61±1.82	26.3 2.86±1.64	F=2.574 p=0.057
Within column ANOVA value	1009	F=1.989 p=0.161	F=3.117 p=0.079	F=12.278 p=0.001**	F=17.823 p<0.001***	
	615	F=0.134 p=0.715	F=1.226 p=0.271	F=3.044 p=0.083	F=7.408 p=0.007**	

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Summary

Positive attitude towards healthy eating appears as an indicator of fruit and vegetable consumption. Those respondents who had the most positive attitude towards healthy eating consumed on average over a portion of fruits and vegetables more per day than those with no positive attitudes. This pattern was seen irrespective of age and smoking status.

Table 5.27: Baseline consumption of fruit and vegetables by attitudes, age (in years) and smoking status						
Number of positive attitudes	Age in years	Smoking status	Number n=1009 (%)*	Mean±sd n=1009	Number n=615 (%)*	Mean±sd n=615
0	17-24	Never and ex	6 (0.6)	1.36±0.91	2 (0.3)	1.28±1.62
		All smokers	16 (1.6)	1.37±0.64	11 (1.8)	1.53±0.64
	25-34	Never and ex	11 (1.1)	1.70±0.84	7 (1.1)	1.67±0.90
		All smokers	21 (2.1)	1.36±0.91	14 (2.3)	1.59±0.99
	35-44	Never and ex	6 (0.6)	2.36±2.78	4 (0.7)	1.17±0.41
		All smokers	18 (1.8)	1.27±0.96	11 (1.8)	1.45±0.99
	45-64	Never and ex	8 (0.8)	2.48±1.58	5 (0.8)	2.20±1.45
		All smokers	23 (2.3)	2.70±1.58	11 (1.8)	2.57±1.73
	65 plus	Never and ex	10 (1.0)	3.31±1.58	5 (0.8)	3.37±1.58
		All smokers	9 (0.9)	3.31±1.53	5 (0.8)	3.25±1.42
1	17-24	Never and ex	13 (1.3)	1.59±0.72	7 (1.1)	1.44±0.73
		All smokers	11 (1.1)	1.37±0.58	6 (1.0)	1.16±0.60
	25-34	Never and ex	19 (1.9)	2.11±1.37	13 (2.1)	2.19±1.51
		All smokers	29 (2.9)	1.57±0.85	14 (2.3)	1.77±0.85
	35-44	Never and ex	15 (1.5)	2.18±0.75	10 (1.6)	2.14±0.57
		All smokers	22 (2.2)	1.53±0.78	12 (2.0)	1.73±0.91
	45-64	Never and ex	23 (2.3)	3.03±3.02	12 (2.0)	4.16±3.85
		All smokers	14 (1.4)	2.21±0.94	8 (1.3)	2.21±1.18
	65 plus	Never and ex	18 (1.8)	3.15±1.37	13 (2.1)	3.46±1.43
		All smokers	17 (1.7)	3.69±3.18	11 (1.8)	4.48±3.67
2	17-24	Never and ex	8 (0.8)	2.75±1.85	6 (1.0)	2.83±1.86
		All smokers	15 (1.5)	2.00±1.15	7 (1.1)	1.67±0.98
	25-34	Never and ex	26 (2.6)	3.04±3.69	16 (2.6)	2.16±1.30
		All smokers	27 (2.7)	1.94±1.21	18 (2.9)	2.03±1.44
	35-44	Never and ex	34 (3.4)	2.98±1.97	25 (4.1)	2.94±1.88
		All smokers	33 (3.3)	2.04±1.30	25 (4.1)	2.10±1.43
	45-64	Never and ex	48 (4.8)	3.55±2.35	31 (5.0)	3.21±1.87
		All smokers	41 (4.1)	2.88±1.95	29 (4.7)	3.21±2.21
	65 plus	Never and ex	51 (5.1)	3.56±2.74	30 (4.9)	3.73±3.26
		All smokers	27 (2.7)	2.99±1.64	17 (2.8)	3.31±1.76
3	17-24	Never and ex	13 (1.3)	1.68±0.66	9 (1.5)	1.63±0.65
		All smokers	8 (0.8)	1.68±0.69	2 (0.3)	2.42±0.00
	25-34	Never and ex	36 (3.6)	2.97±1.40	16 (2.6)	3.18±1.58
		All smokers	30 (3.0)	2.11±1.30	21 (3.4)	1.91±1.22
	35-44	Never and ex	54 (5.4)	2.99±1.19	35 (5.7)	2.87±1.10
		All smokers	40 (4.0)	2.56±1.46	20 (3.3)	2.77±1.59
	45-64	Never and ex	67 (6.7)	4.05±2.00	45 (7.3)	4.16±2.06
		All smokers	43 (4.3)	3.26±1.66	22 (3.6)	3.79±1.75
	65 plus	Never and ex	71 (7.1)	3.87±2.21	45 (7.3)	4.09±2.24
		All smokers	13 (1.3)	2.91±1.54	6 (1.0)	3.16±1.28

*Figures in parenthesis are percentage of wave total (n=1009 or n=615)

5.4.5 Buying and consuming fruits and vegetables

This section examines the factors respondents cite as affecting and limiting their choice of food bought, and were assessed through a series of yes/no questions as described in Figure 5.3.

Figure 5.3: Questions used to assess factors affecting and limiting food choice	
Affecting food choice	**Limiting food choice**
• The cost of food/my food budget • Not eating certain foods because advised not to by health professionals • What my spouse/partner will eat • What my child/children will eat • Trying to eat a healthy balanced diet • The kinds of food I like eating • Convenience • Whether my spouse/partner is with me • Whether my child/children are with me • Packaging/display • Food advertising • Programmes/news items about food in the media • The kinds of foods my friends buy • The kinds of foods my relatives buy • Whether I'm hungry or not • Personal beliefs (e.g. religious/cultural/ vegetarianism)	• What is available in the store that I can get to • Not much space to store food at home • Small or no fridge • Limited cooking facilities • Don't know how to cook some foods • Ability to carry and transport foods home • Food goes off before it's eaten • Difficult to get to shops with children • Difficult to get to shops because of age or disability

In terms of factors affecting the choice of food bought (tables 5.28a and 5.28b), nearly three-quarters of all respondents mentioned 'cost of food/my food budget' as the main factor, although the proportion mentioning cost was not different between the two groups as defined by their fruit and vegetables intake in relation to the sample mean. Other factors cited by the majority of respondents were 'the kinds of food I like eating' and 'trying to eat a healthy balanced diet'. Factors not thought to be important included 'the kinds of foods my friends buy', 'the kinds of foods my relatives buy', 'packaging/display', 'personal beliefs' and 'food advertising' – all fewer than 11% of respondents.

Higher fruit and vegetable intake consumers were statistically (Pearson chi-square test) more likely to cite 'trying to eat a healthy diet', 'advise from health professionals', (both $p<0.001$) and 'programmes/news items about food in the media ($p<0.05$) but were statistically less likely to refer to 'what my child/children will eat' ($p<0.001$), 'convenience' ($p<0.05$) and 'whether my child/children are with me' ($p<0.01$ when n=1009 and $p<0.05$ when n=615).

For factors limiting the choice of foods bought (table 5.29), 'what is available in the store that I can get to' was the most cited response by just over half the sample. The next most cited responses were 'food goes off before it's eaten' (30%) and 'ability to carry and transport foods home' (28%). Higher fruit and vegetable consumers were statistically (Pearson chi-square test) more likely to cite 'difficult to get to shops because of age or disability' ($p<0.01$ for n=1009 only) but were statistically less likely to cite 'difficult to get to shops with children' ($p<0.001$ when n=1009 and $p<0.05$ when n=615), 'food goes off before it is eaten' ($p<0.001$ when n=1009 and $p<0.05$ when n=615) and 'not much space to store food at home' ($p<0.05$ when n=1009 only).

Table 5.28a: Factors affecting the choice of food bought by baseline fruit and vegetable consumption

Factors affecting the choice of foods bought	Factor affecting the choice of foods bought (n=1009) (%)				Factor affecting the choice of foods bought (n=615) (%)			
	Overall	Above sample mean$^{\Phi}$ (n=386)	Below sample mean$^{\Phi}$ (n=623)	Chi square value	Overall	Above sample mean$^{¥}$ (n=242)	Below sample mean$^{¥}$ (n=373)	Chi square value
The costs of food/my food budget	73.3	73.1	73.5	χ^2=0.026 p=0.873	74.6	74.0	75.1	χ^2=0.094 p=0.759
Not eating certain foods because advised not to by health professionals	18.2	29.8	11.1	χ^2=55.999 p<0.001***	18.4	32.6	9.1	χ^2=54.180 p<0.001***
What my spouse/partner will eat	44.8	42.2	46.4	χ^2=1.668 p=0.196	47.8	47.9	47.7	χ^2=0.003 p=0.959
What my child/children will eat	40.7	29.8	47.5	χ^2=30.997 p<0.001***	43.4	32.2	50.7	χ^2=20.313 p<0.001***
Trying to eat a healthy balanced diet	51.3	71.0	39.2	χ^2=96.590 p<0.001***	52.7	73.6	39.1	χ^2=69.722 p<0.001***
The kinds of food I like eating	62.5	62.4	62.6	χ^2=0.003 p=0.958	63.7	63.2	64.1	χ^2=0.046 p=0.830
Convenience	33.1	28.5	36.0	χ^2=5.986 p=0.014*	33.2	28.1	36.5	χ^2=4.630 p=0.031*
Whether my spouse/partner is with me	18.0	18.9	17.5	χ^2=0.323 p=0.570	19.7	20.7	19.0	χ^2=0.246 p=0.620
Whether my child/children are with me	16.4	11.9	19.1	χ^2=8.992 p=0.003**	17.6	13.6	20.1	χ^2=4.245 p=0.039*

(Pearson) Chi square statistical test: Statistical difference between consumption groups ***p<0.001, **p<0.01, *p<0.05
Φ Sample mean is 2.77 portions of fruit and vegetables per person per day,
¥ Sample mean is 2.88 portions of fruit and vegetables per person per day.

Table 5.28b: Factors affecting the choice of food bought by baseline fruit and vegetable consumption

Factors affecting the choice of foods bought	**Factor affecting the choice of foods bought (n=1009) (%)**				**Factor affecting the choice of foods bought (n=615) (%)**			
	Overall	Above sample mean$^{\Phi}$ (n=386)	Below sample mean$^{\Phi}$ (n=623)	Chi square value	Overall	Above sample mean$^{¥}$ (n=242)	Below sample mean$^{¥}$ (n=373)	Chi square value
Packaging/display	6.8	6.2	7.2	χ^2=0.378 p=0.539	7.6	6.6	8.3	χ^2=0.601 p=0.438
Food advertising	9.1	9.8	8.7	χ^2=0.398 p=0.528	10.1	9.9	10.2	χ^2=0.012 p=0.913
Programmes/news items about food in the media	11.4	14.2	9.6	χ^2=5.033 p=0.025*	11.7	2.9	1.6	χ^2=1.169 p=0.280
The kinds of foods my friends buy	2.3	3.1	1.8	χ^2=1.930 p=0.165	2.1	3.3	3.8	χ^2=0.085 p=0.770
The kinds of foods my relatives buy	3.3	4.1	2.7	χ^2=1.511 p=0.219	3.6	32.6	34.3	χ^2=0.184 p=0.668
Whether I'm hungry or not	32.7	31.3	33.5	χ^2=0.524 p=0.469	33.7	6.6	3.8	χ^2=2.584 p=0.108
Personal beliefs (e.g. religious/cultural/vegetarianism)	5.3	8.5	3.2	χ^2=13.650 p<0.001***	4.9	2.9	1.6	χ^2=1.169 p=0.280

(Pearson) Chi square statistical test: Statistical difference between consumption groups ***p<0.001, **p<0.01, *p<0.05

Φ Sample mean is 2.77 portions of fruit and vegetables per person per day,

¥ Sample mean is 2.88 portions of fruit and vegetables per person per day .

Table 5.29: Factors limiting the choice of food bought by baseline fruit and vegetable consumption

Factors limiting the choice of foods bought	Factor limiting the choice of foods bought (n=1009) (%)				Factor limiting the choice of foods bought (n=615) (%)			
	Overall	Above sample mean$^{\Phi}$ (n=386)	Below sample mean$^{\Phi}$ (n=623)	Chi square value	Overall	Above sample mean$^{¥}$ (n=242)	Below sample mean$^{¥}$ (n=373)	Chi square value
What is available in the store that I can get to	51.5	52.8	50.7	χ^2=0.511 p=0.511	54.0	54.1	53.9	χ^2=0.004 p=0.953
Not much space to store food at home	11.6	8.8	13.3	χ^2=4.738 p=0.030*	11.4	9.5	12.6	χ^2=1.395 p=0.238
Small or no fridge	6.2	6.2	6.3	χ^2=0.001 p=0.978	6.5	7.4	5.9	χ^2=0.572 p=0.449
Limited cooking facilities	1.9	2.6	1.4	χ^2=1.694 p=0.193	1.5	1.2	1.6	χ^2=0.139 p=0.710
Don't know how to cook some foods	11.8	9.8	13.3	χ^2=3.659 p=0.056	10.9	7.9	12.9	χ^2=3.806 p=0.051
Ability to carry and transport foods home	28.1	30.8	26.5	χ^2=2.224 p=0.136	28.3	29.3	27.6	χ^2=0.215 p=0.643
Food goes off before it's eaten	29.5	23.3	33.4	χ^2=11.615 p<0.001***	30.1	24.8	33.5	χ^2=5.305 p=0.021*
Difficult to get to shops with children	7.2	3.4	9.6	χ^2=13.929 p<0.001***	7.6	4.5	9.7	χ^2=5.421 p=0.020*
Difficult to get to shops because of age or disability	10.9	14.8	8.5	χ^2=9.614 p=0.002**	11.5	14.5	9.7	χ^2=3.327 p=0.068

(Pearson) Chi square statistical test: Statistical difference between consumption groups ***p<0.001, **p<0.01, *p<0.05
Φ Sample mean is 2.77 portions of fruit and vegetables per person per day,
¥ Sample mean is 2.88 portions of fruit and vegetables per person per day.

For differences in consumption in terms of factors affecting the choice of food bought, those answering yes to 'not eating certain foods because advised not to by health professionals', 'trying to eat a healthy balanced diet', 'programmes/news items about food in the media', 'personal beliefs' (all $p<0.001$) and 'the kinds of foods my friends buy' ($p<0.05$ when $n=1009$ and $p<0.01$ when $n=615$) all had statistically higher levels of fruit and vegetable consumption. Furthermore, those answering no to 'what my child/children will eat' ($p<0.001$), or 'whether my children are with me' ($p<0.01$ when $n=1009$ and $p<0.05$ when $n=615$) had statistically lower intakes of fruits and vegetables (table 5.30).

With regards to factors limiting the choice of foods bought, higher intakes of fruits and vegetables were found in those answering yes to ' difficult to get to shops because of age or disability' ($p<0.001$) or 'limited cooking facilities' ($p<0.05$ when $n=1009$ only). Statistically lower intakes of fruits and vegetables were found in those answering yes to 'difficult to get to shops with children' ($p<0.001$), 'food goes off before it's eaten' ($p<0.01$ when $n=1009$ and $p<0.05$ when $n=615$) or 'don't know how to cook some foods' ($p<0.01$ when $n=615$ only) (table 5.31).

Table 5.30: Baseline fruit and vegetable consumption by factors affecting the choice of food bought

Factors affecting the choice of foods bought	Factor affecting the choice of foods bought (n=1009)			Factor affecting the choice of foods bought (n=615)		
	Yes	No	ANOVA value	Yes	No	ANOVA value
The costs of food/my food budget	2.80±2.05 n=740	2.69±1.69 n=269	F=0.592 p=0.442	2.90±2.13 n=459	2.82±1.56 n=156	F=0.163 p=0.686
Not eating certain foods because advised not to by health professionals	3.88±2.47 n=184	2.53±1.73 n=825	F=76.919 p<0.001***	4.31±2.72 n=113	2.56±1.64 n=502	F=79.666 p<0.001***
What my spouse/partner will eat	2.71±1.73 n=452	2.82±2.12 n=557	F=0.762 p=0.383	2.84±1.82 n=294	2.91±2.16 n=321	F=0.184 p=0.668
What my child/children will eat	2.32±1.43 n=411	3.08±2.20 n=598	F=38.322 p<0.001***	2.42±1.52 n=267	3.23±2.24 n=348	F=25.836 p<0.001***
Trying to eat a healthy balanced diet	3.37±2.11 n=518	2.14±1.55 n=491	F=110.016 p<0.001***	3.56±2.26 n=324	2.12±1.31 n=291	F=90.210 p<0.001***
The kinds of food I like eating	2.77±1.92 n=631	2.78±2.02 n=378	F=0.022 p=0.882	2.89±2.01 n=392	2.86±1.98 n=223	F=0.035 p=0.851
Convenience	2.61±1.84 n=334	2.85±2.01 n=675	F=3.372 p=0.067	2.74±2.03 n=204	2.95±1.98 n=411	F=1.568 p=0.211
Whether my spouse/partner is with me	2.74±1.42 n=182	2.78±2.06 n=827	F=0.067 p=0.795	2.83±1.41 n=121	2.89±2.12 n=494	F=0.075 p=0.785
Whether my child/children are with me	2.39±1.53 n=165	2.85±2.02 n=844	F=7.467 p=0.006**	2.51±1.78 n=108	2.96±2.04 n=507	F=4.511 p=0.034*
Packaging/display	2.87±2.01 n=69	2.77±1.95 n=940	F=0.166 p=0.684	2.87±2.16 n=47	2.88±1.99 n=568	F=0.002 p=0.963
Food advertising	3.07±2.59 n=92	2.74±1.88 n=917	F=2.310 p=0.129	3.07±2.87 n=62	2.86±1.88 n=553	F=0.622 p=0.431
Programmes/news items about food in the media	3.38±2.64 n=115	2.70±1.84 n=894	F=12.531 p<0.001***	3.70±3.07 n=72	2.77±1.79 n=543	F=13.979 p<0.001***
The kinds of foods my friends buy	3.65±3.77 n=23	2.75±1.89 n=986	F=4.767 p=0.029*	4.58± 4.78 n=13	2.84±1.89 n=602	F=9.775 p=0.002**
The kinds of foods my relatives buy	2.73±1.69 n=33	2.77±1.97 n=976	F=0.018 p=0.892	2.58±1.72 n=22	2.89±2.01 n=593	F=0.518 p=0.472
Whether I'm hungry or not	2.73±1.79 n=330	2.79±2.04 n=679	F=0.199 p=0.656	2.84±1.84 n=207	2.90±2.08 n=408	F=0.134 p=0.715
Personal beliefs (e.g. religious/cultural/vegetarianism)	3.60±2.26 n=53	2.73±1.93 n=956	F=10.170 p=0.001**	3.70±2.59 n=30	2.84±1.96 n=585	F=5.416 p=0.020*

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Table 5.31: Baseline fruit and vegetable consumption by factors limiting the choice of food bought

Factors limiting the choice of foods bought	Factor limiting the choice of foods bought (n=1009)			Factor limiting the choice of foods bought (n=615)		
	Yes	No	ANOVA value	Yes	No	ANOVA value
What is available in the store that I can get to	2.82±1.94 n=520	2.72±1.97 n=489	F=0.663 p=0.416	2.94±2.10 n=332	2.81±1.87 n=283	F=0.709 p=0.400
Not much space to store food at home	2.59±2.36 n=117	2.80±1.90 n=892	F=1.141 p=0.286	2.56±1.51 n=70	2.92±2.05 n=545	F=2.027 p=0.155
Small or no fridge	2.57±1.83 n=63	2.79±1.97 n=946	F=0.727 p=0.394	2.85±2.16 n=40	2.88±2.16 n=575	F=0.007 p=0.933
Limited cooking facilities	3.82±4.23 n=19	2.75±1.89 n=990	F=5.561 p=0.019*	2.98±2.37 n=9	2.88±2.00 n=606	F=0.025 p=0.874
Don't know how to cook some foods	2.40±1.95 n=119	2.82±1.95 n=890	F=4.884 p=0.027*	2.24±1.42 n=67	2.96±2.05 n=548	F=7.747 p=0.006**
Ability to carry and transport foods home	2.92±2.11 n=284	2.71±1.90 n=725	F=2.332 p=0.127	3.02±2.40 n=174	2.82±1.82 n=441	F=1.255 p=0.263
Food goes off before it's eaten	2.49±1.66 n=298	2.89±2.06 n=711	F=9.202 p=0.002**	2.64±1.76 n=185	2.98±2.09 n=430	F=3.849 p=0.050*
Difficult to get to shops with children	2.10±1.32 n=73	2.82±1.99 n=936	F=9.485 p=0.002**	2.10±1.26 n=47	2.94±2.04 n=568	F=7.809 p=0.005**
Difficult to get to shops because of age or disability	3.34±2.37 n=110	2.70±1.89 n=899	F=10.763 p=0.001**	3.54±2.65 n=71	2.79±1.88 n=544	F=8.969 p=0.003**

ANOVA statistical test: Statistical difference within groups ***p<0.001, **p<0.01, *p<0.05

Summary

In terms of factors affecting and limiting the choice of foods bought, 'the cost of food/my food budget' was the most cited factor followed by 'the kinds of food I like eating' and 'what is available in the store that I can get to'. When the sample was divided into those consuming more or less than the sample mean for fruit and vegetables, differences were found between the groups. Factors higher intake consumers were statistically more likely to cite included 'trying to eat a healthy diet', 'advise from health professionals' and 'difficult to get to shops because of age or disability' but were less likely to refer to 'what my child/children will eat', 'convenience', 'difficult to get to shops with children', 'food goes off before it is eaten' and 'not much space to store food at home'.

Furthermore, with respect to fruit and vegetable intake, those answering yes to (including) 'advise from health professionals', 'trying to eat a healthy diet', 'the media', and 'personal beliefs' had statistically higher consumption, whereas those answering yes to (including) 'whether my child/children are with me', 'what my child/children will eat', 'difficult to get to shops with children' and 'food goes off before its eaten' had statistically lower consumption levels.

5.4.6 Identification of the lower intake consumers of fruit and vegetables

In order to determine who at baseline were the lower intake consumers of fruit and vegetables and what their profile was (i.e. what were their characteristics with regards to socio-demographic, lifestyle and attitudinal variables) a backwards-stepwise likelihood ratio logistic regression model was developed.

Lower intake consumers were classified as those who ate two or fewer portions of fruits and vegetables per day, a figure chosen as it was below the wave one sample mean for fruit and vegetable consumption. There were 423 (41.9%) respondents in the sample who were classified as lower intake consumers. Higher intake consumers were classified as those who ate at least three portions of fruit and vegetables per day, of which there were 361 (35.8%) in the whole sample. The cut-off figure of three portions per day was chosen as it is estimated to be the national average for British adults for fruit and vegetable consumption (Gregory et al 1990).

The variables in the model were all discrete (sex, age, three attitudinal statements on healthy eating, education, receipt of benefits, annual household income and smoking status) with the exception of household deprivation and number of children in the household under the age of 16, which were continuous in nature.

Tables 5.32a and 5.32b shows both the crude odds ratio and adjusted odds ratio of being a lower intake consumer of fruit and vegetables, as well as the proportion of lower intake consumers within each group (after adjustment). The crude odds ratios were for within each variable only whilst the adjusted odds ratios take into account all variables in the model and the effect they had on each other. In this way it was possible to separate out the overlapping effect certain variables had on each other. An odds ratio above one implies a greater 'probability' of being a lower intake consumer.

From the crude odds ratios it can be seen that the lower intake consumers were more likely to be younger, disagree or not have an outright opinion on the attitudinal statement 'I mostly eat a healthy diet nowadays', agree with the attitudinal statement 'I don't really care what I eat', not have an outright opinion on the attitudinal statement 'Healthy eating is just another fashion', smoke, had increasing household deprivation and an increasing number of children under the age of 16 years. The largest differences in proportion of lower intake consumers were seen for age where 88.6% of 17-24 year olds were classified as lower intake consumers compared to 30.9% of 65 plus year olds.

For the adjusted model 93% (n=729) of the potential 784 cases were included in the model. Cases were not included if information for any of the included variables in the model were missing. Of the 729 cases in the model, 396 (54.3%) were lower intake consumers whilst 333 (45.7%) were higher intake consumers. The adjusted odds ratio shows that the most important determinants of being a lower fruit and vegetable consumer were age (between the ages of 17 and 44 years), being a heavy smoker, disagreeing with the attitudinal statement 'I mostly eat a healthy diet' and agreeing with the statement 'I don't really care what I eat', having lower educational attainment, and having increasing numbers of children under the age of 16 years.

The variables not included in the model, were excluded in the following order: sex, receipt of benefits, annual household income, and household deprivation index. The order in which variables leave the model give some estimate of their significance – i.e. sex has the least effect on determining the likelihood of being a lower fruit and vegetable consumer or not.

Table 5.32a: Probability of being a lower fruit and vegetable intake consumer at baseline (under two portions per day) n=1009					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Age					
17-24 years	70	88.6	15.567 (p<0.001)***	10.841 (p<0.001)***	4.53 - 25.97
25-34 years	146	72.6	5.898 (p<0.001)***	3.409 (p<0.001)***	1.775 – 6.547
35-44 years	165	62.4	3.599 (p<0.001)***	2.821 (p<0.001)***	1.563 – 5.092
45-64 years	196	39.8	1.428 (p=0.103)	1.285 (p=0.320)***	0.784 – 2.104
65 plus years	152	30.9	1.0	1.0	
Attitude statement – Healthy eating is just another fashion					
Agree	209	55.5	1.231 (p=0.205)	0.919 (p=0.688)	0.610 – 1.387
Disagree	411	49.9	1.0	1.0	
Don't know/neither	109	68.8	2.009 (p=0.001)**	1.698 (p=0.054)	0.991 – 2.910
Attitude statement – I mostly eat a healthy diet nowadays					
Agree	489	43.1	1.0	1.0	
Disagree	168	81.5	5.810 (p<0.001)***	3.118 (p<0.001)***	1.920 – 5.065
Don't know/neither	72	66.7	2.431 (p<0.001)***	1.499 (p=0.180)	0.830 – 2.710
Attitude statement – I don't really care what I eat					
Agree and don't know/neither	241	71.8	1.0	1.0	
Disagree	488	45.7	0.370 (p<0.001)***	0.578 (p<0.008)**	0.387 – 0.865
Educational attainment					
GCSE (or equivalent) and below	523	55.8	1.197 (p=0.261)	1.631 (p<0.019)*	1.083 – 2.404
Above GCSE (or equivalent)	206	50.5	1.0	1.0	
Smoking status					
Non-smokers	379	41.2	1.0	1.0	
Smokers	350	68.6	3.002 (p<0.001)***	2.325 (p<0.001)***	1.639 – 3.296
Children in household under the age of 16 years (continuous variable)					
Increasing number of children	729	54.3	1.627 (p<0.001)***	1.224 (p=0.034))*	1.016 – 1.476

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios were adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

Table 5.33b: Probability of being a lower fruit and vegetable intake consumer at baseline (under two portions per day) n=1009					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Gender					
Male	133	49.6	0.782 (p=0.182)		
Female	596	55.4	1.0		
Receipt of benefits level					
None	231	54.1	1.0		
On benefits for less than one year	52	46.2	0.845 (p=0.565)		
On benefits for more than one year	446	55.4	1.064 (p=0.691)		
Annual household income					
Refused	127	52.8	1.257 (p=0.387)		
Under £5000	129	49.6	1.129 (p=0.645)		
£5000 - £9999	192	59.4	1.733 (p=0.025)*		
£10,000 - £14,999	103	56.3	1.470 (p=0.167)		
£15,000 - £19,999	80	61.3	1.848 (p=0.042)*		
£20,000 plus	98	44.9	1.0		
Household deprivation index (continuous variable)					
Increasing level of deprivation	729	54.3	1.577 (p<0.001)***		

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios were adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

The same model was run for the 615 respondents in wave one who subsequently completed wave two of data collection (tables 5.33a and 5.33b). Of these 615, 239 (38.9%) would be classified as lower intake consumers of fruits and vegetables in that they had a mean fruit and vegetable intake of two or fewer portions per day, whilst 242 (39.3%) would be classified as having three or more portions per day, i.e. higher intake consumers.

As with the previous model, from the crude odds ratios it can be seen that the lower intake consumers were more likely to be younger, disagree or not have an outright opinion on the attitudinal statement 'I mostly eat a healthy diet nowadays', agree with the attitudinal statement 'I don't really care what I eat', not have an outright opinion on the attitudinal statement 'Healthy eating is just another fashion', smoke, had increasing household deprivation and an increasing number of children under the age of 16 years.

For the adjusted model as previously 93% (n=448) of the potential cases (n=481) were included in the model. Of the 448 cases in the model, 225 (50.2%) were lower intake consumers while 223 (49.8%) were higher intake consumers. The adjusted odds ratios show as with the first model the most important determinants of being a lower fruit and vegetable consumer were age (between the ages of 17 and 44 years), being a smoker, disagreeing with the attitudinal statement 'I mostly eat a healthy diet' and agreeing with the statement 'I don't really care what I eat', and having lower educational attainment. However the variables not having an outright opinion on the attitudinal statement 'Healthy eating is just another fashion' and having increasing numbers of children under the age of 16 years were removed from the model but the variable increasing household deprivation was included.

The variables not included in the model, were excluded in the following order: receipt of benefits, increasing number of children, annual household income, sex and attitudinal statement 'Healthy eating is just another fashion'. The order in which variables leave the model give some estimate of their significance –i.e. receipt of benefits has the least effect on determining the likelihood of being a lower fruit and vegetable consumer or not.

Table 5.33a: Probability of being a lower fruit and vegetable intake consumer at baseline (under two portions per day) n=615					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Age					
17-24 years	37	89.2	27.414 (p<0.001)***	19.178 (p<0.001)***	5.803 – 63.383
25-34 years	91	72.5	8.800 (p<0.001)***	7.157 (p<0.001)***	3.404 – 15.049
35-44 years	105	59.0	4.806 (p<0.001)***	5.272 (p<0.001)***	2.648 – 10.496
45-64 years	124	34.7	1.770 (p=0.068)	1.804 (p=0.079)	0.935 – 3.481
65 plus years	91	23.1	1.0	1.0	
Attitude statement – I mostly eat a healthy diet nowadays					
Agree	306	38.9	1.0	1.0	
Disagree	102	78.4	5.714 (p<0.001)***	2.895 (p=0.001)**	1.590 – 5.270
Don't know/neither	40	65.0	2.918 (p=0.002)**	1.754 (p=0.158)	0.803 – 3.829
Attitude statement – I don't really care what I eat					
Agree and don't know/neither	144	67.4	1.0	1.0	
Disagree	304	42.1	0.352 (p<0.001)***	0.579 (p=0.031)*	0.352 – 0.952
Educational attainment					
GCSE (or equivalent) and below	321	52.6	1.410 (p=0.103)	1.835 (p=0.022)*	1.093 – 3.081
Above GCSE (or equivalent)	127	44.1	1.0	1.0	
Smoking status					
Non-smokers	245	40.4	1.0	1.0	0.976 – 2.426
Smokers	203	62.1	2.413 (p<0.001)***	1.539 (p=0.063)	
Household deprivation index (continuous variable)					
Increasing level of deprivation	448	50.2	1.689 (p<0.001)***	1.262 (p=0.045)*	1.005 – 1.585

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios were adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

Table 5.33b: Probability of being a lower fruit and vegetable intake consumer at baseline (under two portions per day) n=615					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Children in household under the age of 16 years (continuous variable)					
Increasing number of children	448	50.2	1.728 (p<0.001)***		
Gender					
Male	73	43.8	0.736 (p=0.234)		
Female	375	51.5	1.0		
Attitude statement – Healthy eating is just another fashion					
Agree	134	48.5	1.071 (p=0.749)		
Disagree	250	46.8	1.0		
Don't know/neither	64	67.2	2.327 (p=0.004)**		
Receipt of benefits level					
None	136	50.0	1.0		
On benefits for less than one year	31	38.7	1.066 (p=0.759)		
On benefits for more than one year	281	51.6	0.632 (p=0.258)		
Annual household income					
Refused	77	49.4	1.398 (p=0.345)		
Under £5000	78	46.2	1.230 (p=0.559)		
£5000 - £9999	112	53.6	1.656 (p=0.128)		
£10,000 - £14,999	72	50.0	1.435 (p=0.135)		
£15,000 - £19,999	53	60.4	2.186 (p=0.045)*		
£20,000 plus	56	41.1	1.0		

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios were adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

From this model it was possible to deduce that the lower intake consumers of fruit and vegetables were particularly likely to be those who were young, were smokers and had negative attitudes towards healthy eating. If the respondents from the sample who fit these criteria were selected, it can be seen that their mean fruit and vegetable intake was approximately 1.2 portions per person per day. However, the converse group (older, non-smokers and positive attitudes towards healthy eating) had a mean daily intake of over 2.5 portions more per person per day (table 5.34).

Table 5.34: Profile of lower and higher intake consumers of fruit and vegetables at baseline								
Scenario	**Number in sample**		**Percentage of sample**		**Percentage of relevant age group**		**Mean fruit and vegetable consumption**	
	n=1009	n=615	n=1009	n=615	n=1009	n=615	n=1009	n=615
Lower intake consumers 17 – 24 years Heavy smoker Negative attitude towards diet	18	11	1.8%	1.8%	19.8%	21.6%	1.21	1.23
Higher intake consumers 65 plus years Never smoker Positive attitude towards diet	109	68	10.8%	11.1%	49.3%	50.4%	3.77	4.02

5.4.6.1 Stratified logistic regression models

The binary logistic regression model developed was stratified in order to further analyse the interactions between the variables. However, in order to include all variables a forced entry regression analysis was undertaken. The disadvantage of this type of stratification was the small sample numbers, which may not be statistically viable.

Tables 5.35 and 5.36 show the models and significant variables for n=1009 and n=615 respectively. Furthermore, the Nagelkerke R square value was included which represents how much of the variability of the model was accounted for by the variables included – the closer the figure is to 1.0, the more of the model is explained.

When stratified by age, particularly for those models based on n=1009, smoking status and attitudinal statements were the significant variables predicting consumption. The exception was when age was 17-24 years – in both cases (n=1009 and n=615) no significant variables were found, yet the Nagelkerke value was highest. This indicates that age was such a powerful predictor for this age group, that no other factor was significant. This was further emphasised by the fact that when the models were stratified by smoking status and attitudinal status, lower fruit and vegetable consumers were consistently those from the lowest age groups. Furthermore, as with the backwards step-wise logistic regression model, it appears that age, smoking status and attitudes towards healthy eating were the dominant factors in predicting fruit and vegetable consumption. This implies that any changes in fruit and vegetable consumption in wave two of data collection should be explored and stratified by these three key variables.

Table 5.35: Stratification of logistic regression model at baseline n=1009		
Model and number of cases included in analysis	Significant variables	Nagelkerke R square value
All variables (n=729)	Age (17-44 years) Attitudinal statement 'I don't really care what I eat' (agree) Smoking status (smokers) Attitudinal statement 'I mostly eat a healthy diet nowadays' (neither/don't know)	0.350
Stratified age 17-24 years (n=70)	No significant variables	0.491
Stratified age 25-34 years (n=146)	Smoking status (smokers) Household deprivation marker score (increasing) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.419
Stratified age 35-44 years (n=165)	Smoking status (smokers) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree, neither/don't know)	0.310
Stratified age 45-64 years (n=196)	Attitudinal statement 'I don't really care what I eat' (agree) Smoking status (smokers)	0.235
Stratified age 65 years plus (n=152)	Smoking status (smokers) Household deprivation marker score (increasing)	0.212
Non smokers only (n=379)	Age (17-44 years) Attitudinal statement 'Healthy eating is just another fashion' (don't know, neither) Attitudinal statement 'I don't really care what I eat' (agree) Educational attainment (low) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.330
Smokers only (n=350)	Age (17-44 years) Attitudinal statement 'Healthy eating is just another fashion' (agree) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.304
Number of positive attitudes 0 or 1 (n=238)	Age (25-64 years) Household deprivation marker score (increasing)	0.432
Number of positive attitudes 2 or 3 (n=491)	Age (17-34 years) Attitudinal statement 'I don't really care what I eat' (agree) Smoking status (smokers)	0.256

Table 5.36: Stratification of logistic regression model at baseline n=615

Model and number of cases included in analysis	Significant variables	Nagelkerke R square value
All variables (n=448)	Age (17-44 years) Attitudinal statement 'I don't really care what I eat' (agree) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.380
Stratified age 17-24 years (n=37)	No significant variables	1.000
Stratified age 25-34 years (n=91)	Attitudinal statement 'Healthy eating is just another fashion' (agree)	0.474
Stratified age 35-44 years (n=105)	Benefits (more than one year)	0.353
Stratified age 45-64 years (n=124)	Attitudinal statement 'I don't really care what I eat' (agree) Educational attainment (low)	0.273
Stratified age 65 years plus (n=91)	Attitudinal statement 'I mostly eat a healthy diet nowadays' (don't know/neither)	0.362
Non smokers only (n=245)	Age (17-44 years) Attitudinal statement 'Healthy eating is just another fashion' (don't/know neither) Attitudinal statement 'I don't really care what I eat' (agree) Educational attainment (low)	0.395
Smokers only (n=203)	Age (17-34 years) Attitudinal statement 'Healthy eating is just another fashion' (agree) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.421
Number of positive attitudes 0 or 1 (n=139)	Age (25-44 years) Household deprivation marker score (increasing)	0.460
Number of positive attitudes 2 or 3 (n=309)	Age (17-44 years) Attitudinal statement 'I don't really care what I eat' (agree) Educational attainment (low) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.322

Summary

The logistic regression models suggests that the major and consistent determinants of fruit and vegetable consumption in the wave one sample were age, smoking status and attitudes towards a healthy diet. Indeed as has been demonstrated, those respondents aged 17-24 years (the youngest age group), who smoked and had negative attitudes towards healthy eating consume over 2.5 portions of fruits and vegetables a day less than those respondents aged 65 years and over (the oldest age group), who did not smoke and had positive attitudes towards healthy eating. Mean levels of fruit and vegetable consumption for these two groups were 1.2 and 3.77 to 4.02 respectively.

5.5 Chapter summary

This chapter has given an overview of the results collected during wave one (baseline) – before the opening of the locally accessible superstore in an area with poor physical access to food retailing and low fruit and vegetable consumption. Data were collected from 1009 respondents and results were shown for both these respondents and the 615 who subsequently completed wave two of data collection (i.e. after the opening of the locally accessible superstore).

The mean level of fruit and vegetable consumption stood at 2.77 portions per day (when n=1009) and 2.88 portions per day (when n=615), with median figures of 2.43 for both. The range of consumption of fruit and vegetable consumption was zero to nearly 20 portions per day, with approximately 10% of the samples eating under a portion a day and 10.3 to 11.1% meeting the Government targets of at least five portions of fruits and vegetables a day.

Initial results indicated that older age groups and non-smokers had statistically higher levels of fruit and vegetable consumption, as well as those with no or fewer children under the age of 16 years and those with smaller household numbers. The factors identified as part of the framework of fruit and vegetable consumption, namely; physical access, availability, affordability, attitudes, and the issues affecting the buying and consuming of fruits and vegetables were also examined. In addition, these factors were stratified by age and smoking status where possible in order to assess their effect.

5.5.1 Physical access

Physical access was examined by where fruits and vegetables were bought, the straight-line distance travelled to procure them and what transport was used. Results showed that over 60% of the respondents bought their fruits and vegetables from 'big' stores such as Tesco and Asda, as opposed to 'budget' stores such as Netto and Kwik-Save. Furthermore, those people buying fruits and vegetables from 'big' stores consumed more fruits and vegetables but those buying fruits and vegetables from greengrocers and markets had the highest consumption levels. With respect to distance travelled to procure fruits and vegetables, the mean straight-line distance travelled was approximately 2.5km with only 13% living within 1km of the store used. Distances travelled by 'big' store shoppers were on average just over 1km more than the distance travelled by 'budget' store shoppers.

Just over half of respondents had regular access to a car or van, but there was no difference in consumption levels. However, if the mode of transport used was broken down further, it was shown that those people who used a bus to access their fruit and vegetable store had the highest intakes of fruits and vegetables.

5.5.2 Availability

The availability of fruits and vegetables in a store was assessed by respondents' attitudes towards the store they used to buy fruits and vegetables with respect to the availability, range and quality of the fresh fruits and vegetables. Respondents who perceived their store to be better than other stores were more likely to be 'big' store shoppers, but there was no statistical difference with respect to fruit and vegetable consumption.

5.5.3 Affordability

Fruit and vegetable consumption was measured by a number of economic factors, including employment status, receipt of state benefits, annual household income, and household deprivation marker (composed of housing tenure, household car/van access, household overcrowding and unemployment in the household), in order to assess whether economic factors and constraints may affect consumption levels.

Results showed that receipt of benefit levels and annual household income appeared to have little effect on consumption, whilst retired people and those unemployed had the highest and lowest intakes of fruits and vegetables compared to other 'employment' groups. For the indices of the household deprivation marker there were significant differences in fruit and vegetable for all except household car/van access. Furthermore, the respondents from the most deprived households consumed in excess of a portion of fruit and vegetables less per day than those respondents from the least deprived households.

5.5.4 Attitudes towards healthy eating

Respondents who claimed to have a positive attitude towards healthy eating in general had statistically significant higher consumption of fruits and vegetables than those who did not. Indeed, those respondents who had the most positive attitude towards healthy eating consumed on average over a portion of fruits and vegetables more per day than those with no positive attitudes.

5.5.5 Buying and consuming fruits and vegetables

Respondents were asked to cite from a list the factors they perceived as affecting and limiting their choice of food bought. 'The cost of food/my food budget' was perceived by nearly 75% as being the major determinant, followed by 'the kinds of foods liked', 'what is available in the store' they could get to and 'trying to eat a healthy balanced diet'. Differences in the factors cited were seen between those above and below the sample mean, with those above the sample means more likely to cite (including) 'not eating certain foods because advised not to by health professionals', 'trying to eat a healthy balanced diet' and 'personal beliefs'. Those below the sample mean were more likely to cite (including) what 'my child/children will eat', 'whether my child/children are with me' and 'difficult to get to shops with children'. Many of these factors were also significant determinants of fruit and vegetable consumption. For example, those citing difficulties because of children consistently had lower intakes of fruits and vegetables than those who did not cite these factors.

Finally a backwards step-wise logistic regression model was developed in order to determine who the lower intake consumers (those consuming two or fewer portions per day) were compared to higher intake consumers (those consuming three or more portions per day) during wave one. The major determinants of lower consumption appeared to be age (young), smoking status (smokers) and attitudes towards healthy eating (negative), a finding that appears consistent when the model was stratified by these three variables.

5.6 Chapter discussion

The aim of this research was to determine whether an increase in physical access to fruits and vegetables through the opening of a locally accessible superstore would lead to increased consumption of fruits and vegetables. The results presented in this chapter were the wave one (baseline) results derived before the opening of the superstore. Data were sought by means of a self-completed seven-day checklist and an interviewer administered questionnaire from the person usually responsible for domestic arrangements in each household enrolled into the study.

The participation rate in wave one of eligible respondents (n=1009) was 15% of all households approached but 33% of households where contact was made. Questions may be raised concerning this small number and their representativeness of the population from which they were drawn, i.e. the generalisability of the study. Table 5.3 showed the characteristics of the sample in comparison to 1991 Census data, which overall displays good comparability. Whilst the Census data may be old it is the best currently available reference measure for the wards involved in this study.

Fruit and vegetable intake in wave one of data collection was between 2.77 and 2.88 portions per day depending on the sample size, with a range of 0 to 20 portions per day. With regards to the mean levels of fruit and vegetable consumption found at baseline there is a scarcity of data relating to fruit and vegetable intake in a highly deprived area and so it was not possible to establish how the results found during wave one of data collection compare other than to national averages. With respect to nationally representative samples the mean intake of fruits and vegetables in the UK may be between the three portions per day as estimated by the National Diet and Nutritional survey (NDNS) of British adults (Gregory et al 1990) and 3.9 portions per day as estimated from the 1999 National Food Survey (NFS) (Office for National Statistics 2000). However, as has been demonstrated in chapter two the intake of fruits and vegetables at a national level masks extreme differences at a number of different levels – age, gender, regional and socio-economic.

With regards to regional differences, the NFS examines intake data from Government Office Regions including Yorkshire and Humberside, a region that contains the study area. This data shows that fruit and vegetable consumption is amongst the lowest in Yorkshire and Humberside (3.7 portions per day) and that wave one intakes fall well below this.

The results of the wave one data are similar to other studies in that age was an important determinant of fruit and vegetable consumption (Johansson et al 1999, Thompson et al 1999). The NFS shows a strong age gradient with respondents aged under 25 years having the lowest intakes of fruits and vegetables (approximately 2.4 portions per day) compared to those aged 65 years and above who had the highest (approximately 5.1 portions per day). Results from wave one showed a similar gradient with intakes increasing from 1.73 to 3.75 portions per day for 17 to 24 year olds and 65 plus year olds respectively. This pattern has also been seen in the NDNS of British adults, with 38.4% of women aged over 50 years being in the highest fourth of fruit and vegetable consumption, compared to 12.1% of those aged under 25 years (Billson et al 1999).

Other socio-demographic variables leading to significant differences in fruit and vegetable consumption at baseline were the number of children in the household and the number of people in the household. Anderson and Hunt (1992) found no significant difference of healthy eating by presence of children in the household. However, if data from the 1999 NFS is examined, it can be seen that as the number of children and the number of people in a household increases the consumption of fruits and vegetables decreases. An example shows that the average intake per person in a household with two adults and no children is 5.1 portions per day but steadily declines to 2.3 portions per day in a household with two adults and four children.

However, there were no significant differences for gender and educational attainment, which were often two of the strongest predictors of fruit and vegetable intake. Women are generally found to have higher intakes (Thompson et al 1999), although Billson et al (1999) did find that men had slightly higher intakes than women. People with or from higher educational backgrounds are generally found to have higher intakes of fruits and vegetables (Erkkilä et al 1999, Lynch et al 1997, Johansson et al 1999, Margetts et al 1998, Thompson et al 1999).

Results at baseline showed that cigarette smokers consumed in the region of a portion of fruits and vegetables a day less than non-smokers. Many studies have repeatedly and consistently shown that smokers are lower intake consumers of fruit and vegetables (as well as a healthy diet in general) (e.g. Johansson et al 1999, Palaniappan et al 2001, Prevost et al 1997, Subar et al 1990, Thompson et al 1992, Thompson et al 1999). In terms of portions consumed, Palaniappan et al (2001) found that smokers consumed between 1.1 and 1.6 portions of fruits and vegetables less than non-smokers, although in this sample from Canada the mean consumption of fruits and vegetables for smokers was in the region of 3.7 to 4.0 portions per day – higher than the non-smokers in the present sample. This pattern was similarly shown by Johansson et al (1999), whilst Osler et al (1998) found that non-smoking Danish men and women consumed fruits significantly more often than those who smoked.

As has been described in chapter 1.3 the role of physical access to fruits and vegetables has been placed in a framework allowing the constraints on consumption to be assessed. Currently there is a scarcity of data regarding the physical access people have to stores selling fruits and vegetables. The theory that physical access to fruits and vegetables is a potential rate-limiting step in the consumption of fruits and vegetables has been advocated by a number of different reports, including the Low Income Project Team (Department of Health 1996), the Acheson Report (1998) and Neighbourhood Renewal (Social Exclusion Unit 2000, 2001). In the analysis of wave one data it was established that respondents were travelling on average a straight-line distance of 2.5km to the store used for buying fruits and vegetables. Work in London by Donkin et al (1999, 2000) found that residents on average were within 300m of a store that stocked a wide-range of healthy foods, whilst Cummins and Macintyre (1999) concluded that physical access to food stores was not a problem in their study area (Glasgow).

However, in recent analysis of the Sandwell area of the West Midlands, an area that may be comparable to the study area in this research in terms of deprivation levels, the authors found that accessing food stores was a difficulty for residents, particularly for accessing stores that had a range of fruits and vegetables at an affordable price (Dowler et al 2001). Furthermore, newly published figures have shown that 7% of all households cite difficulties in accessing supermarkets, a figure that increases to 17% of adults of pensionable age (Office for National Statistics 2001). Results showed that whilst there was no difference in consumption figures between those who add had access to a car (58%) and those who did not (42%), when these were broken down into modes of transport, it was found that people using a bus or walking (when n=615) had significantly higher intakes of fruits and vegetables compared to car users.

Furthermore, over 10% of the sample bought their fruit and vegetables from 'budget' stores – i.e. those with limited or discounted ranges. This may be an under-representation compared to the general population, as Robinson et al (2000) found that 19% of deprived adults in social class DE shopped in local cut price stores, compared to 14% who used out-of-town supermarkets.

In terms of the availability of fruits and vegetables, the majority of the sample believed that the store they used had a better availability, range and quality of fresh fruits and vegetables compared to other local stores. However, when the sample was divided into those respondents using 'big' stores such as Tesco, Asda and Sainsbury, and 'budget' stores such as Lidl, Kwik Save and Netto, important differences emerged. 'Big' store users consistently found their stores to be better for availability, range and quality of fresh fruits and vegetables. This may be a matter for concern as Dowler and Calvert (1995a, 1995b) found that those people who shopped exclusively in 'budget' stores bought a more restricted range of fruits and vegetables, and had a much less healthy dietary pattern. As further studies by Mooney (1990), Barratt (1997) and Piachaud and Webb (1996) have indicated, the availability of foods that are needed to adhere to healthy dietary patterns are not as available in stores in deprived areas as they are elsewhere.

There has been much conjecture that economic considerations may be the single most important factor influencing whether fruit and vegetables are purchased or not, particularly for those on low-incomes, the unemployed or the elderly (Anderson and Hunt 1992, Cox et al 1998, Leather 1992, Lennernäs et al 1997, Piachaud and Webb 1996). Employment status, annual household income and household deprivation markers and scores were shown to have a significant effect on fruit and vegetable consumption at baseline. Many studies have demonstrated that those people with higher incomes, with employment or with lack of household deprivation have higher intakes of fruits and vegetables (Billson et al 1999, Marmot et al 1991, Roos et al 1996, Thompson et al 1999, Wandel 1995). Nonetheless, studies have also shown that people with lower incomes can consume healthy diets (Department of Health 1996), and it would therefore be an oversimplification to state that monetary considerations were the only factors constraining choice, and that other factors must be involved.

In previous studies it has been shown that positive attitudes can influence the consumption of a healthy diet in general but also fruits and vegetables (Barker et al 1995, Wardle et al 2000). The questions used to assess attitudes towards healthy eating in this study have been previously used in the Health Education Authority's 1993 Health and Lifestyle Survey. The percentages agreeing and disagreeing to the statements 'I don't really care what I eat', 'Healthy eating is just another fashion' and 'I mostly eat a healthy diet nowadays' were similar to the responses found in the literature (Caraher et al 1998, Thompson et al 1999).

Whilst those respondents with a positive attitude towards healthy eating were consuming significantly more fruits and vegetables than those with a negative attitude, the level of consumption would not be at a level that could be considered to be particularly healthy. An issue that may be significant is whether the respondents are aware of the guidelines to consume greater amounts of fruits and vegetables as indicated by Paramenter et al (2000).

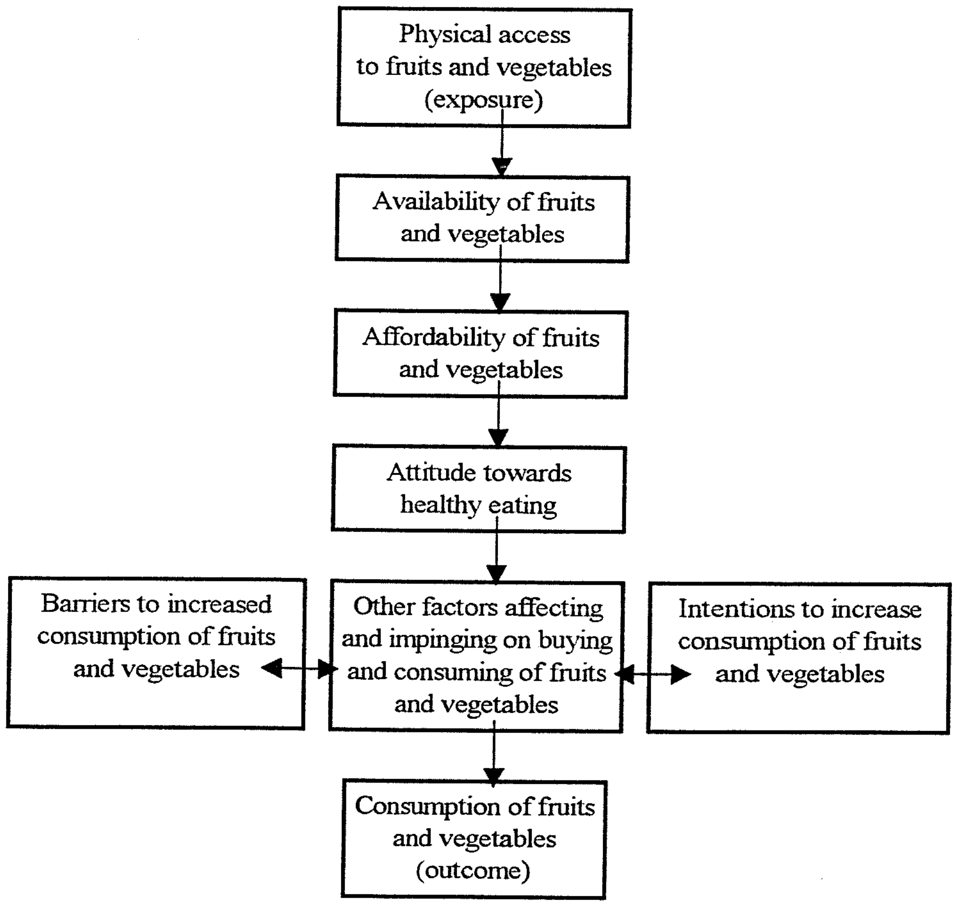
A number of studies have examined barriers and limitations to buying fruits and vegetables, and their subsequent consumption (Cox et al 1998, Caraher et al 1998, Robinson et al 2000, Treiman et al 1996). The major difficulties were seen as the cost of food, and what is available in store, although the percentages citing these and other barriers were much higher than for the same questions used in previous research (Caraher et al 1998). Furthermore, children were often presented as a difficulty – whether children were present when shopping, getting to shops with children and what children will eat, which mirrors other authors findings (Bostock 2001, Caraher et al 1998, Dowler and Calvert 1995a and 1995b).

A backwards step-wise binary logistic regression model was developed to try and identify the lower intake consumers of fruits and vegetables at baseline – those consuming two or fewer portions per day. The major determinants appeared to be age (young), smoking status (smokers) and attitude towards healthy eating (negative), along with educational attainment (low) and having more children in the household. Thompson et al (1999) developed a similar model whereby low intake consumers were characterised as those consuming eight portions or fewer per week of fruits and vegetables. In their analysis, the young, smokers, those with poor attitudes and those with low educational attainment were also found to be low intake consumers of fruits and vegetables.

6 WAVE TWO (FOLLOW UP) RESULTS

This chapter examines wave two (follow-up) data collected on study participants after the opening of the superstore. Self-reported fruit and vegetable intakes were examined within the framework of consumption as described in chapter 1.3 and shown in figure 6.1. The data were obtained through an interviewer-administered questionnaire and a self-completed seven-day food checklist as described in chapter 3.4.

Figure 6.1: Framework for fruit and vegetable consumption



6.1 Wave two (follow up) response rate and sample profile

Data are presented for the 615 respondents who completed both wave one and wave two of data collection (i.e. before and after the opening of the superstore) in order to evaluate changes in fruit and vegetable consumption before and after the opening of the superstore. The respondent was the person in the household principally responsible for domestic arrangements and only one person per household was able to participate. All intakes of fruits and vegetables were measured as portions per day, vegetable consumption excluded all potatoes and potato products but included baked beans, whilst fruit intake included fruit juice upto a maximum of one portion per day as in accordance National Heart Forum guidelines (1997).

The recruitment of the 615 respondents into wave two is shown in figure 6.2. As shown in chapter 5.1, 1009 respondents were recruited into wave one of data collection. All 1009 respondents were then approached for entry into wave two. Of these 1009 households, 22% had no contact made when the interviewer called (13% nobody at home, 9% moved away). Of the remaining 787 respondents where contact was made 13% of the sample refused to participate further, and 4% were subsequently excluded due to incomplete data. This left 615 respondents (61% of wave one respondents) to complete the study.

Tables 6.1a and b show the demographic variables of those completing both waves of data collection and those who did not complete wave two of data collection. As can be seen from the chi-square tests, the two samples were similar in their characteristics, with no statistically significant differences, although those completing both waves of data collection were less likely to be male, were more likely to have additional children in the household under the age of 16 years and were less likely to be renting their property (as opposed to having bought out-right/paying mortgage). As was shown in chapter 5.2.1 the respondents recruited into wave one of data collection were representative of the wider population of the geographical area.

Figure 6.1: Recruitment and response rate for waves one and two of data collection

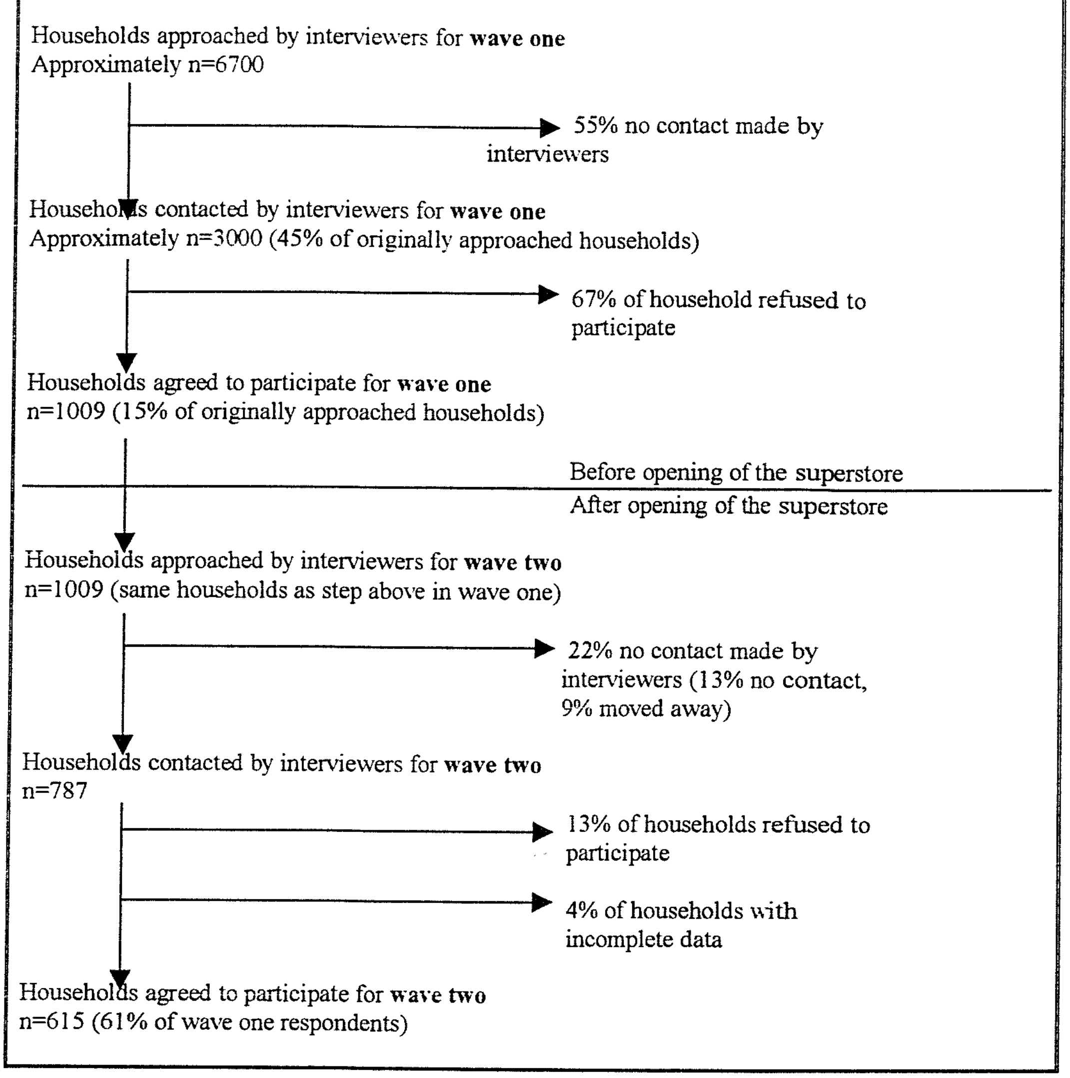


Table 6.1a: Sample profile by individual and household socio-demographic variables for wave two responders and non-responders			
Variable	Number (Percentage) completed wave one and wave two n=615	Number (Percentage) non-responders wave two n=394	Chi-square for difference between samples
Gender			
Male	98 (15.9)	85 (21.6)	χ^2=5.143 p=0.023*
Female	517 (84.1)	309 (78.4)	
Age			
17-24 years	51 (8.3)	40 (10.2)	χ^2=1.919 p=0.752
25-34 years	119 (19.3)	81 (20.6)	
35-44 years	145 (23.6)	82 (20.8)	
45-64 years	165 (26.8)	105 (26.6)	
65+ years	135 (22.0)	86 (21.8)	
Employment status			
Full-time work	116 (18.9)	86 (21.8)	χ^2=2.054 p=0.842
Part-time work	119 (19.3)	70 (17.8)	
Unemployed	33 (5.4)	22 (5.6)	
Retired	171 (27.8)	108 (27.4)	
Full-time education	6 (1.0)	5 (1.3)	
Housewife/husband	157 (25.5)	92 (23.4)	
Educational attainment			
GCSE (or equivalent) and below	441 (71.7)	291 (73.9)	χ^2=0.558 p=0.455
Above GCSE (or equivalent)	174 (28.3)	103 (26.1)	
Receipt of benefit levels			
No benefits	188 (30.6)	138 (35.0)	χ^2=2.760 p=0.252
On benefits for less than one year	39 (6.3)	28 (7.1)	
On benefits for more than one year	388 (63.1)	228 (57.9)	
Children aged under 16 years			
Yes	280 (45.5)	154 (39.1)	χ^2=3.298 p=0.069
No	314 (51.1)	220 (55.8)	
Number of children in household aged under 16 years			
0	332 (54.0)	237 (60.2)	χ^2=16.121 p=0.013*
1	112 (18.2)	59 (15.0)	
2	109 (17.7)	55 (14.0)	
3	42 (6.8)	32 (8.1)	
4 plus	20 (3.3)	11 (2.8)	
Number of people in household (all ages)			
1	103 (16.7)	87 (22.1)	χ^2=13.942 p=0.052
2	192 (31.2)	133 (33.8)	
3	130 (21.1)	62 (15.7)	
4	121 (19.7)	68 (17.3)	
5 plus	69 (11.2)	44 (11.0)	

(Pearson) Chi square statistical test: difference between groups ***p<0.001, **p<0.01, *p<0.05

Table 6.1b: Sample profile by individual and household socio-demographic variables for wave two responders and non-responders			
Variable	Number (Percentage) completed wave one and wave two n=615	Number (Percentage) non-responders wave two n=394	Chi-square for difference between samples
Housing tenure			
Own out-right	117 (19.0)	49 (12.4)	χ^2=7.711 p=0.021*
Own – paying mortgage	138 (22.4)	90 (22.8)	
Rent	350 (56.9)	247 (62.7)	
Car/van access			
Yes	352 (57.2)	236 (59.9)	χ^2=0.700 p=0.403
No	263 (42.8)	158 (40.1)	
Annual household income			
Refused	104 (16.9)	73 (18.5)	χ^2=3.565 p=0.614
Under £5000	101 (16.4)	65 (16.5)	
£5000 – £9999	145 (23.6)	104 (26.4)	
£10,000 - £14,999	93 (15.1)	46 (11.7)	
£15,000 - £19,999	67 (10.9)	38 (9.6)	
£20,000 plus	80 (13.0)	51 (12.9)	
Household deprivation score			
0 (least deprived)	159 (25.9)	98 (24.9)	χ^2=0.732 p=0.947
1	185 (30.1)	112 (28.4)	
2	181 (29.4)	124 (31.5)	
3	75 (12.2)	45 (11.4)	
4 (most deprived)	9 (1.5)	6 (1.5)	

(Pearson) Chi square statistical test: difference between groups ***p<0.001, **p<0.01, *p<0.05

6.2 Overall changes in fruit and vegetable consumption

The sample changes in fruit and vegetable consumption for those respondents completing both waves of data collection are reported in table 6.2 and show a minimal increase in fruit, vegetable, and fruit and vegetable consumption. Combined fruit and vegetable consumption rose by 0.04 portions per day from 2.88 to 2.92 portions per day whilst the median figure remained as 2.43 portions per day although there was a decrease in the modal figure from 2.43 to 2.29 portions per day. In wave one 39.3% of the sample met or exceeded the national average of three portions per day, whilst 11.1% met the national target of at least five portions of fruits and vegetable per day, this compares to wave two where the figures were 40.0% and 11.2% respectively.

Table 6.2: Fruit and vegetable consumption at waves one and two		
	Wave one (n=615)	Wave two (n=615)
Fruit		
Mean ± sd	1.30±1.17	1.31±1.14
95% CI	1.21-1.39	1.22-1.40
Median	1.00	1.14
Mode	0.0 (n=67)	0.0 (n=68)
Range	0.0-8.43	0.0-7.00
Paired sample t-test for consumption levels between waves	t=-0.402 p=0.688	
Vegetables		
Mean ± sd	1.58±1.07	1.61±1.35
95% CI	1.49-1.67	1.50-1.72
Median	1.43	1.43
Mode	1.0 (n=62)	1.14 (n=66)
Range	0.0-11.29	0.0-21.71
Paired sample t-test for consumption levels between waves	t=-0.589 p=0.556	
Fruit and vegetables		
Mean ± sd	2.88±2.00	2.92±2.21
95% CI	2.72-3.04	2.75-3.09
Median	2.43	2.43
Mode	2.43 (n=39)	2.29 (n=30)
Range	0.0-19.57	0.0-28.71
Paired sample t-test for consumption levels between waves	t=-0.591 p=0.555	

Paired sample t-test statistical test: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

The minimal overall difference was also reflected if changes in fruit and vegetable consumption were stratified by the variables identified in chapter 5.4.6 using the back-wards step-wise logistic regression model as being predictors of lower and higher consumption of fruit and vegetable consumption (table 6.3). As can be seen from this table there were neither significant changes in consumption levels occurring between the waves (indeed the largest change was only 0.24 portions per day) nor significant variations in the level of change within variables. The variables used to stratify data here will also be used in the subsequent analysis of the factors in the framework of consumption.

However, and in line with wave one data, older people, non smokers, those with positive attitudes towards healthy eating, those from the least deprived households and those with fewer children continued to have the highest levels of fruit and vegetable consumption.

Table 6.3: Stratified fruit and vegetable consumption at waves one and two			
	Wave one	Wave two	Paired sample t-test
All (n=615)	2.88±2.00	2.92±2.21	t=-0.591 p=0.555
Age			
17-24 years (n=51)	1.73±1.03	1.62±1.11	t=0.774 p=0.443
25-34 years (n=119)	2.10±1.33	2.24±1.27	t=-1.483 p=0.141
35-44 years (n=145)	2.42±1.42	2.49±1.43	t=-0.638 p=0.525
45-64 years (n=165)	3.49±2.18	3.43±2.12	t=0.410 p=0.683
65 years plus (n=135)	3.75±2.43	3.86±3.21	t=-0.484 p=0.629
Within column ANOVA value for change		F=0.375 p=0.826	
Smoking status			
Never smokers (n=196)	3.21±2.19	3.13±1.66	t=0.676 p=0.500
Ex-smokers (n=147)	3.20±2.06	3.25±2.90	t=-0.242 p=0.809
Light smokers (n=102)	2.79±2.01	2.89±2.39	t=-0.581 p=0.563
Heavy smokers (n=169)	2.27±1.52	2.43±1.86	t=-1.636 p=0.104
Within column ANOVA value for change		F=0.583 p=0.626	
Non-smokers (n=343)	3.21±2.14	3.18±2.27	t=0.247 p=0.805
All smokers (n=271)	2.47±1.73	2.60±2.08	t=-1.542 p=0.124
Within column ANOVA value for change		F=1.242 p=0.265	
Number of positive attitudes in wave one			
Zero (n=75)	1.97±1.31	1.88±1.29	t=0.717 p=0.475
One (n=109)	2.58±2.19	2.78±3.28	t=-0.769 p=0.443
Two (n=207)	2.87±2.09	2.94±1.89	t=-0.611 p=0.542
Three (n=224)	3.33±1.89	3.32±1.95	t=0.126 p=0.900
Within column ANOVA value for change		F=0.494 p=0.686	
Educational attainment			
At or below GCSE (n=441)	2.86±2.13	2.87±2.36	t=-0.049 p=0.961
Above GCSE (n=174)	2.92±1.63	3.06±1.75	t=-1.334 p=0.184
Within column ANOVA value for change		F=0.707 p=0.401	
Household deprivation marker score			
Zero (n=159) – lowest	3.19±1.90	3.19±1.51	t=-0.037 p=0.971
One (n=185)	3.07±2.05	2.96±1.65	t=0.865 p=0.388
Two (n=181)	2.76±2.04	3.00±2.97	t=-1.491 p=0.138
Three (n=75)	2.20±1.91	2.25±2.47	t=-0.347 p=0.729
Four (n=9) - highest	2.11±1.42	1.75±1.28	t=1.193 p=0.267
Within column ANOVA value for change		F=1.026 p=0.393	
Number of children in household under the age of 16 years			
Zero (n=332)	3.26±2.25	3.25±2.50	t=0.375 p=0.975
One to two (n=221)	2.37±1.46	2.52±1.76	t=-1.258 p=0.210
Three plus (n=62)	2.15±1.52	2.03±1.30	t=-0.970 p=0.337
Within column ANOVA value for change		F=0.321 p=0.725	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

However, if changes in fruit and vegetable consumption were stratified by what respondents were consuming in wave one, i.e. into those consuming ≤2.0 portions per day (lower intake consumers), those consuming >2.0 and <3.0 portions per day (intermediate intake consumers) and those consuming ≥3.0 portions per day (higher intake consumers), it can be seen that those who were lower intake consumers in wave one significantly increased their consumption levels by 0.44 portions per day (p<0.001), whilst those who were higher intake consumers had significantly lower levels (0.34 portions per day) of consumption in wave two ($p<0.05$) (table 6.4). However, this type of overall change in consumption may indicate that the change was due to regression to the mean rather than a true change in consumption levels.

Table 6.4: Stratified fruit and vegetable consumption by wave one consumption levels

	Lower intake consumers: ≤2.0 portions per day (n=239)		Intermediate intake consumers: >2.0 - <3.0 portions per day (n=134)		Higher intake consumers: ≥3.0 portions per day (n=242)	
	Wave one	Wave two	Wave one	Wave two	Wave one	Wave two
Mean±sd	1.31±0.52	1.75±0.98	2.45±0.22	2.46±1.02	4.67±2.03	4.33±2.72
Paired sample t-test	t=-7.039 p<0.001***		t=-0.171 p=0.864		t=2.056 p=0.041*	
ANOVA value for change	F=3.104 p<0.001***					

Paired sample t-test and ANOVA statistical tests: difference between consumption levels
***p<0.001, **p<0.01, *p<0.05

Summary

If the overall change in fruit and vegetable consumption was examined for the 615 respondents recruited into wave two of data collection a minimal and statistically insignificant increase of 0.04 portions per day to 2.92 portions per day was found ($p=0.555$). The median figure remained as 2.43 portions per day but there was a decrease in the modal figure from 2.43 to 2.29 portions per day. Furthermore, the percentage of respondents either exceeding the national average or meeting the national target for fruit and vegetable consumption hardly changed.

As in wave one, older people, non-smokers, those with positive attitudes towards healthy eating, those from the least deprived households and those with fewer children continued to have the highest levels of fruit and vegetable consumption, although when stratified by these variables there were no statistically significant changes in consumption.

Significant changes did occur when respondents were stratified by wave one consumption levels, with lower intake consumers of fruits and vegetables (i.e. those consuming two or fewer portions per day) and those classified as higher intake consumers (i.e. those consuming three or more portions per day) significantly increasing (1.31 to 1.75 portions per day) and decreasing (4.67 to 4.33 portions per day) their consumption levels respectively.

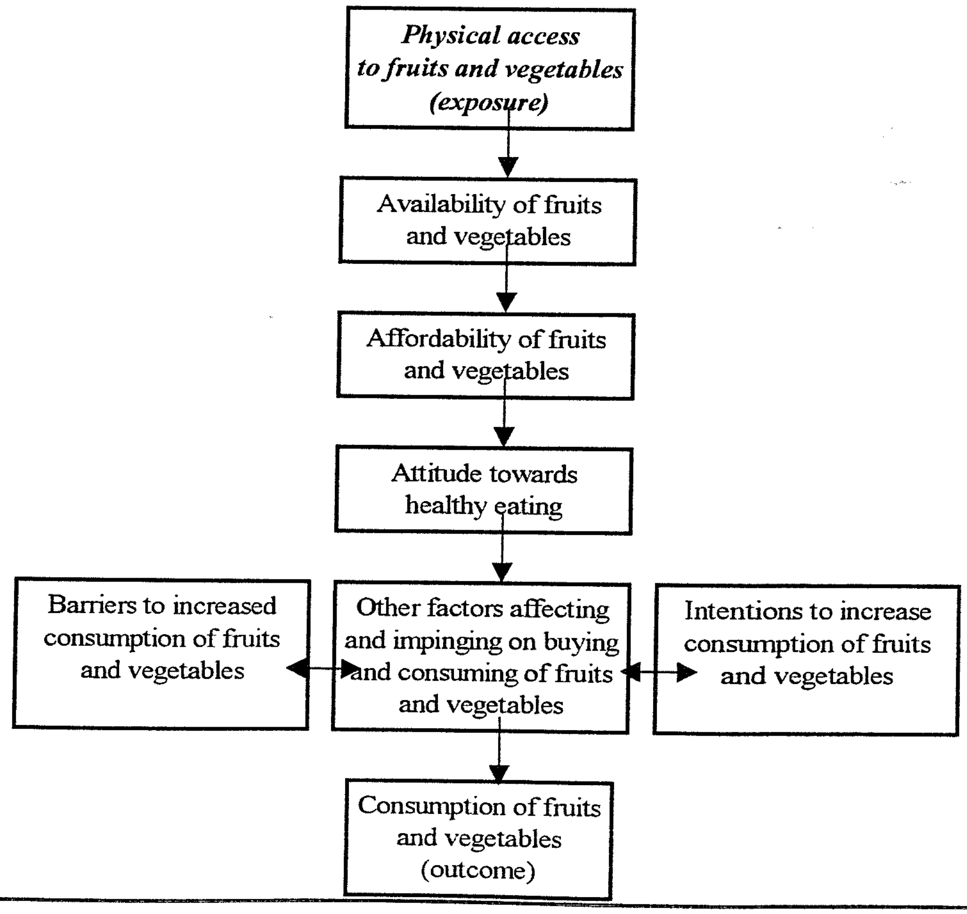
6.3 Factors in framework

In chapter 1.3 a framework to investigate the possible factors influencing changes in fruit and vegetable consumption was described (figure 6.1). These factors were physical access to fruits and vegetables, the availability of fruits and vegetables, the affordability of fruits and vegetables, attitudes towards healthy eating, and other factors impinging on the buying and consumption of fruits and vegetables. It is the intention within the remainder of this chapter to explore this framework and assess changes in fruit and vegetable consumption.

6.3.1 Physical access to fruits and vegetables

The first step in the framework of fruit and vegetable consumption was whether changes in physical access to fruit and vegetables alone affect consumption levels (figure 6.3).

Figure 6.3: Framework for fruit and vegetable consumption – assessment of physical access to fruit and vegetables



Within this thesis, changes in physical access to fruits and vegetables were assessed by those respondents who switched to using the new superstore (Tesco Seacroft) and comparing them to those respondents not using the new superstore. Of the 615 respondents recruited into wave two of data collection, 276 (44.9%) used the new superstore for their main store shopping, whilst 218 (35.4%) used the new superstore for their fruit and vegetable shopping, and 204 (33.2%) used the new superstore for both their main store and fruit and vegetable shopping. For the purposes of this thesis, those respondents who used Tesco Seacroft as their fruit and vegetable shopping store will be examined.

Table 6.5 examines levels of fruit and vegetable consumption by where fruits and vegetables were bought. Tesco Seacroft shoppers had lower intakes of fruits and vegetables than those respondents who shop for their fruits and vegetables elsewhere – 2.75 compared to 3.02 portions per day respectively. However, compared to wave one consumption, those respondents who switched to Tesco Seacroft consumed 0.15 portions more per day, although this was not a statistically significant alteration. This slight increase in fruit and vegetable consumption by those shopping at Tesco Seacroft means that the difference in consumption levels between those shopping at Tesco Seacroft and those not shopping there was no longer statistically different as it was in wave one of data collection (p=0.009 in wave one and p=0.158 in wave two).

Table 6.5: Fruit and vegetable consumption by changes in physical access to fruit and vegetables

	Wave one	Wave two	Change in consumption	Paired sample t-test
Tesco Seacroft used for fruit & vegetable shopping in wave two (n=218)	2.60±1.67	2.75±2.47	+0.15	t=1.207 p=0.229
Tesco Seacroft not used for fruit & vegetable shopping in wave two (n=397)	3.04±2.15	3.02±2.05	-0.02	t=0.234 p=0.815
Within column ANOVA	F=6.888 p=0.009**	F=1.999 p=0.158	F=1.377 p=0.241	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Fruit and vegetable consumption was stratified by where fruits and vegetables were bought (Tesco Seacroft or elsewhere) and by the predictor variables of fruit and vegetable consumption derived from wave one (see appendix 6, tables 1 and 2).

There were virtually no significant changes in fruit and vegetable consumption, with only those respondents who had two positive attitudes in wave one having a significant increase (0.27 portions per day). Furthermore, there were no significant differences in wave two consumption levels (except for heavy smokers/all smokers, those households with an HDM score of three in wave one) or the changes in consumption between Tesco Seacroft shoppers and non Tesco Seacroft shoppers. As has consistently been seen previously, those respondents who were young, those who smoked, those with negative attitudes to healthy eating, those with lower educational attainment, those with higher household deprivation scores and those with more children under the age of 16 years in the household had lower levels of fruit and vegetable intake, irrespective of where fruits and vegetables were bought from.

Stratification by wave one consumption levels shows that lower wave one consumers of fruits and vegetables significantly increased their fruit and vegetable intakes by upto 0.48 portions per day, this is regardless of whether they shopped at Tesco Seacroft or not, although there was no significant difference in the level of change dependent on where fruits and vegetables were shopped for (p=0.378) (table 6.6).

Table 6.6: Stratified fruit and vegetable consumption by wave one fruit and vegetable intake and changes in physical access

Wave one fruit and vegetable consumption	Tesco Seacroft fruit and vegetable shoppers			Non Tesco Seacroft fruit and vegetable shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.31 ± 0.49	1.69 ± 0.87	t=-4.390 p<0.001*** n=101	1.31 ± 0.54	1.79 ± 1.05	t=-5.512 p<0.001*** n=138	t=-0.890 p=0.374	t=-0.859 p=0.378
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.43 ± 0.21	2.50 ± 1.18	t=-0.370 p=0.713 n=41	2.45 ± 0.23	2.45 ± 0.95	t=0.097 p=0.923 n=93	t=0.253 p=0.801	t=0.374 p=0.709
Higher intake consumers: ≥3.0 portions per day	4.39 ± 1.49	4.31 ± 3.44	t=0.259 p=0.796 n=76	4.79 ± 2.23	4.35 ± 2.33	t=2.499 p=0.013* n=166	t=-0.093 p=0.926	t=0.934 p=0.352
Within column ANOVA value for change	F=1.328 p=0.267			F=11.751 p<0.001***				

Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If the distribution of fruit and vegetable consumption was divided into portions per day as in figures 6.4 to 6.6, there was little change in either the distribution of Tesco or non-Tesco shoppers between waves one and two (χ^2=5.885 p=0.318 for Tesco shoppers, χ^2=1.575 p=0.904 for non-Tesco shoppers), although slightly more Tesco shoppers now meet the Government target of at least five portions of fruits and vegetables per day. Furthermore, the distribution after wave two was not significantly different between Tesco and non-Tesco shoppers when analysed using the chi-squared test (χ^2=8.473 p=0.132).

Figure 6.4: Distribution of fruit and vegetable consumption in waves one and two for all respondents (n=615)

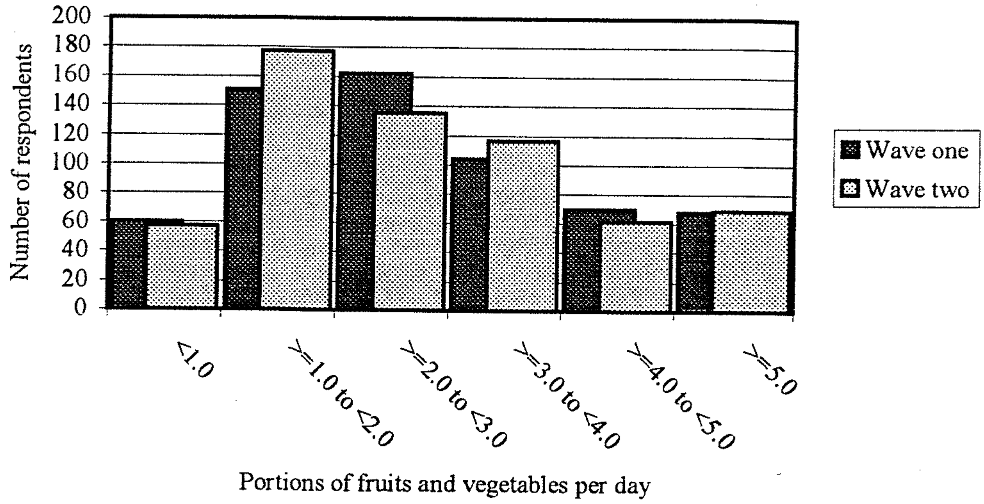


Figure 6.5: Distribution of fruit and vegetable consumption for waves one and two for those respondents swtiching to Tesco Seacroft as fruit and vegetable store (n=218)

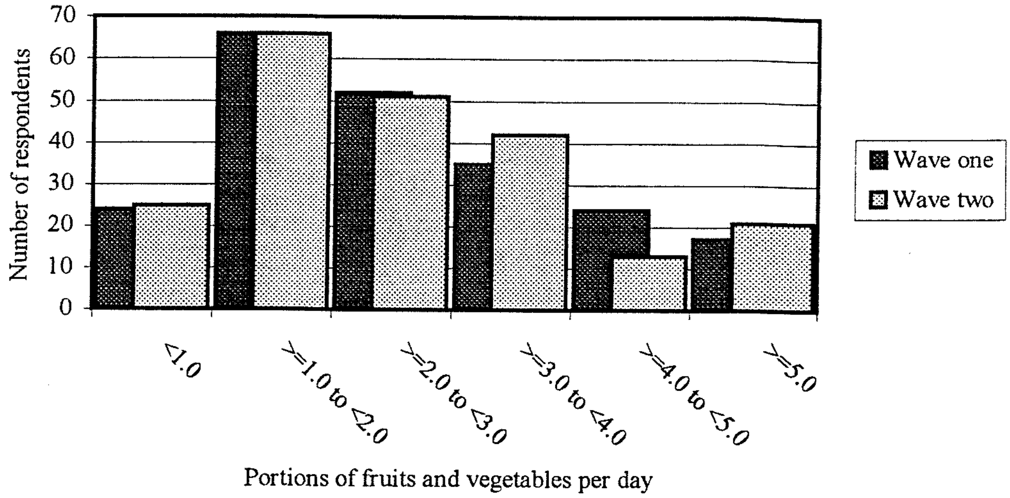
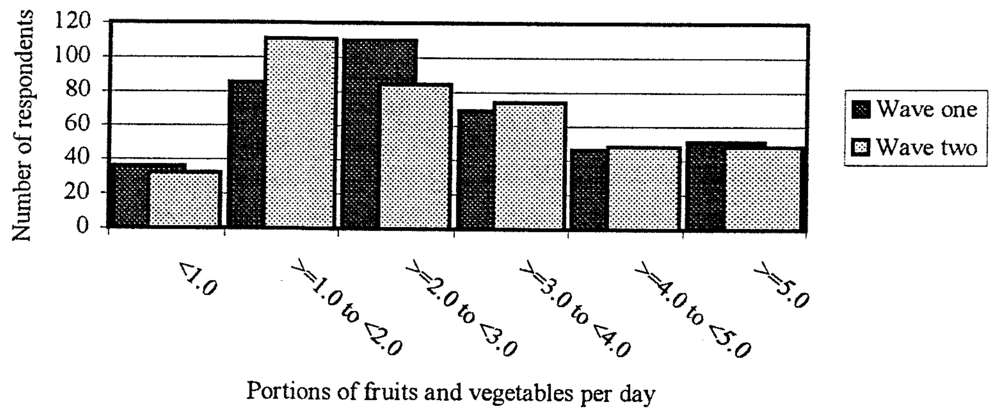


Figure 6.6: Distribution of fruit and vegetable consumption for waves one and two for those respondents not swtiching to Tesco Seacroft as fruit and vegetable store (n=397)



In terms of switching behaviour and changes in consumption, 42.2% and 37.5% of respondents who previously shopped for fruits and vegetables in what would be described as budget and big stores respectively in wave one now used Tesco Seacroft in wave two (table 6.7). However, as can be seen from table 6.8 although there has been a increase in consumption particularly for previous budget store shoppers (+0.35 portions per day) this has not been to a significant level.

Table 6.7: Where fruits and vegetables are bought in waves one and two				
	Wave one (%)	Wave two (%)	Number moving to Tesco Seacroft	Number moving to Tesco Seacroft - % of wave one usage
Big store	60.7	69.8	140	37.5%
Budget store	10.4	4.2	27	42.2%
Other stores (not specified) & other sources	25.2	25.5	43	27.7%
Store not known	3.7	0.5	8	34.8%

However, it is the group (n=27) that switched from budget stores in wave one to Tesco Seacroft in wave two that is of most interest. It may be conjectured that it is they who have seen the most improvement in their access to and availability of fruits and vegetables, but there has only been an increase in their consumption levels of 0.35 portions per day (95% confidence intervals –0.21 to 0.91 portions per day).

Table 6.8: Fruit and vegetable consumption by fruit and vegetable store type

	Use store type in both waves			Tesco Seacroft shoppers in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Big store	2.77 ± 1.73	2.90 ± 2.23	t=-0.233 p=0.816	2.67 ± 1.74	2.94 ± 2.68	t=-1.533 p=0.128	t=-0.125 p=0.900	t=-0.933 p=0.352
Budget store	2.48 ± 1.17	2.22 ± 1.56	t=1.107 p=0.290	2.52 ± 1.80	2.87 ± 2.73	t=-0.869 p=0.393	t=1.049 p=0.301	t=-0.806 p=0.441
Non specified stores & other sources	3.39 ± 2.45	3.59 ± 2.69	t=-0.960 p=0.340	2.49 ± 1.35	2.20 ± 1.42	t=1.698 p=0.097	t=-3.504 p=0.001**	t=0.355 p=0.723
Store not known	n/a	n/a	n/a	2.09 ± 1.72	1.96 ± 1.59	t=0.606 p=0.564	n/a	

Independent sample t-test statistical tests: difference between consumption levels ***$p<0.001$, **$p<0.01$, *$p<0.05$

Table 6.9 examines the changes in physical distance between waves one and two to the store where fruit and vegetables were bought, as calculated by straight-line distance. Overall, for all shoppers the mean straight-line distance travelled fell by 0.5km to 1.96km ($p<0.001$), and may be attributed to those respondents who switched to Tesco Seacroft for whom the new store was on average 1.26km closer than the store used for fruit and vegetable shopping in wave one ($p<0.001$), whilst for non-Tesco Seacroft shoppers there was no significant change in the distance travelled.

Table 6.9: Straight-line distance to where fruits and vegetables are bought at waves one and two

	Wave one	Wave two			
All shoppers	2.46±1.80	1.96±1.96	n=346	t=6.616	p<0.001***
Tesco Seacroft shoppers only	2.25±1.32	0.99±0.48	n=153	t=12.360	p<0.001***
Not Tesco Seacroft shoppers only	2.62±2.09	2.73±2.32	n=193	t=-1.374	p=0.171
	Tesco Seacroft shoppers	Not Tesco Seacroft shoppers			
Wave one distance	2.25±1.32	2.74±2.40	n=406	t=2.634	p=0.09*
Wave two distance	0.95±0.46	2.80±2.48	n=455	t=11.245	p<0.001***

Paired sample t-test: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Analysis of the characteristics of those respondents who switched to Tesco Seacroft and those who continued to use the same fruit and vegetable store as wave one is presented in table 6.10, and shows that there were very few statistically significant variables that may explain switching behaviour. However, one finding of potential importance was that respondents now using Tesco Seacroft lived significantly closer to the store in distance terms than those who did not use it ($p=0.005$).

Table 6.10: Sample characteristics of fruit and vegetable store switching behaviour			
Variable	Use same store in waves one and two for fruit and vegetable shopping (n=255)	Use Tesco Seacroft in wave two for fruit and vegetable shopping (n=218)	Statistical difference between samples
Female (%)	85.8	81.7	χ^2=0.593 p=0.441
Age (%)			χ^2=1.818 p=0.178
17-44 years	47.0	53.7	
45 years plus	53.0	46.3	
Smoking status (%)			χ^2=2.590 p=0.459
Never	31.2	33.5	
Ex	25.4	21.6	
Current	43.4	44.9	
Economically active (%)	38.3	42.4	χ^2=0.621 p=0.431
GCSE or below (%)	81.7	79.4	χ^2=1.028 p=0.311
Not on benefits (%)	30.7	30.7	χ^2=4.420 p=0.110
Household income (%)			χ^2=1.325 p=0.932
Below £10000	43.4	41.3	
£10000-£20000	24.9	26.6	
Above £20000	13.7	15.1	
HDM – Car/van access in household (%)	59.6	58.7	χ^2=0.790 p=0.374
HDM – no unemployment present in household (%)	88.1	85.8	χ^2=1.441 p=0.230
HDM – household paying mortgage/own house	41.1	42.2	χ^2=0.028 p=0.868
HDM –overcrowding present in household (%)	14.2	24.8	χ^2=7.964 p=0.005**
HDM score total (%)			χ^2=6.356 p=0.174
0 - lowest	26.4	27.1	
1	32.7	23.4	
2	29.4	32.6	
3	8.4	11.0	
4 - highest	1.8	2.8	
Number of children under 16 years (mean±sd)	0.72±1.15	0.80±1.08	t=-0.455 p=0.656
Distance to wave two store (km) (mean±sd)	2.80±2.48	0.95±0.46	t=9.847 p<0.001***
Distance to Tesco Seacroft (km) (mean±sd)	1.09±0.40	0.95±0.46	t=2.799 p=0.005**

Paired sample t-test and (Pearson) Chi square statistical test: difference between groups ***p<0.001, **p<0.01, *p<0.05

Summary

Exploring those respondents switching/not switching to the new superstore assessed changes in physical access to fruits and vegetables. Approximately 35% of the 615 respondents recruited into wave two switched to the new superstore (Tesco Seacroft) for their fruit and vegetable shopping. However, there was no significant change in fruit and vegetable consumption for Tesco Seacroft shoppers (+0.15 to

2.75 portions per day), and no significant change in the distribution of fruit and vegetable consumption across the sample population. Indeed, stratification of consumption levels by where fruit and vegetable shopping occurred and predictor variables revealed no significant differences in either the amount of wave two consumption levels or the change in consumption between waves one and two.

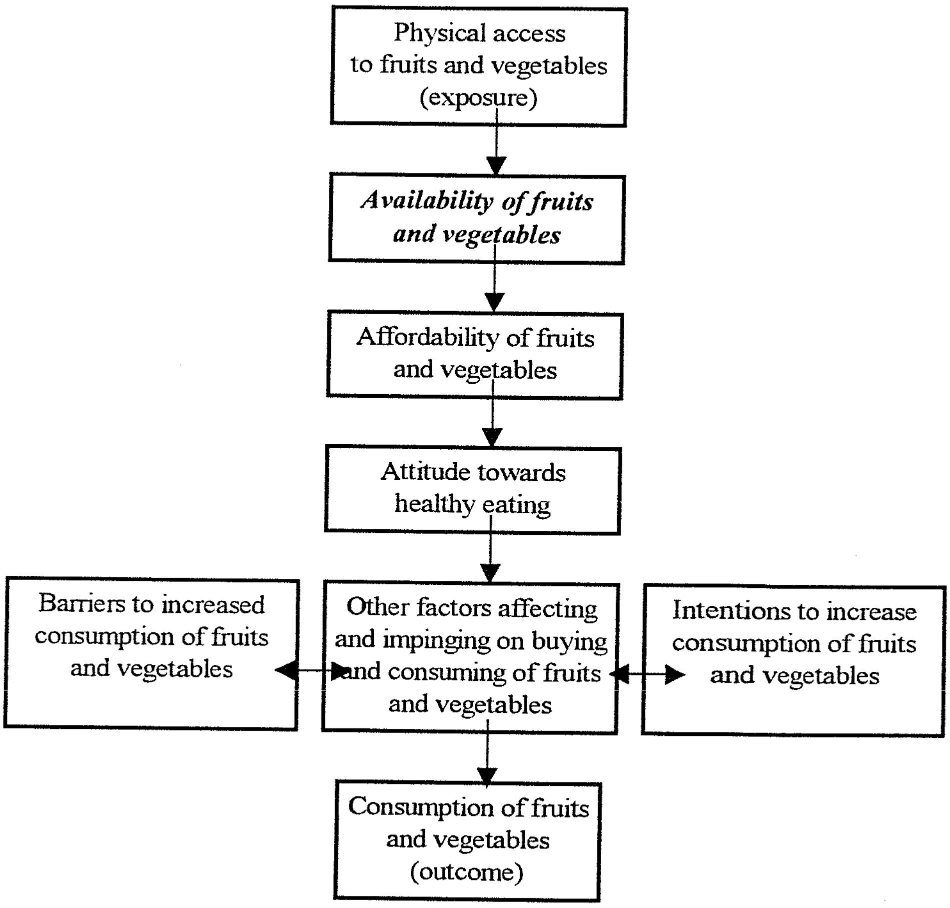
Of those respondents switching to Tesco Seacroft, 42% of previous budget store and 38% of previous big store shoppers now use the new superstore. However, although this switching has seen an increase in consumption particularly for the former budget store shoppers it was not to a statistically significant level. Of the characteristics of those making the switch to buying fruits and vegetables at Tesco Seacroft, distance to the new store was highly significant. Indeed, those switching to Tesco Seacroft saw a significant decrease in the distance travelled in order to access fruits and vegetables.

6.3.2 Availability of fruits and vegetables

Following changes in accessibility, availability of fruits and vegetables was the next level in the framework used to describe fruit and vegetable consumption (figure 6.7). Availability has been measured using the questions 'thinking about your main food store, do you think it's better, the same or worse compared with other food stores around here that you can easily get to' (with regards to):

- Availability of fresh fruits and vegetables,
- The range of fresh fruits and vegetables,
- The quality of fresh fruits and vegetables.'

Figure 6.7: Framework for fruit and vegetable consumption – assessment of the availability of fruits and vegetables



Because of the nature of the questions, these can only be used to explore consumption in respondents using the same store for both their main food shopping and their fruits and vegetables shopping. For Tesco Seacroft shoppers and non-Tesco Seacroft shoppers, this was 204 and 215 respondents respectively.

The proportion of the respondents who believed their store was 'better' does not significantly differ depending on where fruits and vegetables were bought, with the majority of respondents perceiving the store they used to be 'better' or the same as other local stores (table 6.11), and was in line with wave one data.

Table 6.11: Availability, range and quality of fresh fruits and vegetables at respondents main store					
	Wave one n=615 (%)	Wave two			Chi-square test for Tesco/Non Tesco shoppers
		Overall (%)	Tesco Seacroft shoppers only n=204 (%)*	Non Tesco Seacroft shoppers only n=215 (%)*	
Availability of fresh fruits and vegetables					
Better	39.3	49.2	45.1	52.1	χ^2=4.487 p=0.213
The same	47.6	44.1	48.0	41.4	
Worse	6.8	5.1	4.9	5.6	
Don't know	6.2	1.7	2.0	0.9	
The range of fresh fruits and vegetables					
Better	41.3	50.1	48.0	52.1	χ^2=2.107 p=0.550
The same	44.1	43.1	44.6	41.9	
Worse	7.8	5.1	5.4	5.1	
Don't know	6.8	1.7	2.0	0.9	
The quality of fresh fruits and vegetables					
Better	40.5	47.5	43.1	50.7	χ^2=2.432 p=0.488
The same	46.0	46.0	50.5	42.8	
Worse	6.0	4.1	4.4	4.2	
Don't know	7.5	2.4	2.0	2.3	

*where main store and fruit and vegetable store are the same. (Pearson) chi square statistical test: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Levels of consumption were assessed for those respondents who saw an improvement in their availability of fruits and vegetables –i.e. those respondents not answering 'better' in wave one but answering 'better' in wave two with regards to the availability statements listed above. If changes in availability were measured on the number of 'better' statements agreed to in comparison to wave one data (number of 'better' statements greater in wave two, number of 'better' statements same or less in wave two) it can also be seen that there has been no significant change in consumption, with both those having an increase or not in availability having a minimal increase of 0.06 portions per day (table 6.12).

Table 6.12: Fruit and vegetable consumption by changes in availability of fruit and vegetables				
	Wave one	Wave two	Change in consumption	Paired sample t-test
Increase in availability of fruit and vegetables (n=136)	2.64±1.57	2.70±1.64	+0.06	t=-0.583 p=0.571
No increase in the availability of fruits and vegetables (n=283)	2.71±1.83	2.77±2.43	+0.06	t=-0.485 p=0.628
Within column ANOVA	F=0.170 p=0.680	F=0.101 p=0.750	F=0.000 p=0.986	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

This pattern was also true if changes in consumption related to changes in availability were stratified by the predictor variables for fruit and vegetable consumption. There were no significant changes either between waves or between the amounts of change depending on changes in availability (see appendix 6, tables 3 and 4).

If changes in fruit and vegetable consumption were assessed by stratification using wave one consumption figures, it can be seen lower intake consumers in wave one significantly increase their fruit and vegetable consumption regardless of a change in availability (both $p<0.001$) (table 6.13).

Table 6.13: Stratified fruit and vegetable consumption by wave one fruit and vegetable consumption levels and changes in availability of fruits and vegetables

Wave one fruit and vegetable consumption	Increase in availability of fruits and vegetables			No increase in availability of fruits and vegetables			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.28 ± 0.49	1.78 ± 1.00	t=-4.005 p<0.001*** n=70	1.32 ± 0.53	1.74 ± 0.98	t=5.776 p<0.001*** n=169	t=0.316 p=0.752	t=0.565 p=0.573
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.47 ± 0.22	2.46 ± 1.06	t=0.037 p=0.971 n=52	2.43 ± 0.22	2.46 ± 1.00	t=-0.259 p=0.796 n=82	t=-0.001 p=0.999	t=-0.182 p=0.856
Higher intake consumers: ≥3.0 portions per day	4.82 ± 2.46	4.15 ± 2.13	t=2.322 p=0.023* n=72	4.60 ± 1.82	4.43 ± 2.94	t=0.983 p=0.327 n=170	t=-0.757 p=0.450	t=-1.363 p=0.175
Within column ANOVA value for change	F=8.338 p<0.001***			F=5.007 p=0.007**				

Paired sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If changes in availability were considered against where fruits and vegetables were bought – i.e. those switching to Tesco Seacroft or not, there has been no significant effect on consumption. Indeed, those respondents switching to Tesco but did not perceive a change in availability actually increased their consumption by more than those respondents who perceived they did have a change in availability (table 6.14). However, what was also noticeable was that 137 (67.2%) of the 204 respondents who now used Tesco Seacroft did not perceive that they now had a change in availability of fruits and vegetables.

Furthermore, if Tesco Seacroft shoppers only were stratified by age and smoking status there were no significant changes either, although older people and non-smokers consistently consume more fruits and vegetables regardless of changes in availability (table 6.15).

Summary

A change in availability to fruits and vegetables was assessed using questions on respondents' perception of food stores with regards to availability, range and quality of fresh fruits and vegetables. For respondents experiencing an increased perception for each of these questions there was no significant change in consumption, regardless of where fruits and vegetables were bought. This was also found to be true when the number of statements agreed to were used as a measure of increased availability of fruits and vegetables. Indeed for Tesco Seacroft shoppers, only a minority actually perceived that they now had increased availability of fruits and vegetables (33%).

Table 6.14: Fruit and vegetable consumption by changes in availability and physical access to fruits and vegetables

Change in availability of fruits and vegetables	Tesco Seacroft shoppers			Not Tesco Seacroft shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Increase in availability of fruits and vegetables	2.47 ± 1.67	2.54 ± 1.39	t=-0.367 p=0.715 n=67	2.79 ± 1.45	2.85 ± 1.52	t=-0.458 p=0.649 n=69	t=-1.248 p=0.214	t=0.038 p=0.970
No increase in availability of fruits and vegetables	2.64 ± 1.68	2.87 ± 2.92	t=-1.247 p=0.215 n=137	2.78 ± 1.96	2.67 ± 1.85	t=0.751 p=0.454 n=146	t=0.684 p=0.495	t=1.446 p=0.150
Within column ANOVA	F=0.439 p=0.508	F=0.782 p=0.378		F=0.003 p=0.955	F=0.487 p=0.486			

Paired sample t-test, Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.15: Fruit and vegetable consumption by changes in availability for smoking status and age for Tesco Seacroft shoppers

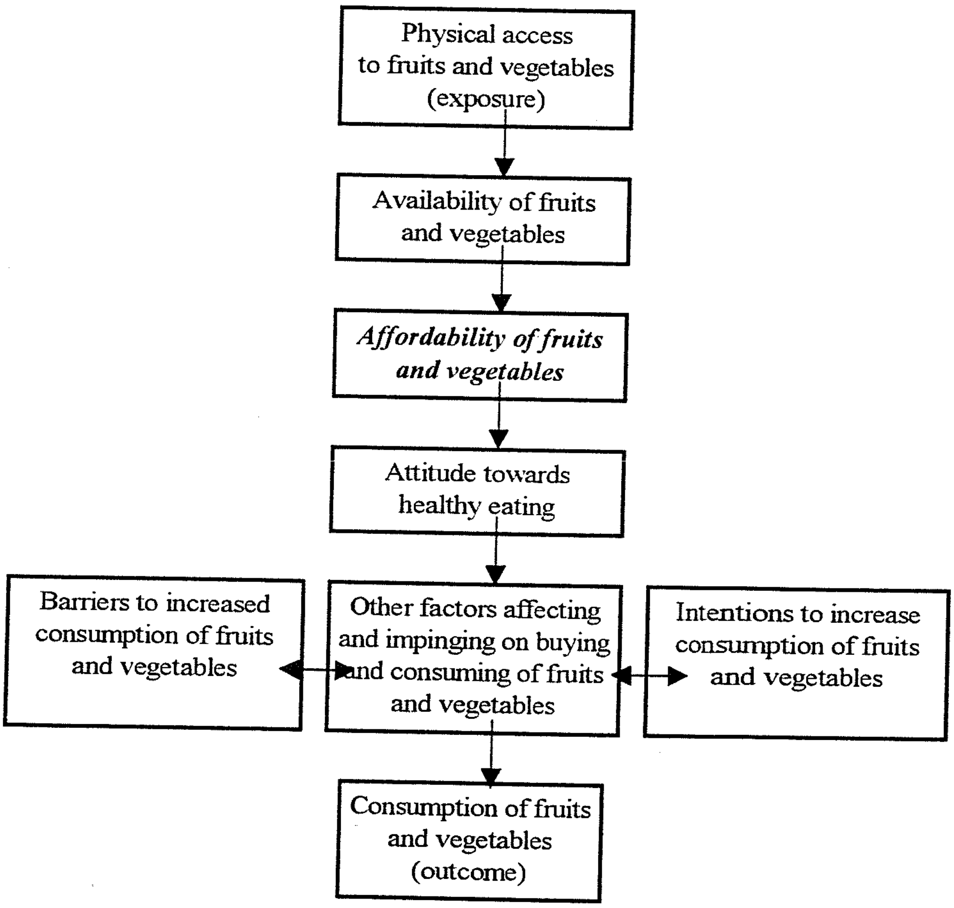
	Increase in availability of fruits and vegetables			No increase in availability of fruits and vegetables			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Non-smokers	2.88 ± 2.02	2.87 ± 1.37	t=0.039 p=0.969 n=38	3.01 ± 1.75	3.28 ± 3.33	t=-0.977 p=0.331 n=82	t=-0.963 p=0.338	t=-0.708 p=0.481
Smokers	2.13 ± 1.21	2.18 ± 1.34	t=-0.336 p=0.739 n=35	2.14 ± 1.39	2.31 ± 1.98	t=-0.872 p=0.387 n=63	t=-0.370 p=0.712	t=-0.431 p=0.668
17-44 years	2.10 ± 1.12	2.21 ± 1.33	t=-0.746 p=0.459 n=46	2.02 ± 1.28	2.01 ± 1.13	t=0.072 p=0.943 n=71	t=0.813 p=0.418	t=0.636 p=0.526
45 plus years	3.24 ± 2.26	3.11 ± 1.34	t=0.329 p=0.745 n=27	3.22 ± 1.76	3.67 ± 3.67	t=-1.370 p=0.175 n=74	t=-1.125 p=0.263	t=-1.138 p=0.259

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

6.3.3 Affordability of fruits and vegetables

The next step in the framework was to assess the effect of changes in economic access to fruits and vegetables and thus the effect affordability may have had on consumption levels (figure 6.8).

Figure 6.8: Framework for fruit and vegetable consumption – assessment of the affordability of fruits and vegetables



Variations in household deprivation marker (HDM) scores and annual household income were calculated as proxy measures of increased affordability and related to changes in fruit and vegetable consumption. If a household experienced either a decrease in their HDM score or an increase in their annual household income then they were regarded as having increased affordability of fruits and vegetables.

As described in chapter 5.2 the HDM score was based on the Townsend deprivation index and was comprised of four indices – in-access to a household car or van, live in rented housing, household unemployment and household overcrowding. Any household experiencing any of these indices was awarded a point (upto a maximum of four), the higher the score the more deprived a household was. In wave two 79 households (12.8%) saw a reduction in their HDM scores and thus an improvement in their economic access to fruits and vegetables. This was in comparison to 66 (10.7%) and 451 (73.3%) households who saw their HDM score either increase or stay the same, and thus saw no improvement in their economic access to fruits and vegetables.

For annual household income, excluding those respondents who refused to answer what their annual household income was in either waves one or two (n=196), 113 (27%) households had increased annual household incomes, and were thus assumed to have had increased economic access, whilst 103 (25%) households had decreased annual household incomes and 203 (48%) households had no change in annual household incomes and thus were assumed not to have had increased economic access.

Overall 174 (28.3%) households saw a reduction in either their HDM score or an increase in their annual household income and thus increased affordability, whilst 61.7% did not see an increase in their affordability of fruits and vegetables. Table 6.16 shows whether changes in economic affordability of fruits and vegetables changes fruit and vegetable consumption. As can be seen there were no significant changes in fruit and vegetable consumption, with respondents having increased affordability consuming 0.09 portions more per day than in wave one.

Table 6.16: Fruit and vegetable consumption by changes in affordability of fruits and vegetables

Change in affordability in wave two of fruits and vegetables	Wave one	Wave two	Change in consumption	Paired sample t-test
Increase in affordability (n=174)	2.65±1.95	2.74±2.58	+0.09	t=-0.527 p=0.599
No increase in affordability (n=441)	2.97±2.02	3.00±1.89	+0.03	t=-0.340 p=0.734
Within column ANOVA	F=1.176 p=0.178	F=1.099 p=0.289	F=1.041 p=0.394	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels
***p<0.001, **p<0.01, *p<0.05

Furthermore, this was irrespective of stratification by the predictor variables from wave one, with no significant changes occurring in those with increased affordability except for those with an HDM score of four, who saw their intakes decrease by 0.59 portions per day (p=0.041). Overall, only light smokers saw a significant difference in the level of change between those with increased affordability and those with no change in affordability. Indeed, even in this case, light smokers with increased affordability actually decreased their consumption levels whilst those with no increase in affordability increased their consumption (p=0.027 for changes) (see appendix 6, tables 5 and 6).

When wave one consumption levels stratify consumption, those respondents who had the lower intakes of fruits and vegetables were found to have significantly increased their consumption in wave two regardless of changes in affordability. However, the amount of change did not significantly differ by changes in affordability. Higher intake consumers with increased affordability did not significantly change, although those higher intake consumers with no increase in affordability saw a fall in their consumption levels of nearly half a portions per day (p=0.006) (table 6.17).

If changes in affordability were assessed in relation to where fruits and vegetables were bought once again switching to Tesco Seacroft did not have a significant effect on consumption. Those respondents with an increased affordability who switched to Tesco Seacroft, increased consumption levels by 0.29 portions per day to 2.62 portions per day (p=0.412) (table 6.18).

Table 6.17: Stratified fruit and vegetable consumption by wave one fruit and vegetable intake and changes in affordability of fruits and vegetables

Wave one fruit and vegetable consumption	Increase in affordability in wave two			No increase in affordability in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.29 ± 0.54	1.58 ± 0.97	t=-3.040 p=0.003** n=80	1.32 ± 0.51	1.84 ± 0.98	t=-6.413 p<0.001*** n=159	t=-1.957 p=0.052	t=-1.931 p=0.055
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.44 ± 0.21	2.11 ± 0.89	t=2.176 p=0.037* n=34	2.45 ± 0.22	2.58 ± 1.04	t=-1.300 p=0.197 n=100	t=-2.583 p=0.012*	t=-2.531 p=0.014*
Higher intake consumers: ≥3.0 portions per day	4.59 ± 2.09	4.64 ± 4.06	t=-0.118 p=0.907 n=60	4.70 ± 2.02	4.23 ± 2.11	t=2.802 p=0.006** n=182	t=0.739 p=0.462	t=1.121 p=0.266
Within column ANOVA value for change	F=1.078 p=0.343			F=15.685 p<0.001***				

Paired sample t-test, Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.18: Fruit and vegetable consumption by changes in affordability and physical access to fruits and vegetables

Affordability in wave two	Tesco Seacroft shoppers			Not Tesco Seacroft shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Increased affordability	2.33 ± 1.45	2.62 ± 3.64	t=-0.826 p=0.412 n=61	2.83 ± 2.15	2.80 ± 2.34	t=0.206 p=0.837 n=113	t=-0.337 p=0.737	t=0.842 p=0.403
No increased affordability	2.70 ± 1.75	2.80 ± 1.83	t=-0.884 p=0.378 n=157	3.12 ± 2.14	3.10 ± 1.92	t=0.153 p=0.879 n=284	t=-1.618 p=0.107	t=0.763 p=0.446

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If Tesco Seacroft shoppers only were considered and modification in affordability were stratified by age and smoking status, there were no significant differences in either consumption levels or level of change, although there were quite large increases for non-smokers and those aged 45 years plus (table 6.19). The lack of a significant results for these groups may be due to the small numbers involved.

Table 6.19 Fruit and vegetable consumption by changes in affordability for smoking status and age for Tesco Seacroft shoppers

	Increase in affordability in wave two			No increase in affordability in wave two			Independent sample t-test for wave two	Independent sample t-test for change
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Non-smokers	2.52 ± 1.57	3.29 ± 4.85	t=-1.184 p=0.245 n=32	3.13 ± 1.90	3.10 ± 1.67	t=0.218 p=0.828 n=88	t=0.223 p=0.825	t=1.202 p=0.237
Smokers	2.12 ± 1.30	1.88 ± 1.11	t=1.779 p=0.086 n=29	2.14 ± 1.34	2.42 ± 1.97	t=-1.542 p=0.128 n=69	t=-1.729 p=0.087	t=-2.297 p=0.024*
17-44 years	1.89 ± 1.10	1.76 ± 1.02	t=1.015 p=0.316 n=43	2.22 ± 1.41	2.32 ± 1.36	t=-0.920 p=0.360 n=80	t=-2.566 p=0.012*	t=-1.370 p=0.174
45 plus years	3.39 ± 1.64	4.67 ± 6.15	t=-1.125 p=0.276 n=18	3.19 ± 1.92	3.30 ± 2.11	t=-0.495 p=0.622 n=77	t=0.935 p=0.362	t=1.015 p=0.323

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.20 explores the permutations of changes in fruit and vegetable consumption in terms of where fruits and vegetables were bought, changes in availability and changes in affordability. As can be seen, the small number (n=26) who switched to Tesco Seacroft, increased their availability of fruits and vegetables and improved affordability, actually decrease their consumption by 0.21 portions per day, and indeed had the lowest level of consumption for any of the eight possible permutations (although none of the changes were statistically significant).

Table 6.20: Fruit and vegetable consumption by changes in physical access, availability and affordability				
Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Tesco user, improved availability, increased affordability (n=26)	2.05±1.14	1.84±0.99	t=1.634	p=0.115
Tesco user, improved availability, no increased affordability (n=47)	2.78±1.93	2.93±1.44	t=-0.620	p=0.539
Tesco user, no improved availability, increased affordability (n=35)	2.54±1.62	3.21±4.67	t=-1.115	p=0.273
Tesco user, no improved availability, no increased affordability (n=110)	2.66±1.67	2.75±1.98	t=-0.632	p=0.529
Not Tesco user, improved availability, increased affordability (n=35)	3.02±2.34	2.86±3.03	t=0.618	p=0.541
Not Tesco user, improved availability, no increased affordability (n=86)	3.21±2.40	3.10±1.51	t=0.481	p=0.631
Not Tesco user, no improved availability, increased affordability (n=78)	2.74±2.08	2.77±1.98	t=-0.177	p=0.860
Not Tesco user, no improved availability, no increased affordability (n=198)	3.08±2.02	3.10±2.07	t=-0.205	p=0.838

Paired sample t-test: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Summary

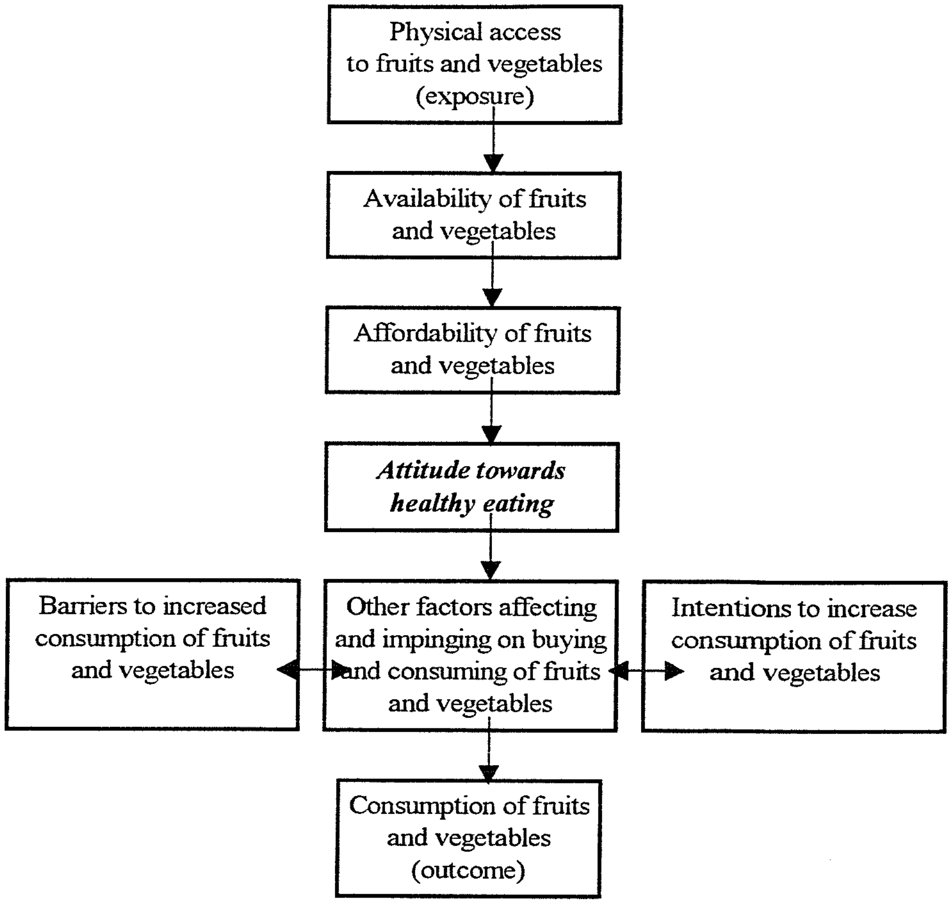
Improved economic access to fruits and vegetables were calculated using the proxy measures of reduced household deprivation marker (HDM) score and increased annual household income. Approximately 13% and 27% of respondents saw a change in these two measures respectively, and households that saw an improvement in either were considered to have increased affordability of fruits and vegetables (28%). However, an improvement in affordability did not show a related change in consumption levels, either overall or by use of Tesco Seacroft. Indeed, the small number of respondents who switched to Tesco Seacroft, had improved availability and had increased economic access actually saw their fruit and vegetable intake fall, although not to a statistically significant level.

6.3.4 Attitudes towards healthy eating

The next stage in the framework of consumption was to look at the effect of an individuals' attitude towards healthy eating (figure 6.9). Attitude was assessed using three questions; 'Do you agree or disagree with the following statements':

- Healthy eating is just another fashion,
- I mostly eat a healthy diet nowadays,
- I don't really care what I eat.

Figure 6.9: Framework for fruit and vegetable consumption- assessment of attitude towards healthy eating



For the purposes of this thesis those respondents disagreeing, agreeing and disagreeing to each of the statements respectively were seen as having a positive attitude for each. In wave one, these statements and overall attitude towards healthy eating were amongst the strongest predictors of fruit and vegetable consumption, with those people having a more positive attitude towards healthy eating consuming significantly more portions of fruits and vegetables.

Changes in consumption by changes in attitudes are expressed in table 6.21 but as can be seen an improvement in attitudes does not coincide with an improvement in intake and indeed a decrease in the number of positive attitudes actually showed a larger increase (+0.19 portions per day). However, those respondents with no positive attitudes in both waves of data collection continued to have the lowest consumption levels (1.45 portions per day) whilst those with the maximum of three positive attitudes in both waves had the highest consumption levels (3.42 portions per day).

Table 6.21: Fruit and vegetable consumption by changes in attitude to healthy eating				
Changes in attitude	Wave one consumption	Wave two consumption	Change in consumption	Paired sample t-test
No positive attitudes in either wave (n=19)	1.56±1.18	1.45±1.14	-0.11	t=0.508 p=0.618
Same number of positive attitudes in both waves (n=106)	2.47±1.52	2.69±1.81	+0.22	t=-1.688 p=0.094
Increase in number of positive attitudes from wave one (n=212)	2.92±2.37	2.87±2.75	-0.05	t=0.310 p=0.757
Decrease in number of positive attitudes from wave one (n=132)	2.67±1.80	2.86±2.07	+0.19	t=-1.307 p=0.194
All positive attitudes in both waves (n=146)	3.48±1.80	3.42±1.62	-0.06	t=0.501 p=0.617
Within column ANOVA	F=7.055 p<0.001***	F=4.403 p=0.002**	F=0.750 p=0.558	

Paired sample t-test, and ANOVA statistical tests: difference between consumption levels
***p<0.001, **p<0.01, *p<0.05

Table 6.22 shows the group changes in fruit and vegetable consumption by changes in attitudes. Overall, those respondents who had improved positive attitude towards healthy eating (those with a greater number of attitude statements in wave two than wave one or had the maximum three positive attitudes in both waves) had significantly higher fruit and vegetable intakes than those with no improved positive attitude towards healthy eating (those respondents with the same or less number of positive attitudes in wave two) - 3.09 compared to 2.68 portions per day (p=0.023). However, the level of change between those with or without an improvement in attitudes did not differ significantly (p=0.117).

Table 6.22: Fruit and vegetable consumption by overall changes in attitude to healthy eating				
	Wave one	Wave two	Change in consumption	Paired sample t-test
Improvement in positive attitudes towards healthy eating (n=359)	3.15±2.17	3.09±2.37	-0.06	t=0.504 p=0.615
No improvement in positive attitudes towards healthy eating (n=256)	2.51±1.67	2.68±1.94	+0.17	t=-1.925 p=0.055
Within column ANOVA	F=15.633 p<0.001***	F=5.175 p=0.023*	F=2.458 p=0.117	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels
***p<0.001, **p<0.01, *p<0.05

In terms of differences in wave two consumption levels, heavy smokers with improved attitudes experienced a significant increase in fruit and vegetable consumption, whilst those respondents with improved attitudes who were aged 35-44 years, were heavy smokers, had three positive attitudes in wave one, or had an HDM score of zero, had significantly higher intakes than their counterparts with no improved attitudes. However, in terms of level of change, an improvement in positive attitudes does not appear to have had an effect, indeed in the only two variables where they was a significant difference in the level of change (non-smokers and those with an HDM score of one), those with improved positive attitudes actually reduced their consumption (see appendix 6, tables 7 and 8). With respect to wave one consumption levels, lower intake consumers saw a significant increase in intake regardless of change in attitudes (both $p<0.001$) (table 6.23).

If changes in attitudes and fruit and vegetable were related to where fruits and vegetables were bought, those respondents who switched to Tesco Seacroft but did not have an improvement in attitudes increased their consumption by 0.43 portions per day ($p=0.004$) (table 6.24). Additionally, if Tesco Seacroft shoppers only were considered, stratification of changes in attitudes by smoking status and age shows that there were no significant changes in fruit and vegetable consumption, although non-smokers and older people with better attitudes had the highest intake levels (table 6.25).

Table 6.23: Stratified fruit and vegetable consumption by wave one fruit and vegetable intake and changes in attitude towards healthy eating

Wave one fruit and vegetable consumption	Improved positive attitude towards healthy eating			No improved positive attitude towards healthy eating			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.37 ± 0.48	1.79 ± 0.95	t=-4.878 p<0.001*** n=124	1.25 ± 0.56	1.70 ± 0.01	t=-5.065 p<0.001*** n=115	t=0.693 p=0.489	t=-0.217 p=0.828
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.46 ± 2.22	2.26 ± 0.95	t=1.773 p=0.081 n=70	2.43 ± 0.23	2.68 ± 1.06	t=-1.943 p=0.057 n=64	t=-2.407 p=0.018*	t=-2.630 p=0.010*
Higher intake consumers: ≥3.0 portions per day	4.77 ± 2.19	4.42 ± 2.80	t=1.674 p=0.096 n=165	4.45 ± 1.62	4.15 ± 2.55	t=1.218 p=0.227 n=77	t=0.757 p=0.450	t=-0.164 p=0.870
Within column ANOVA value for change	F=2.008 p<0.001***			F=2.627 p<0.001***				

Paired sample t-test, Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.24: Fruit and vegetable consumption by changes in attitude and physical access to fruits and vegetables

Change in attitudes	Tesco Seacroft shoppers			Not Tesco Seacroft shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Improved positive attitude towards healthy eating	2.91 ± 1.74	2.87 ± 2.74	t=0.201 p=0.841 n=129	3.28 ± 2.37	3.21 ± 2.13	t=0.493 p=0.623 n=230	t=-1.228 p=0.221	t=0.097 p=0.923
No improved positive attitude towards healthy eating	2.14 ± 1.46	2.57 ± 2.00	t=-2.930 p=0.004** n=89	2.70 ± 1.74	2.73 ± 1.91	t=-0.314 p=0.754 n=167	t=-0.625 p=0.533	t=2.142 p=0.033*

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.25 **Fruit and vegetable consumption by changes in attitude towards healthy eating for smoking status and age for Tesco Seacroft shoppers**								
	Improved positive attitude towards healthy eating			No improved positive attitude towards healthy eating			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Non-smokers	3.25 ± 1.83	3.26 ± 3.24	t=-0.030 p=0.976 n=82	2.37 ± 1.70	2.92 ± 1.78	t=-3.216 p=0.003* n=38	t=0.733 p=0.465	t=-1.597 p=0.113
Smokers	2.32 ± 1.41	2.20 ± 1.30	t=0.913 p=0.366 n=47	1.96 ± 1.23	2.32 ± 2.13	t=-1.556 p=0.126 n=51	t=-0.344 p=0.732	t=-1.804 p=0.075
17-44 years	2.33 ± 1.24	2.17 ± 1.25	t=1.521 p=0.133 n=65	1.70 ± 1.10	1.98 ± 1.17	t=-1.996 p=0.051 n=52	t=0.862 p=0.391	t=-2.510 p=0.014*
45 plus years	3.50 ± 1.98	3.58 ± 3.56	t=-0.227 p=0.822 n=64	2.76 ± 1.67	3.42 ± 2.56	t=-2.196 p=0.035* n=37	t=0.270 p=0.788	t=-1.198 p=0.234

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

The permutations of changes in fruit and vegetable consumption were explored in terms of where fruits and vegetables were bought, changes in availability, changes in affordability and changes in attitudes (see appendix 6, table 9). The 12 respondents who switched to Tesco Seacroft, increased their availability of fruits and vegetables, had increased affordability and had improved attitudes, these respondents actually decreased their consumption by 0.30 portions per day (p=0.104), and had one of the lowest level of consumption for any of the 16 possible permutations. Indeed, the only permutations that led to a significant increase in fruits and vegetables were for those who had switched to Tesco, had increased availability, and had no change in either economic affordability or attitudes (n=18, p=0.033), and for those who switched to Tesco and had no other changes in availability, affordability or attitudes (n=43, p=0.050).

Summary

Changes in attitudes were assessed using three questions and compared to answers from wave one of data collection. Those respondents with improved attitudes continued to have significantly higher intakes than those without an improvement in attitudes, although the change in consumption did not significantly differ. This pattern was also generally found when attitudes were stratified by where fruits and vegetables were bought, although those respondents who switched to Tesco

Seacroft but did not have an improvement in attitudes increased their consumption by 0.43 portions per day (p=0.004). Furthermore, exploration of the permutations of respondents with respect to physical access, availability, affordability and attitudes showed that there were few significant changes. In fact the small number of those respondents who had switched to Tesco Seacroft, had a perceived increase in availability of fruits and vegetables, had increased affordability of fruits and vegetables, and had improved positive attitudes towards healthy eating, had one of the lowest intakes of fruits and vegetables and actually saw an fall in their intakes.

6.3.5 Factors affecting and limiting food choice and consumption

Other issues that may impinge on the buying and consumption of fruits and vegetables were the next level in the framework of consumption (figure 6.10), assessed in relation to factors that affect or limit food choice, through a series of yes/no questions as described in figure 6.11.

Figure 6.10: Framework for fruit and vegetable consumption – assessment of other factors affecting and impinging on buying and consuming fruits and vegetables

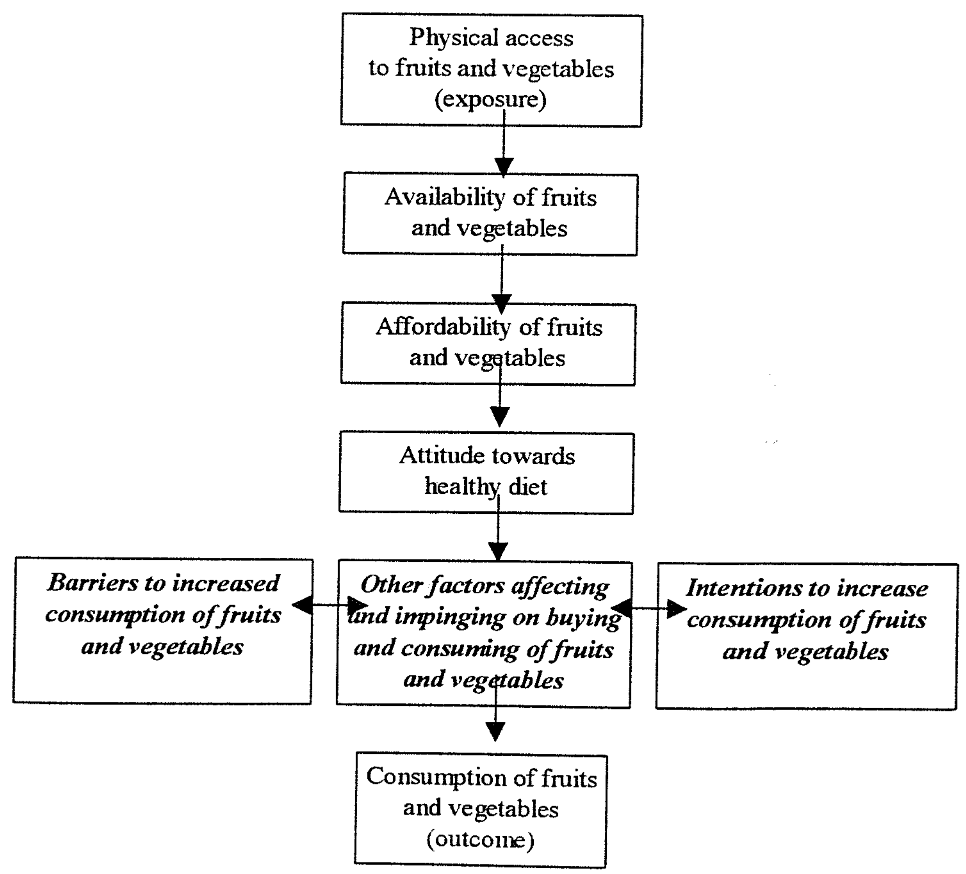


Figure 6.11: Questions used to assess factors affecting and limiting food choice	
Affecting food choice	**Limiting food choice**
• The cost of food/my food budget • Not eating certain foods because advised not to by health professionals • What my spouse/partner will eat • What my child/children will eat • Trying to eat a healthy balanced diet • The kinds of food I like eating • Convenience • Whether my spouse/partner is with me • Whether my child/children are with me • Packaging/display • Food advertising • Programmes/news items about food in the media • The kinds of foods my friends buy • The kinds of foods my relatives buy • Whether I'm hungry or not • Personal beliefs (e.g. religious/cultural/ vegetarianism)	• What is available in the store that I can get to • Not much space to store food at home • Small or no fridge • Limited cooking facilities • Don't know how to cook some foods • Ability to carry and transport foods home • Food goes off before it's eaten • Difficult to get to shops with children • Difficult to get to shops because of age or disability

In terms of factors affecting food choice, as in wave one the factor perceived to have the greatest influence was 'cost of food/my food budget' which was cited by over 70% of both Tesco and non-Tesco shoppers, followed by 'the kinds of food I like eating' and 'trying to eat a balanced diet'. Factors seen as least important were 'the kinds of foods my friends buy', 'the kinds of foods my relatives buy' and 'personal beliefs', which were cited by fewer than 5% (table 6.26).

Of the factors that were cited in wave one but not in wave two (i.e. no longer perceived to be a factor affecting food choice), these differed slightly by whether the respondent shopped at Tesco Seacroft or not. For Tesco Seacroft shoppers the order was 'the kinds of foods I like eating' (15.1%), 'the costs of food/my food budget' (14.7%), 'what my spouse partner will eat' and 'whether my spouse/partner is with me' (both 13.8%), whilst for non-Tesco shoppers the order was, 'the kinds of foods I like eating' (17.4%), 'trying to eat a healthy balanced diet' (16.4%) and 'the cost of food/my food budget' (13.9%).

For factors limiting food choice, as in wave one 'what is available in the store I can get to' was quoted most (48.0%) overall but also by both Tesco Seacroft shoppers (49.5%) and non-Tesco Seacroft shoppers (47.1%). However, over 20% of respondents answering yes to this question in wave one did not answer yes to it in wave two. Other factors seen as limitations on food choice were 'ability to carry and transport foods home' and 'food goes off before it is eaten', whilst 'limited cooking facilities' and 'difficult to get to shops with children' were seen as the least important factors (both under 10%). In terms of factors no longer seen as limiting food choice other than 'what is available in the store I can get', 'ability to carry and transport foods home' were quoted by 13.8% of Tesco Seacroft shoppers (table 6.27).

Table 6.26: Factors affecting the choice of foods bought in wave two

	Wave one	Wave two				
Factors affecting the choice of foods bought	Overall n=615 (%)	Overall n=615 (%)	Tesco Seacroft shoppers		Not Tesco Seacroft shoppers	
			Factor cited in wave two	Factor cited in wave one but not wave two	Factor cited in wave two	Factor cited in wave one but not wave two
The cost of food/my food budget	74.6	73.2	74.3	14.7	72.5	13.9
Not eating certain foods because advised not to by health professionals	18.4	15.9	14.2	7.8	16.9	11.1
What my spouse/partner will eat	47.8	46.7	44.0	13.8	48.1	11.8
What my child/children will eat	43.4	43.6	49.5	8.3	40.3	6.5
Trying to eat a healthy balanced diet	52.7	53.5	55.0	9.2	52.6	16.4
The kinds of food I like eating	63.7	63.6	69.7	15.1	60.2	17.4
Convenience	33.2	37.1	46.3	11.9	32.0	12.1
Whether my spouse/partner is with me	19.7	17.4	15.1	13.8	18.6	10.3
Whether my child/children are with me	17.6	16.4	18.8	10.6	15.1	8.8
Packaging/display	7.6	9.3	10.6	3.7	8.6	4.0
Food advertising	10.1	8.9	12.8	7..3	6.8	6.5
Programmes/news items about food in the media	11.7	10.2	9.6	8.7	10.6	7.8
The kinds of foods my friends buy	2.1	1.5	0.9	1.8	1.8	2.0
The kinds of foods my relatives buy	3.6	2.4	0.5	3.2	3.5	2.8
Whether I'm hungry or not	33.7	28.0	33.5	11.9	24.9	21.4
Personal beliefs (e.g. religious/cultural)	4.9	4.2	6.4	1.4	3.0	2.8

Table 6.27: Factors limiting the choice of foods bought in wave two						
	Wave one	Wave two				
Factors limiting the choice of foods bought	Overall n=615 (%)	Overall n=615 (%)	Tesco Seacroft shoppers		Not Tesco Seacroft shoppers	
			Factor cited in wave two	Factor cited in wave one but not wave two	Factor cited in wave two	Factor cited in wave one but not wave two
What is available in the store that I can get to	54.0	48.0	49.5	23.4	47.1	21.4
Not much space to store food at home	11.4	14.0	13.3	6.9	14.4	5.3
Small or no fridge	6.5	9.1	11.5	3.2	7.8	3.5
Limited cooking facilities	1.5	2.0	3.7	1.4	1.0	1.5
Don't know how to cook some foods	10.9	12.2	13.8	6.0	11.3	4.8
Ability to carry and transport foods home	28.3	30.7	32.6	13.8	29.7	7.6
Food goes off before it's eaten	30.1	32.7	33.0	11.9	32.5	11.6
Difficult to get to shops with children	7.6	6.0	7.3	6.4	5.3	3.5
Difficult to get to shops because of age or disability	11.5	10.4	8.3	4.1	11.6	5.3

Consumption levels of fruit and vegetables were assessed depending on the number of factors cited by respondents in comparison to wave one – either fewer factors or more/same number of factors. Overall in contrast to wave one data , 254 (41.3%) and 175 (28.5%) respondents cited fewer factors affecting and limiting their food choice respectively, but as is shown in table 6.28, the number of factors did not appear to have a significant effect on consumption levels.

Table 6.28: Fruit and vegetable consumption by changes in factors affecting or limiting food choice				
Changes in number of factors affecting or limiting food consumption	Wave one consumption	Wave two consumption	Change in consumption	Paired sample t-test
Less factors affecting food choice in wave two (n=254)	2.97±2.20	2.91±2.04	-0.06	t=0.547 p=0.253
The same or more factors affecting food choice in wave two (n=361)	2.82±1.84	2.93±2.32	+0.11	t=-1.137 p=0.256
Within column ANOVA	F=0.852 p=0.356	F=0.010 p=0.919	F=1.333 p=0.249	
Less factors limiting food choice in wave two (n=175)	3.05±2.09	3.13±2.95	+0.08	t=-0.507 p=0.613
The same or more factors limiting food choice in wave two (n=440)	2.81±1.96	2.84±1.83	+0.03	t=-0.352 p=0.725
Within column ANOVA	F=1.766 p=0.184	F=2.157 p=0.142	F=0.105 p=0.746	

Paired sample t-test and ANOVA statistical tests: difference between consumption levels
***p<0.001, **p<0.01, *p<0.05

If these changes in the number of factors affecting/limiting food choice were assessed by where fruits and vegetables were bought (as in table 6.29), once again it was found that there was little difference in consumption levels and no significant changes.

In terms of stratification of changes in the levels of fruit and vegetable consumption between those with less factors affecting food choice and those with more/the same number of factors, there were few significant changes except for those respondents aged 65 years plus, and for those respondents with HDM scores of either two or four. However, in each of these cases those people with a reduction in the number of factors affecting food choice actually saw their consumption levels fall (see appendix 6, tables 10 and 11).

As has been seen before those respondents who were classified as lower intake consumers in wave one significantly increased their consumption levels by over 0.40 portions per day ($p<0.001$), irrespective of the number of factors affecting food choice. However, the level of change did not differ significantly across the two groups (table 6.30).

Table 6.29: Fruit and vegetable consumption by changes in factors affecting or limiting food choice and physical access to fruits and vegetables

Changes in number of factors affecting/limiting food consumption	Tesco Seacroft shoppers			Not Tesco Seacroft shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Less factors affecting food choice in wave two	2.79 ± 1.85	2.78 ± 1.68	t=0.064 p=0.949 n=91	3.07 ± 2.38	2.99 ± 2.21	t=0.597 p=0.551 n=163	t=-0.845 p=0.399	t=0.363 p=0.717
The same or more factors affecting food choice in wave two	2.46 ± 1.53	2.73 ± 2.91	t=-1.406 p=0.162 n=127	3.01 ± 1.97	3.04 ± 1.93	t=-0.217 p=0.828 n=233	t=-1.048 p=0.296	t=1.123 p=0.263
Less factors limiting food choice in wave two	2.99 ± 1.98	3.11 ± 3.55	t=-0.345 p=0.731 n=69	3.09 ± 2.16	3.14 ± 2.50	t=-0.403 p=0.687 n=106	t=-0.072 p=0.943	t=0.170 p=0.865
The same or more factors limiting food choice in wave two	2.41 ± 1.48	2.59 ± 1.74	t=-1.633 p=0.105 n=148	3.02 ± 2.14	2.97 ± 1.86	t=0.447 p=0.655 n=291	t=-2.124 p=0.034*	t=1.474 p=0.141

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Table 6.30: Stratified fruit and vegetable by wave one consumption levels and changes in factors affecting food choice

Wave one fruit and vegetable consumption	Less factors affecting food choice in wave two			The same or more factors affecting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.37 ± 0.54	1.79 ± 0.96	t=-4.171 p<0.001*** n=97	1.27 ± 0.54	1.73 ± 0.99	t=-5.674 p<0.001*** n=142	t=0.475 p=0.635	t=-0.311 p=0.756
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.44 ± 0.21	2.59 ± 1.00	t=-1.256 p=0.214 n=57	2.45 ± 0.23	2.36 ± 1.04	t=0.789 p=0.432 n=77	t=1.327 p=0.187	t=1.459 p=0.147
Higher intake consumers: ≥3.0 portions per day	4.82 ± 2.44	4.18 ± 2.49	t=2.881 p=0.005** n=100	4.56 ± 1.69	4.44 ± 2.87	t=0.525 p=0.600 n=142	t=-0.750 p=0.454	t=-1.634 p=0.104
Within column ANOVA value for change	F=11.578 p<0.001***			F=3.964 p=0.020*				

Paired sample t-test, Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If Tesco shoppers only were considered, there were no significant changes in fruit and vegetable consumption when stratified by either age or smoking status. Although there were no significant changes in intakes, older people and non-smokers continued to have significantly higher intake levels compared to younger people and smokers respectively (table 6.31).

Table 6.31 Fruit and vegetable consumption by changes in factors affecting food choice for smoking status and age for Tesco Seacroft shoppers

	Less factors affecting food choice in wave two			The same or more factors affecting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Non-smokers	3.22 ± 2.05	3.31 ± 1.78	t=-0.394 p=0.696 n=52	2.78 ± 1.64	3.03 ± 3.47	t=-0.769 p=0.445 n=68	t=0.576 p=0.566	t=-0.386 p=0.700
Smokers	2.21 ± 1.36	2.07 ± 1.23	t=1.060 p=0.296 n=39	2.08 ± 1.31	2.39 ± 2.05	t=-1.500 p=0.139 n=59	t=-0.990 p=0.325	t=-1.836 p=0.070
17-44 years	2.09 ± 1.21	2.16 ± 1.20	t=-0.520 p=0.606 n=44	2.03 ± 1.23	2.04 ± 1.23	t=-0.152 p=0.880 n=73	t=0.518 p=0.606	t=0.299 p=0.765
45 plus years	3.44 ± 2.10	3.35 ± 1.87	t=0.331 p=0.742 n=47	3.04 ± 1.70	3.67 ± 4.06	t=-1.446 p=0.154 n=54	t=-0.514 p=0.609	t=-1.413 p=0.161

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If these analyses were repeated for the factors limiting food choice, a similar pattern emerges. When stratified by wave one predictor variables, only never smokers saw a significant change in fruit and vegetable consumption by the number of factors – although in this case those respondents with fewer factors limiting them actually decreased their intakes by 0.45 portions per day (see appendix 6, tables 12 and 13).

The pattern for lower intake consumers as described by their wave one consumption levels were the same as cited above for factors affecting food choice. Lower wave one intake consumers increased their consumption by over 0.30 portions per day irrespective of the change in the number of factors limiting food choice, although the level of difference in consumption between waves one and two were not significantly different across the groups (table 6.32).

Table 6.32: Stratified fruit and vegetable by wave one consumption levels and changes in factors limiting food choice

Wave one fruit and vegetable consumption	Less factors limiting food choice in wave two			The same or more factors limiting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Lower intake consumers: ≤2.0 portions per day	1.30 ± 0.54	1.61 ± 0.85	t=-2.676 p=0.010* n=63	1.31 ± 0.51	1.80 ± 1.02	t=-6.584 p<0.001*** n=176	t=-1.395 p=0.165	t=-1.253 p=0.213
Intermediate intake consumers: >2.0 - <3.0 portions per day	2.50 ± 0.23	2.54 ± 1.12	t=-0.179 p=0.859 n=36	2.43 ± 0.21	2.43 ± 0.99	t=-0.087 p=0.931 n=98	t=0.479 p=0.634	t=0.113 p=0.911
Higher intake consumers: ≥3.0 portions per day	4.76 ± 2.05	4.67 ± 3.81	t=0.265 p=0.791 n=76	4.63 ± 2.03	4.18 ± 2.03	t=2.494 p=0.014* n=166	t=1.039 p=0.302	t=0.927 p=0.356
Within column ANOVA value for change	F=0.652 p=0.522			F=14.214 p<0.001***				

Paired sample t-test, Independent sample t-test and ANOVA statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

If Tesco shoppers only were considered, non-smokers and older respondents had significantly higher consumption levels than those who smoked and were younger irrespective of changes in the number of factors limiting food choice. However, there were no significant changes in consumption levels between waves one and two by smoking status or age (table 6.33).

Table 6.33: Fruit and vegetable consumption by changes in factors limiting food choice for smoking status and age for Tesco Seacroft shoppers

	Less factors limiting food choice in wave two			The same or more factors limiting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
Non-smokers	3.39 ± 2.25	3.68 ± 4.45	t=-0.494 p=0.624 n=40	2.76 ± 1.56	2.89 ± 1.53	t=-1.019 p=0.311 n=80	t=1.086 p=0.283	t=0.265 p=0.792
Smokers	2.44 ± 1.38	2.33 ± 1.43	t=0.666 p=0.511 n=29	2.01 ± 1.29	2.24 ± 1.91	t=-1.271 p=0.208 n=69	t=0.248 p=0.805	t=-1.382 p=0.171
17-44 years	2.33 ± 1.30	2.10 ± 1.32	t=1.709 p=0.096 n=39	1.91 ± 1.15	2.08 ± 1.16	t=-1.566 p=0.121 n=78	t=0.044 p=0.965	t=-2.314 p=0.023*
45 plus years	3.85 ± 2.37	4.42 ± 4.92	t=-0.753 p=0.458 n=30	2.96 ± 1.61	3.14 ± 2.08	t=-0.930 p=0.356 n=71	t=1.378 p=0.177	t=0.506 p=0.616

Paired sample t-test and Independent sample t-test statistical tests: difference between consumption levels ***p<0.001, **p<0.01, *p<0.05

Factors that were cited in wave one but not in wave two may be seen as factors that no longer affect or limit an individuals' food choice (see appendix 6, tables 14 and 15). However, only for 'trying to eat a healthy balanced diet' in non-Tesco shoppers was there a significant change in consumption levels – in this case a decrease of 0.51 portions per day. Furthermore, in most cases where a factor was no longer cited as affecting food choice there was actually a small decrease in consumption.

The permutations of fruit and vegetable consumption in terms of where fruits and vegetables were bought (i.e. physical access), changes in availability, changes in affordability (through changes in HDM score or annual household income), changes in attitudes towards healthy eating and changes in the number factors affecting and limiting food choice were explored (see appendix 6, tables 16 to 19). The six respondents who switched to Tesco Seacroft, increased their availability of fruits and vegetables, had an increased affordability, had improved attitudes and had less factors affecting or limiting food choice, actually decreased their consumption by upto 0.55 portions per day. However, the small numbers involved show how difficult it is to assess changes on the number of different levels within the framework. The only permutation of factors that led to increased consumption of fruits and vegetables was; those switching to Tesco Seacroft, had increased availability but no changes in affordability, attitude or factors limiting food choice (n=15 p=0.004).

Summary

Factors affecting and limiting food choice were assessed through a series of yes/no questions. In terms of factors affecting food choice, the factor perceived to have the greatest influence was 'cost of food/my food budget' which was cited by over 70% of both Tesco and non-Tesco shoppers, followed by 'the kinds of food I like eating' and 'trying to eat a balanced diet'. For factors limiting food choice, both Tesco Seacroft shoppers and non-Tesco Seacroft shoppers quoted 'what is available in the store I can get to' most often.

Of factors that were cited in wave one but not in wave two (i.e. no longer perceived to be a factor affecting food choice), for Tesco Seacroft shoppers the order was 'the kinds of foods I like eating', 'the costs of food/my food budget' and 'what my spouse partner will eat', 'whether my spouse/partner is with me'. In terms of factors no longer seen as limiting food choice 'what is available in the store I can get' and 'ability to carry and transport foods home' were quoted most by Tesco Seacroft shoppers. However, this does not appear to have had a significant effect on consumption levels.

Those respondents who switched to Tesco Seacroft and had an improvement in availability, affordability, attitudes and factors affecting/limiting food choice, actually saw their consumption levels fall by upto 0.55 portions per day, although the very small numbers involved (n=6) may partly explain why this was not a statistically significant result.

6.3.6 Logistic regression models

The logistic regression model developed in wave one (chapter 5.4.6) in order to assess which respondents would be lower or higher intake consumers of fruits and vegetables were applied to the wave two data. Lower consumption was defined as those respondents consuming two or fewer portions per day, whilst higher intake consumers were those consuming three or more portions per day. The variables in the model were all discrete (sex, age, three attitudinal statements on healthy eating, education, receipt of benefits, annual household income and smoking status) with the exception of household deprivation and number of children in the household under the age of 16, which were continuous in nature.

Tables 6.34a and b show both the crude odds ratio and adjusted odds ratio of being a lower intake consumer of fruit and vegetables, as well as the proportion of lower intake consumers within each group (after adjustment). The crude odds ratios were for within each variable only whilst the adjusted odds ratios take into account all variables in the model and the effect they had on each other. In this way it was possible to separate out the overlapping effect certain variables had on each other. An odds ratio above one implies a greater 'probability' of being a lower intake consumer.

From the crude odds ratios it can be seen that the lower intake consumers were more likely to be younger, disagree with the attitudinal statement 'I mostly eat a healthy diet nowadays', agree with the attitudinal statement 'I don't really care what I eat', not have an outright opinion on the attitudinal statement 'Healthy eating is just another fashion', smoke, had increasing household deprivation and an increasing number of children under the age of 16 years. The largest differences in proportion of lower intake consumers were seen for age where 87.5% of 17-24 year olds were classified as lower intake consumers compared to 26.4% of 65 plus year olds, whilst for smokers and non-smokers the percentages were 61.2% and 38.5% respectively.

The adjusted odds ratio shows that the most important determinants of being a lower fruit and vegetable consumer were age (between the ages of 17 and 44 years), being a smoker, disagreeing with the attitudinal statement 'I mostly eat a healthy diet' and having an increasing household deprivation marker score. The variables not included in the model, were excluded in the following order: education level, increasing numbers of children under the age of 16 years, annual household income, receipt of benefits, attitudinal statement 'I don't really care what I eat', sex and attitudinal statement 'Healthy eating is just another fashion'. The order in which variables leave the model give some estimate of their significance – i.e. educational level has the least effect on determining the likelihood of being a lower fruit and vegetable consumer or not in wave two. The number of respondents included in the model was 453, of which 48.8% (n=221) were lower intake consumers and 51.2% (n=232) were higher intake consumers. Using these variables a Nagelkerke R-square value of 0.350 was achieved.

The significant variables predicting consumption in wave two were very similar to those predicting consumption in wave one. All the variables in wave two used to predict consumption were found in wave one as well, although lower educational attainment and agreeing with the attitudinal statement 'I don't really care what I eat' were no longer included.

Table 6.35 shows the significant variables for the logistic regression model when stratified by age, smoking status and attitudes, but also whether the respondent was a Tesco Seacroft shopper or not. As can be seen the significant variables varied widely depending on the stratification, but age, smoking status, HDM score and attitudinal variables consistently emerged throughout. The amount of variance explained by the variables (i.e. the Nagelkerke value) ranged from 0.086 (for those people aged 65 years and over) to 1.000 (for those people aged 17 to 24 years).

Table 6.34a: Probability of being a lower fruit and vegetable intake consumer (under two portions per day) in wave two					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Age					
17-24 years	32	87.5	22.391 (p<0.001)***	10.648 (p<0.001)***	3.233 – 35.066
25-34 years	79	69.6	6.511 (p<0.001)***	3.448 (p=0.001)**	1.715 – 6.931
35-44 years	114	60.5	4.151 (p<0.001)***	2.780 (p=0.001)**	1.505 – 5.134
45-64 years	118	33.9	1.437 (p=0.199)	1.158 (p=1.158)	0.630 – 2.129
65 plus years	110	26.4	1.0	1.0	
Attitude statement – I mostly eat a healthy diet nowadays					
Agree	329	38.6	1.0	1.0	
Disagree	95	83.2	8.221 (p<0.001)***	6.002 (p<0.001)***	3.194 – 11.278
Don't know/neither	29	51.7	1.925 (p=0.074)	1.121 (p=0.636)	0.475 – 2.646
Smoking status					
Non-smokers	247	38.5	1.0	1.0	
Smokers	206	61.2	2.479 (p<0.001)***	1.727 (p=0.015)*	1.110 – 2.686
Household deprivation index (continuous variable)					
Increasing level of deprivation	483	48.8	1.766 (p<0.001)***	1.524 (p<0.001)***	1.220 – 1.903

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios are adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

Table 6.34b: Probability of being a lower fruit and vegetable intake consumer (under two portions per day) in wave two					
Variable	**Number of respondents in adjusted analysis**	**Percentage of lower intake consumers in adjusted analysis**	**Crude odds ratio**	**Adjusted odds ratio**	**Adjusted 95% confidence intervals**
Attitude statement – I don't really care what I eat					
Agree and don't know/neither	101	68.3	2.541 (p<0.001)***		
Disagree	352	43.2	1.0		
Educational attainment					
GCSE (or equivalent) and below	368	48.1	0.865 (p=0.545)		
Above GCSE (or equivalent)	85	51.8	1.0		
Children in household under the age of 16 years (continuous variable)					
Increasing number of children	483	48.8	1.675 (p<0.001)***		
Gender					
Male	72	44.4	0.812 (p=0.396)		
Female	381	49.6	1.0		
Attitude statement – Healthy eating is just another fashion					
Agree	124	57.3	1.758 (p=0.008)**		
Disagree	278	43.5	1.0		
Don't know/neither	51	56.9	1.537 (p=0.139)		
Receipt of benefits level					
None	141	47.5	1.0		
On benefits for less than one year	28	35.7	0.606 (p=0.222)		
On benefits for more than one year	284	50.7	1.131 (p=0.543)		
Annual household income					
Refused	73	39.7	1.134 (p=0.709)		
Under £5000	72	51.4	1.659 (p=0.137)		
£5000 - £9999	125	51.2	1.664 (p=0.093)		
£10,000 - £14,999	66	50.0	1.569 (p=0.194)		
£15,000 - £19,999	51	62.7	3.051 (p=0.004)**		
£20,000 plus	66	37.9	1.0		

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios are adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

Table 6.35: Stratified probability of being a lower fruit and vegetable intake consumer (under two portions per day) in wave two

Model and number of cases included in analysis	Significant variables	Nagelkerke R square value
All variables (n=453)	Age (17-44 years) Smoking status (smokers) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree) Household deprivation marker score (increasing)	0.350
Stratified age 17-24 years (n=32)	No significant variables	1.000
Stratified age 25-34 years (n=79)	Smoking status (smokers)	0.440
Stratified age 35-44 years (n=114)	Household deprivation marker score (increasing)	0.209
Stratified age 45-64 years (n=118)	Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.300
Stratified age 65 years plus (n=110)	No significant variables	0.086
Non smokers only (n=247)	Age (17-44 years) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree) Household deprivation marker score (increasing)	0.213
Smokers only (n=206)	Age (17-44 years) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree)	0.388
Number of positive attitudes 0 or 1 (n=114)	Age (17-44 years) Smoking status (smokers)	0.259
Number of positive attitudes 2 or 3 (n=339)	Age (17-44 years) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree) Attitudinal statement 'I don't really care what I eat' (agree) Household deprivation marker score (increasing)	0.308
Wave two – all variables, Tesco Seacroft shoppers only (n=152)	Number of children under the age of 16 years (increasing) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree) Attitudinal statement 'I don't really care what I eat' (agree) Household deprivation marker score (increasing)	0.474
Wave two – all variables, non Tesco Seacroft shoppers only (n=301)	Age (17-44 years) Attitudinal statement 'Healthy eating is just another fashion' (agree and don't know/neither) Attitudinal statement 'I mostly eat a healthy diet nowadays' (disagree) Smoking status (smokers) Household deprivation marker score (increasing)	0.321

Changes in the factors in the framework of consumption (i.e. physical access, availability, affordability, attitudes, and other factors) were included in a logistic regression model in order to establish if they helped predict wave two consumption. The model included 480 respondents in the analysis, of whom 48.7% (n=234) were lower intake consumers and 51.3% (n=246) were higher intake consumers. The crude and adjusted odds ratios indicate that changes in affordability and changes in attitudes may help to predict wave two, although those respondents who did not have a change in affordability were less likely to be lower intake consumers (table 6.36). A Nagelkerke R-square value of 0.060 was achieved, which tends to indicate that very little of the difference in consumption between lower and higher intake consumers of fruits and vegetables was due to the factors in the framework.

Table 6.36: Probability of being a lower fruit and vegetable intake consumer (under two portions per day) in wave two using factors in framework of consumption

Variable	Number of respondents in adjusted analysis	Percentage of lower intake consumers in adjusted analysis	Crude odds ratio	Adjusted odds ratio	Adjusted 95% confidence intervals
Tesco Seacroft store shopper					
Yes	167	54.5	1.0	1.0	
No	313	45.7	0.703 (p=0.067)	0.695 (p=0.064)	0.473 – 1.022
Change in availability of fruits and vegetables					
Yes	145	46.9	1.0		
No	335	49.6	1.112 (p=0.593)		
Change in affordability of fruits and vegetables					
Yes	139	61.2	1.0	1.0	
No	341	44.0	0.514 (p=0.001)**	0.509 (p=0.001)**	0.339 – 0.765
Change in attitudes					
Yes	279	43.4	1.0	1.0	
No	201	56.2	1.677 (p=0.006)**	1.696 (p=0.005)**	1.170 – 2.459
Change in factors affecting food choice					
Yes	195	49.2	1.0		
No	285	48.4	0.968 (p=0.862)		
Change in factors limiting food choice					
Yes	144	48.6	1.0		
No	336	48.8	1.008 (p=0.968)		

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Backwards-stepwise logistic regression analyses with lower intake consumers of fruit and vegetables (dependent variable), odds ratios are adjusted for other variables in the model. Variables with no values did not meet the entry criteria for the model (p<0.05).

If this model using the factors in the framework were stratified by age, smoking status and attitudes, then as can be seen from table 6.37, shopping at Tesco Seacroft, changes in availability and changes in factors affecting or limiting food choice did not appear, although for five of the 11 models no significant variables emerge. The range of Nagelkerke R-square values were from 0.024 (for higher number of positive attitudes) to 0.294 (for lower number of positive attitudes).

Table 6.37: Stratified probability of being a lower fruit and vegetable intake consumer (under two portions per day) in wave two using factors in framework of consumption

Model and number of cases included in analysis	Significant variables	Nagelkerke R square value
All variables (n=480)	Change in affordability (yes) Change in attitudes (no)	0.060
Stratified age 17-24 years (n=43)	No significant variables	0.259
Stratified age 25-34 years (n=95)	No significant variables	0.052
Stratified age 35-44 years (n=109)	Change in attitudes (yes)	0.054
Stratified age 45-64 years (n=124)	No significant variables	0.042
Stratified age 65 years plus (n=109)	No significant variables	0.047
Non smokers only (n=266)	Change in affordability (no)	0.041
Smokers only (n=213)	No significant variables	0.056
Number of positive attitudes 0 or 1 (n=120)	Tesco Seacroft shopper (yes) Change in affordability (yes) Change in attitude (yes) Change in factors affecting food choice (yes)	0.294
Number of positive attitudes 2 or 3 (n=360)	Change in affordability (yes)	0.024
Tesco Seacroft shoppers only (n=167)	Change in affordability (yes)	0.060
Non-Tesco Seacroft shoppers only (n=397)	Change in affordability (yes) Change in attitudes (no)	0.046

Summary

The variables predicting the consumption of fruits and vegetables in wave two was similar to those derived in wave one – age (young), smoking status (smokers) and attitudes towards healthy eating (negative) and household deprivation score (increasing). These variables also consistently emerged when the model was stratified by age, smoking status, attitudes and whether the respondent shopped at Tesco Seacroft or not.

The factors in the framework of consumption were included in a logistic regression model in order to assess whether they helped predict wave two consumption. Lower intake consumers were more likely not to have had a change in attitudes. However, overall these factors seem to have little bearing on the difference in consumption between lower and higher intake consumers of fruits and vegetables in wave two.

6.4 Overall changes in consumption

Overall the change in consumption between waves one and two of data collection was very small – in the region of 0.04 portions per day. However, 31.2% (n=192) of the sample increased their consumption by at least half a portion of fruits and vegetables per day whilst 29.1% (n=179) decreased their consumption by at least half a portion of fruits and vegetables per day. The mean changes for these two groups were an increase of 1.58 portions per day and a decrease of 1.52 portions per day respectively.

Analysis was carried out in order to assess if there were any differences between these two groups in terms of socio-demographic variables or through changes occurring either by the opening of the new superstore or factors in the framework of consumption. Table 6.38 shows a comparison between the two groups for a range of variables. As can be seen there were very few statistical differences between the two groups, except that those respondents who had increased their consumption were more likely to have lower educational attainment (p=0.010), were more likely to have a car or van in the household (p=0.037) but possibly most importantly had significantly lower initial fruit and vegetable intakes in wave one (p<0.001). Indeed, after wave two those who had increased their consumption by at least 0.5 portions per day had significantly higher intakes (p<0.001). However, there were no significant differences in consumption levels for any of the factors in the framework of consumption – i.e. whether they shopped at Tesco Seacroft, had increased/improved availability, affordability or positive attitudes, or had less factors affecting or limiting food choice.

Table 6.38: Characteristics of respondents with changes in fruit and vegetable consumption between waves one and two			
Variable	Increased consumption by ≥0.5 portions per day (n=192)	Decreased consumption by ≥0.5 portions per day (n=179)	Statistical difference between groups
Female (%)	82.8	82.1	χ^2=0.030 p=0.861
Age (%)			χ^2=0.012 p=0.912
17-44 years	46.4	46.9	
45 years plus	53.6	53.1	
Smoking status (%)			χ^2=2.239 p=0.524
Never	33.3	30.2	
Ex	21.4	25.7	
Current	45.3	43.6	
Economically active (%)	42.7	41.4	χ^2=0.858 p=0.973
GCSE or below (%)	82.3	72.6	χ^2=6.578 p=0.010*
Not on benefits (%)	34.9	31.3	χ^2=0.755 p=0.686
Household income (%)			χ^2=2.382 p=0.794
Below £10000	39.0	43.0	
£10000-£20000	26.6	26.8	
Above £20000	15.6	12.3	
HDM – car (0) (%)	64.1	53.1	χ^2=4.362 p=0.037*
HDM – unemployment (0) (%)	84.4	87.7	χ^2=0.855 p=0.355
HDM – own/mortgage (0) (%)	43.8	43.0	χ^2=0.002 p=0.968
HDM – overcrowding (0) (%)	82.8	82.7	χ^2=0.001 p=0.973
HDM total (%)			χ^2=3.620 p=0.460
0 - lowest	28.6	25.1	
1	30.2	27.4	
2	30.7	34.1	
3	5.7	8.9	
4 - highest	3.6	1.7	
Number of children under 16 years (mean±sd)	0.72±1.05	0.64±1.05	t=0.766 p=0.444
Use Tesco Seacroft for fruits and vegetables shopping (%)	32.8	34.1	χ^2=0.067 p=0.796
Wave one fruit and vegetable consumption (mean±sd)	2.48±1.69	3.92±2.34	t=-6.755 p<0.001***
Wave two fruit and vegetable consumption (mean±sd)	4.06±2.88	2.40±1.51	t=7.024 p<0.001***
Distance to Tesco Seacroft (km) (mean±sd)	1.00±0.44	1.08±0.39	t=-1.794 p=0.074
Distance to Tesco Seacroft for those using it for fruits ands vegetable shopping (km) (mean±sd)	0.96±0.49	0.95±0.39	t=0.068 p=0.946
Distance to store used for fruits and vegetable shopping for those not using Tesco Seacroft (km) (mean±sd)	2.81±2.42	2.34±1.82	t=1.285 p=0.201
Have increased availability (%)	28.6	31.3	χ^2=0.308 p=0.579
Have increased affordability (%)	26.0	26.3	χ^2=0.002 p=0.962
Have improved positive attitudes (%)	55.7	62.6	χ^2=1.792 p=0.181
Have less factors affecting food choice (%)	39.6	39.7	χ^2=0.000 p=0.987
Have less factors limiting food choice (%)	23.4	27.9	χ^2=0.983 p=0.322

(Pearson) Chi square statistical test: difference betweens groups ***p<0.001, **p<0.01, *p<0.05

If a logistic regression analysis is carried out using the factors in the framework – comparing those who increased by 0.5 portions per day or more to those who had decreased by 0.5 portions per day or more, 371 respondents were included. However, this analysis shows that none of the variance in the change in fruit and vegetable consumption was due to the factors in the framework as an Nagelkerke R-square value of 0.000 was achieved and no variables remain in the model.

Furthermore, if the analysis was also performed including the predictors of fruit and vegetable consumption as carried out in the wave one logistic regression analysis, 351 cases were included, a Nagelkerke R-square value of 0.026 was obtained. The only factor remaining was education level, where those respondents with lower levels of education were more likely to have decreased their consumption (OR 0.488, p=0.009, 95%CI 0.284 – 0.839). This tends to indicate that the factors that predicted lower or higher consumption of fruits and vegetables in both waves one and two of data collection were not the predictors of changes in fruit and vegetable consumption. Additionally, the factors identified as possible determinants of change in the framework of consumption were not predictors of changes in consumption in these groups either. Indeed, if change of consumption was examined in terms of crude odds ratios only educational level was found at a statistically significant level (p=0.011) (tables 6.39a and b).

Table 6.39a: Probability of having a higher change in fruit and vegetable consumption (≥0.5 portions per day) between waves one and two				
Variable	**Number of respondents analysis**	**Percentage of those with higher change in analysis**	**Crude odds ratio**	**Nagelkerke R-square value**
Age				
17-24 years	29	41.4	1.484 (p=0.363)	0.005
25-34 years	50	54.0	0.892 (p=0.749)	
35-44 years	94	53.2	0.992 (p=0.785)	
45-64 years	112	52.7	0.941 (p=0.832)	
65 plus years	86	51.2	1.0	
Attitude statement – I mostly eat a healthy diet nowadays				
Agree	285	52.3	1.0	0.010
Disagree	61	44.3	1.380 (p=0.257)	
Don't know/neither	25	64.0	0.616 (p=0.264)	
Smoking status				
Non-smokers	205	51.2	1.0	0.000
Smokers	165	52.7	0.941 (p=0.773)	
Household deprivation index (continuous variable)				
Increasing level of deprivation	364	52.2	1.078 (p=0.459)	0.002
Attitude statement – I don't really care what I eat				
Agree and don't know/neither	86	54.7	0.859 (p=0.539)	0.001
Disagree	285	50.9	1.0	
Educational attainment				
GCSE (or equivalent) and below	288	54.9	0.498 (p=0.011)*	0.025
Above GCSE (or equivalent)	69	37.7	1.0	
Children in household under the age of 16 years (continuous variable)				
Increasing number of children	371	51.8	0.933 (p=0.485)	0.002
Gender				
Male	65	50.8	1.049 (p=0.861)	0.000
Female	306	52.0	1.0	
Attitude statement – Healthy eating is just another fashion				
Agree	104	53.8	0.836 (p=0.447)	0.008
Disagree	235	49.4	1.0	
Don't know/neither	32	62.5	0.585 (p=0.167)	
Receipt of benefits level				
None	123	54.5	1.0	0.003
On benefits for less than one year	26	46.2	1.396 (p=0.441)	
On benefits for more than one year	222	50.9	1.154 (p=0.525)	
Annual household income				
Refused	68	52.9	1.212 (p=0.604)	0.009
Under £5000	56	44.6	1.691 (p=0.177)	
£5000 - £9999	96	52.1	1.255 (p=0.514)	
£10,000 - £14,999	53	54.7	1.129 (p=0.759)	
£15,000 - £19,999	46	47.8	1.488 (p=0.330)	
£20,000 plus	52	57.7	1.0	

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Logistic regression analyses with higher intake consumers of fruit and vegetables (dependent variable)

Table 6.39b: Probability of having a higher change in fruit and vegetable consumption (≥0.5 portions per day) between waves one and two				
Variable	Number of respondents analysis	Percentage of those with higher change in analysis	Crude odds ratio	Nagelkerke R-square value
Shop at Tesco Seacroft for fruits and vegetables				
Yes	124	50.8	1.0	0.000
No	247	52.2	0.945 (p=0.796)	
Improvement in availability of fruits and vegetables				
Yes	111	49.5	1.0	0.001
No	260	52.7	0.882 (p=0.579)	
Improvement in affordability of fruits and vegetables				
Yes	97	51.5	1.0	0.000
No	274	51.8	0.989 (p=0.962)	
Improvement in attitudes towards healthy eating				
Yes	219	48.9	1.0	0.006
No	152	52.7	0.753 (p=0.181)	
Less factors affecting food choice				
Yes	147	51.7	1.0	0.000
No	224	51.8	0.997 (p=0.987)	
Less factors limiting food choice				
Yes	95	47.4	1.0	0.004
No	276	53.3	0.790 (p=0.322)	

Figures in parentheses are the statistical significance level: ***p<0.001, **p<0.01, *p<0.05. Logistic regression analyses with higher intake consumers of fruit and vegetables (dependent variable)

Following the binary logistic regression analysis using the cut-off points of ± 0.5 portions of fruits and vegetables per day, multivariate regression analysis was performed in which absolute change (positive or negative) in fruit and vegetable consumption between waves one and two of data collection formed the dependent variable. When the factors from the framework were included, none reached a level of statistical significance and a Nagelkerke R-square value of 0.11 was achieved (n=614).

In order to try and assess the factors that affected absolute changes in fruit and vegetable intakes, a further multivariate regression analysis was performed. This analysis included the factors derived from the framework of consumption, but also a series of categorical variables including switching from a 'budget' store, educational attainment, receipt of benefit levels and economic activity, as well as a series of continuous variables (or variables that could be treated as continuous) including age, distance to Tesco Seacroft, wave one fruit and vegetable intakes and household marker deprivation scores (table 6.40). A Nagelkerke R-square value of 0.15 (n=441) was achieved but only three variables were associated with changes in fruit and vegetable intake at a statistically significant level. These variables were increasing age, decreasing wave one fruit and vegetable intakes and gender (being male).

Table 6.40: Multivariate regression analysis for changes in fruit and vegetable consumption between wave one and wave two		
Explanatory variable	Parameter estimate	Level of significance
Factors in framework		
Shop at Tesco Seacroft for fruits and vegetables	0.074	0.700
Improvement in the availability of fruits and vegetables	-0.179	0.349
Improvement in the affordability of fruits and vegetables	0.012	0.950
Improvement in attitudes towards healthy eating	0.104	0.573
Less factors affecting food choice	-0.127	0.489
Less factors limiting food choice	0.259	0.196
Categorical variables		
Female	-0.737	*0.005***
Switched from a budget store	0.008	0.978
Economically active	0.164	0.169
Higher educational attainment	-0.179	0.467
Not on benefits	0.268	0.243
Continuous variables		
Wave one fruit and vegetable consumption	-0.313	*<0.001****
Age	0.290	*0.006***
Distance from Tesco Seacroft	-0.182	0.412
Children under the age of 16 years in household	-0.236	0.332
Smoking status	0.067	0.394
Household deprivation marker score	0.143	0.203
Annual household income	0.124	0.178

Multivariate regression analyses with change in fruit and vegetable consumption (dependent variable). Statistical significance level: ***p<0.001, **p<0.01, *p<0.05.

Summary

Approximately 31% and 29% of respondents had either an increase or decrease of at least half a portion of fruits and vegetables per day respectively, and were similar to the proportions found in the repeatability study (28% and 29% respectively). Analysis was carried out in order to establish if there were differences between these two groups in terms of socio-demographic factors or in changes in the framework of consumption. Those respondents who increased their consumption were statistically more likely to have lower educational attainment and have access to a car. None of the factors in the framework were statistically different between the groups. However, those respondents who increased their consumption had initially significantly lower intakes of fruits and vegetables in wave one, but ended up having significantly higher intakes (both p<0.001).

A logistic regression analysis using the variables that predicted lower or higher consumption levels in both waves one and two, showed that very little of the variance in consumption was due to these factors and that educational attainment was the only significant variable. At no stage did any of the factors in the framework predict the level of change in fruit and vegetable consumption.

Furthermore, a multiple logistic regression analysis that assessed absolute change in fruit and vegetable consumption following the opening of the new superstore showed that none of the factors in the framework were statistically associated with the changes in consumption levels. However, the variables that did predict fruit and vegetable consumption changes included wave one consumption levels – lower intake consumers in wave one changed the most.

6.5 Chapter summary and discussion

This chapter presented data on 615 respondents who completed wave two (follow-up) of data collection – i.e. following the opening of the new superstore. The chapter explored changes in fruit and vegetable consumption following the opening of the superstore within a developed framework of consumption comprising: physical access to fruit and vegetables; the availability of fruits and vegetables; the affordability of fruits and vegetables; attitudes towards healthy eating; and other factors impinging on the buying and consumption of fruits and vegetables.

Following the opening of the superstore, the overall change in fruit and vegetable consumption between the two waves of data collection (i.e. before and after the opening of the superstore) was an increase of 0.04 portions per day to 2.92 portions per day ($t=-0.591$, $p=0.555$). The median intake remained as 2.43 portions per day although there was a decrease in the modal figure from 2.43 to 2.29 portions per day. In wave two 40% of the sample met or exceeded the national average of three portions per day, whilst 11.2% met the national target of at least five portions of fruits and vegetables per day, this compares to wave one where the figures were 39.3% and 11.1% respectively.

Logistic regression analysis of wave one data identified key variables that predicted whether respondents would be lower (two portions or fewer per day) or higher (at least three portions per day) intake consumers of fruits and vegetables. These variables included age, attitudes towards healthy eating, and smoking status and were used to assess changes in fruit and vegetable consumption between the two waves of data collection. The change in fruit and vegetable consumption did not differ within any of these variables, for example non-smokers themselves did not change significantly and they did not change significantly when compared to smokers. However, those respondents who were classified in wave one as being lower intake consumers of fruits and vegetables (those consuming two or fewer portions per day) saw a significant increase in their consumption levels of 0.45 portions per day to 1.75 portions per day ($t=-7.039$, $p<0.001$). Nonetheless, 38% of the sample continued to have intakes of two portions or fewer per day after wave two (compared to 39% after wave one).

Within the framework of consumption, changes in physical access to fruit and vegetables were measured between those respondents who switched to the new superstore and those who did not. Of the 615 respondents in wave two of data collection, 218 (35.4%) reportedly used the new superstore (Tesco Seacroft) as their main source of fruit and vegetable shopping, and were therefore assumed to have increased physical access to fruit and vegetables. However, the majority of the respondents (n=140) who switched to Tesco Seacroft were respondents who were already using what would be considered a 'big' superstore such as Asda, Sainsbury, Morrison's or Safeway, and included 59 respondents who switched from an existing Tesco store. A further 27 (42.2% of previous budget store users) respondents switched from limited range/budget stores such as Lidl or Netto.

The respondents using the new superstore underwent a small and statistically insignificant increase in consumption of 0.15 portions per day to 2.75 portions per day ($t=1.207$ $p=0.229$), compared to those not using the new superstore who saw no discernable change in their consumption levels (-0.02 portions per day, $t=0.234$, $p=0.815$). Furthermore, whilst there were increases in intakes they were not to statistically significant levels for those switching from either another 'big' store or a 'budget' store to Tesco Seacroft, +0.27 portions per day for previous 'big' store shoppers ($t=-1.533$, $p=0.128$) and +0.35 portions per day for previous 'budget' store shoppers ($t=-0.869$, $p=0.393$). In terms of absolute intakes some care must be taken in assessing what levels of fruit and vegetables were consumed as the two waves of data collection took place at the same corresponding period of the year and therefore do not take account of the seasonal fluctuations in the amount eaten (Cox et al 2000). Therefore, the absolute amounts eaten may either be an over or underestimation compared to other times in the year for the sample population, but there was no way of estimating this within the study. However, this study was designed to assess the effect of the opening of a superstore on changes in fruit and vegetable consumption, and so comparing data collected at the same period in the year may be seen as an advantage.

Analysis showed that those respondents using Tesco Seacroft as their main source of fruit and vegetable shopping lived comparatively closer to the store than those who did not shop there. Furthermore, the new store shoppers saw the mean (straight-line) distance they travelled fall by 1.26km to 0.99km ($p<0.001$), although this figure was still above the 500m target for the distance travelled to access food as suggested by the Government. However, in comparison, those not using the new superstore travelled 2.73km to the store they used for purchasing fruits and vegetables. Indeed, the implication from these straight-line results suggest that for the vast majority of people their physical access to fruit and vegetables has not changed according to Government directives as only 10.6% (n=65) now lived within 500m of the new store, whilst a further 36.4% (n=224) lived between 500 and 1000m from the new store. Therefore, over half the sample population lived further than 1km from the new store and of these people 28.8% shopped for fruits and vegetables in the new store (compared to 42.9% who lived with 1km of the new store, and 55.4% who lived within 0.5km of the new store). Donkin et al (1999) in their study in London found that people did not need to travel more than 207m (median) to find a shop selling any food or 323m (median) if price and range of healthy foods were taken into account. In the present study after the opening of the superstore, the median distance to any store including 'budget' stores with a limited range of healthy foods was 0.64km (mean±sd was 0.80±0.48), whilst the median distance to a 'big' store including the new superstore was 0.92km (mean±sd was 0.92±0.41).

Whilst there were no statistically significant changes in fruit and vegetable consumption at the group level, those who had lower intakes of fruits and vegetables after wave one (i.e. those consuming two or fewer portions per day, n=239) consistently and significantly increased their intakes across all the levels of the framework. This group of lower intake consumers increased their consumption 33.6% from 1.31 portions per day to 1.75 portions per day ($t=-7.039$, $p<0.001$), compared to those with intermediate consumption after wave one (more than two and fewer than three portions per day) who had virtually no change in consumption ($t=-0.171$, $p=0.864$, n=134) or those with higher consumption after wave one (those consuming at least three portions per day) who had 7.3% reduction in intakes from 4.67 to 4.33 portions per day ($t=2.056$, $p=0.041$, n=242).

Changes in the availability of fruits and vegetables in the framework were measured using the questions 'thinking about your main food store, do you think it's better, the same or worse compared with other food stores around here that you can easily get to' with regards to:

- Availability of fresh fruits and vegetables,
- The range of fresh fruits and vegetables,
- The quality of fresh fruits and vegetables.

Those respondents who had a perceived increase in availability of fruits and vegetables (n=136) did not undergo either a significant change in fruit and vegetable consumption or in comparison to those respondents who did not have a perceived increase in availability. If these groups were stratified by whether they shopped at Tesco Seacroft or not, again there was again no statistical difference in consumption levels, with Tesco Seacroft shoppers undergoing an increase of 0.07 portions per day.

It might be assumed in this study that those using the new superstore had as full a range of fruits and vegetables as they might need and that availability was not therefore an issue. However, somewhat surprisingly those respondents not switching to Tesco Seacroft consistently believed that the store they used had a better availability, range and quality of fruits and vegetables than other local stores, than those who switched to Tesco Seacroft. Indeed, only 67 (30.7%) of Tesco shoppers believed they had seen an improvement in their availability of fruits and vegetables and of these only 9 (13.4%) were previously limited range/budget store shoppers, where the issue of availability of fruits and vegetables was thought to be particularly serious in terms of the ability to buy a range of fresh fruits and vegetables (Dowler and Calvert 1995a, 1995b).

In order to assess the effect changes in economic access to fruits and vegetables and thus their affordability had on consumption levels, variations in household deprivation marker (HDM) scores and annual household income were calculated as proxy measures of increased affordability. If a household experienced either a decrease in their HDM score or an increase in their annual household income, then they were regarded as having increased affordability of fruits and vegetables. In wave two, 79 households (12.8%) saw a reduction in their HDM scores whilst 113 (18.3%) households had increased annual household incomes, which meant that 174 (28.3%) of households had an improvement in their economic access to fruits and vegetables.

The overall change in consumption for those with increased affordability of fruits and vegetables was under 0.10 portions per day, whilst those respondents with an increased affordability who switched to Tesco Seacroft, increased consumption levels by 0.29 portions per day to 2.62 portions per day ($t=-0.826$, $p=0.412$). If the changes in intake were analysed in terms of those respondents ($n=26$) who switched to Tesco Seacroft, increased their availability of fruits and vegetables and had an improved affordability, actually decreased their consumption by 0.21 portions per day, and indeed had the lowest level of consumption for any of the eight possible permutations, although none of the changes were statistically significant.

Whilst changes in annual household income and HDM scores were used as a proxy measure for changes in the affordability of fruits and vegetables, it did not actually measure whether there was any more money either for food in general or fruits and vegetables in particular. Furthermore, it is possible that even though fruits and vegetables were available in the new superstore, there was no evidence that they were sold at an affordable price for the respondents shopping there to buy. As shown in this study there was some evidence that those people shopping in greengrocers or markets had higher intakes of fruits and vegetables, whilst it has also been shown that these sources are often a cheaper source of fruits and vegetables.

The next stage in the framework of consumption was to look at the effect of an individuals' attitude towards healthy eating. Attitude was assessed using three questions; 'Do you agree or disagree with the following statements':

- Healthy eating is just another fashion,
- I mostly eat a healthy diet nowadays,
- I don't really care what I eat.

Changes in attitudes did not coincide with an improvement in intake and indeed a decrease in the number of positive attitudes actually showed a larger increase (+0.19 portions per day). However, those respondents with no positive attitudes in both waves of data collection continued to have the lowest consumption levels (mean of 1.45 portions per day) whilst conversely those with the maximum of three positive attitudes in both waves had the highest consumption levels (mean of 3.42 portions per day).

In terms of those respondents who switched to Tesco Seacroft, those who had an improvement in attitudes did not have an increase in consumption but those who did not have an improvement in attitudes significantly increased their consumption by 0.43 portions per day (p=0.004). In terms of changes in fruit and vegetable consumption, those who switched to Tesco Seacroft, increased their availability of fruits and vegetables, increased their affordability and improved their attitudes (n=12), actually decreased their consumption by 0.30 portions per day, although this was not statistically significant.

The issue of an individual's attitude towards healthy eating has also been hypothesised as being an important factor in the choice of foods made (Murcott 1998). Whilst a change towards a more positive attitude towards healthy eating did not have a significant effect on fruit and vegetable consumption, those respondents who had a more positive attitude had significantly higher intakes of fruits and vegetables at both baseline and follow-up, as has been shown in other studies (Thompson et al 1999).

However, at follow-up 74.1% of respondents claimed to agree with the statement 'I mostly eat a healthy diet nowadays' (including 70.2% of Tesco Seacroft shoppers) and 78.4% claimed to disagree with the statement 'I don't really care what I eat' (including 78.0% of Tesco Seacroft shoppers). Therefore, the perception may be that the respondents think they eat a healthy enough diet already and do not therefore need to change. Other examples of this type of thinking has been found elsewhere, including Kearney et al (1997) in that 62% of UK respondents agreed with the statement 'I do not need to make changes to the food I eat, as it is already healthy enough'. Furthermore, Anderson et al (1993) and Parmenter et al (2000) both found that over 50% of people who consumed fewer than two/three portions of fruits and vegetables per day respectively believed they were consuming enough.

Other issues that may impinge on the buying and consumption of fruits and vegetables within the framework were assessed in relation to factors that affect or limit food choice, through a series of yes/no questions. In terms of factors affecting food choice, the factor perceived to have the greatest influence was 'cost of food/my food budget' which was cited by over 70% of both Tesco and non-Tesco shoppers, followed by 'the kinds of food I like eating' and 'trying to eat a balanced diet'. Of the factors that were cited in wave one but not in wave two (i.e. no longer perceived to be a factor affecting food choice), these differed slightly by whether the respondent shopped at Tesco Seacroft or not. For Tesco Seacroft shoppers the order was 'the kinds of foods I like eating' (15.1%), 'the costs of food/my food budget' (14.7%), 'what my spouse partner will eat', and 'whether my spouse/partner is with me' (both 13.8%), whilst for non-Tesco shoppers the order was, 'the kinds of foods I like eating' (17.4%), 'trying to eat a healthy balanced diet' (16.4%) and 'the cost of food/my food budget' (13.9%).

For factors limiting food choice, both Tesco Seacroft shoppers and non-Tesco Seacroft shoppers quoted 'what is available in the store I can get to' most often.

However, over 20% of respondents answering yes to this question in wave one did not answer yes to it in wave two. In terms of factors no longer seen as limiting food choice 'what is available in the store I can get' and 'ability to carry and transport foods home' were quoted by 23.4% and 13.8% of Tesco Seacroft shoppers respectively.

Consumption levels of fruit and vegetables were assessed depending on whether less or more/same number of factors were affecting and limiting the respondents choice of food in wave two. Overall, 254 (41.3%) and 175 (28.5%) respondents had less factors affecting and limiting their food choice respectively. However, the number of factors did not appear to have a significant effect on consumption levels, and changes in the number of factors between waves did not appear to have an effect on consumption levels either. This pattern was irrespective of whether the respondent shopped at Tesco Seacroft or not.

Factors that were cited in wave one but not in wave two may be seen as factors that no longer affect or limit an individuals' food choice. However, only for 'trying to eat a healthy balanced diet' in non-Tesco shoppers was there a significant change in consumption levels – in this case a decrease of 0.51 portions per day. Furthermore, in most cases where a factor was no longer cited as affecting food choice there was actually a small decrease in consumption.

In the very small number (n=6) who switched to Tesco Seacroft, had increased their availability of fruits and vegetables, had increased affordability, had improved attitudes and had less factors affecting or limiting food choice, a decrease in their consumption of upto 0.55 portions per day was found, although the very small numbers involved may partly explain why this was not a statistically significant result.

Treiman et al (1996) in a study of low-income women found that barriers to consumption (other than cost and availability) that might encroach on the decision to increase consumption included, not liking fruits and vegetables, preferring other things, sticking to what is known and liked, time and effort to prepare, and issues of spoilage and wastage. With respect to this it can be hypothesised that even if an individual knows that they should be consuming more fruits and vegetables, there may be other factors that impinge on whether fruits and vegetables can be bought and consumed. Over 65% of respondents in the study sample indicated that what either their partner or their child/children would eat affected the choice of food bought – furthermore, this percentage increased to nearly 67% for those respondents using Tesco Seacroft. In certain cases the unwillingness of other family members to consume fruits and vegetables may affect the respondents' ability to purchase and consume fruits and vegetables as shown by Anderson et al (1994). In addition, just over 12% of the respondents (including 14% of Tesco Seacroft shoppers) alluded to problems with cooking skills. A number of studies have shown that a lack of cooking skills can be a major barrier to the increased consumption of vegetables in particular (Anderson et al 1994, Treiman et al 1996).

Other relevant issues that might further undermine the ability of the respondent to purchase and consume fruits and vegetables were found to be 'the ability to carry and transport foods home', 'the kinds of foods liked' and perhaps particularly relevant to fruits and vegetables considering their perishable nature 'food goes off before its eaten'. The ability to carry and transport foods home was also found to be a major issue in the analysis of the Health Education Authority's 1993 Health and Lifestyles Survey (Caraher et al 1998).

This constant pattern throughout the framework of no overall significant change in fruit and vegetable consumption may lead to the conclusion that at a population level there has been no effect on fruit and vegetable consumption, and that physical access to fruit and vegetables was not a rate-limiting step in the consumption of fruits and vegetables. This was further emphasised if those respondents who increased their consumption of fruits and vegetables by at least half a portion per day (mean increase 1.58 portions per day, n=192) were compared to those who decreased their consumption of fruits and vegetables by at least half a portion per day (mean decrease of 1.52 portions per day, n=179). In terms of socio-demographic variables or factors within the framework, there were very few statistical differences between the two groups, except that those respondents who increased their consumption were more likely to have lower educational attainment (p=0.010), were more likely to have a car or van in the household (p=0.037) but possibly most importantly had significantly lower initial fruit and vegetable intakes in wave one ($p<0.001$). Indeed, after wave two those who had increased their consumption by at least half a portion per day had significantly higher intakes ($p<0.001$). However, there were no significant differences in consumption levels for any of the factors in the framework of consumption – i.e. whether they shopped at Tesco Seacroft, had increased availability, affordability or positive attitudes, or had less factors affecting or limiting food choice.

Indeed, a logistic regression analysis showed that the factors in the framework or the factors that so strongly accounted for lower or higher fruit and vegetable consumption in both waves one and two, accounted for very little of the variance in the change in consumption levels. This tends to indicate that the factors that predicted higher or lower consumption were not predictors of changes in fruit and vegetable consumption, nor were the factors identified in the framework.

Therefore, taking into consideration all these factors and the framework of consumption developed, it must be concluded that within the context of this study and for the population studied that increased physical access to fruit and vegetables through the opening a locally accessible superstore has not significantly affected the consumption of fruits and vegetables. Therefore, it may also be concluded that physical access to fruit and vegetables was not a rate-limiting step in changing consumption and is not an effective means of trying to improve health status.

7 DISCUSSION

This chapter includes a discussion of the overall results in the context of other literature in this area of study, the limitations of the study, the public health implications of the results of the study, and possible future work.

7.1 The study hypothesis, aim and objectives are restated below:

7.1.1 Hypothesis:

People with poor physical access to fruit and vegetables, who have an increase in physical access to fruit and vegetables as a result of the opening of a superstore (exposure) will increase their consumption of fruit and vegetables by 20%, from an average of 2.88 portions per person per day to 3.46 portions per person per day (outcome).

7.1.2 Aim:

To determine whether an increase in physical access to fruit and vegetables through the opening of a locally accessible superstore in an area of low fruit and vegetable consumption will lead to increased consumption of fruits and vegetables.

7.1.3 Objectives:

- To assess changes in the amount of fruit and vegetables consumed.
- To identify those people who have increased their consumption of fruit and vegetables.
- To identify the factors influencing increased fruit and vegetable consumption.

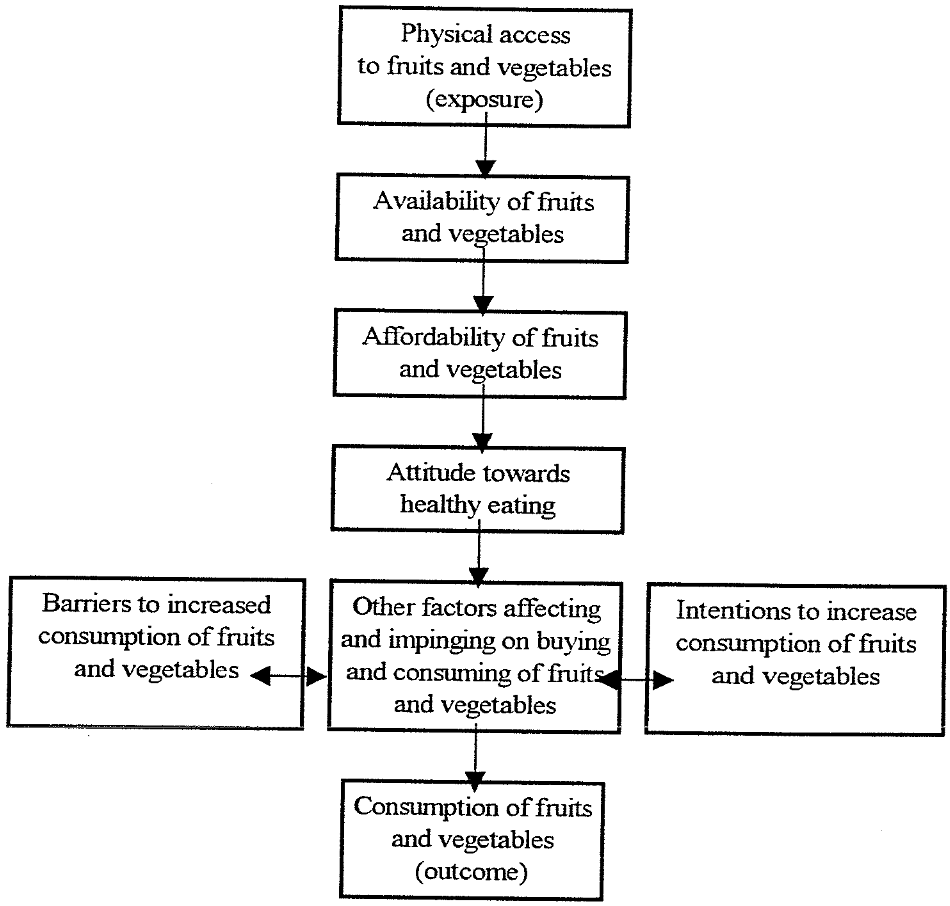
7.1.4 Framework of consumption:

In order to fully explore the impact of changes of physical access on fruit and vegetable consumption, a framework of consumption that may underpin the process by which individuals may change their consumption was developed (figure 7.1). The rationale for the development of the framework, which may also be viewed as a causal pathway, was that it is also necessary to understand the role of other social, cultural and economic factors that may encroach on the decision making process. As a result, in order to effectively determine whether an increase in physical access to fruit and vegetables will lead to their increased consumption, it is important to establish the steps an individual must go through in order to consume fruit and vegetables.

By doing this, it is possible to establish whether an increase in physical access to fruit and vegetables (exposure) will lead to a change in fruit and vegetables consumption (outcome), and whether any change in the outcome is actually down to the exposure. The arrows in the figure are designed to illustrate the causal route and thus combination of factors that may lead to an increase in fruit and vegetable consumption. However, at each level of the framework, individuals may not undergo a change, and thus a different route and combination of factors will be experienced. There are a possible 32 possible combination of factors ranging from those who experience a positive change to each of the factors in the framework – i.e. in their physical access to fruits and vegetables, their availability of fruits and vegetables, their ability to afford fruits and vegetables, their attitudes towards healthy eating and factors perceived to impinge on the buying and consuming of fruits and vegetables, to those who do not experience any change in any of these factors.

It is perceived that an improvement in a factor in the framework will potentially have a positive influence on a respondents' fruit and vegetable consumption, whilst a respondent not undergoing an improvement in a factor will not have a positive influence on their fruit and vegetable consumption levels. Overall, it may be postulated that only respondents experiencing a positive change in each of the factors will increase their fruit and vegetable consumption.

Figure 7.1: Framework for fruit and vegetable consumption



7.2 Key findings

- Following the opening of the new superstore (Tesco Seacroft), fruit and vegetable consumption increased by 0.04 portions per day (p=0.555).
- 218 (35.4%) of respondents followed-up used the new store for their fruit and vegetable shopping, the majority of whom switched from other 'big' superstore chains. Those switching to the new store lived closer to the store than those who did not (p=0.005).
- For those using the new superstore, fruit and vegetable consumption increased by 0.15 portions per day (p=0.229).
- Positive changes in the framework of consumption (availability of fruits and vegetables, affordability of fruits and vegetables, attitudes towards healthy

eating, and other factors impinging on the buying and consuming of fruits and vegetables) alongside changes in physical access to fruits and vegetables did not significantly change consumption levels (range of p-values 0.412 to 0.949).

- Those respondents who consumed lower levels of fruit and vegetable (two or fewer portions per day) before the opening of the new superstore significantly increased their consumption irrespective of changes in physical access ($p<0.001$).
- Changes in physical access to fruits and vegetables does not appear to be a rate-limiting step in the increased consumption of fruits and vegetables, and thus the hypothesis for the study should be rejected.

7.3 General discussion

This is the first study that has explored changes in fruit and vegetable consumption following a change in the physical access to fruits and vegetables. The study is based on the assumption that poor physical access to a food store selling fruits and vegetables is a rate-limiting step in their increased consumption. Fruits and vegetables are a key dietary food group that may strongly affect health status, thus an improvement in the consumption of fruits and vegetables is assumed to improve health status.

This study may be seen in part as responding to a number of different Government led reports that have advocated that physical access to food be investigated and/or tackled as a possible rate-limiting step in consumption patterns (for example Acheson 1998, Department of Health 1996, Social Exclusion Unit 2000 and 2001), particularly with regards to the issue of food deserts. Food deserts have been used to describe socially excluded deprived areas with poor retail provision, as well as poor economic and physical access to food (Acheson 1998, Department of Health 1996). Despite the term triggering an interest in the issues mentioned (Whitehead 1998), several recent papers have questioned their true definition and have subsequently described them as a metaphor (Wrigley et al 2002) and as a factoid (Cummins and Macintyre 2002) that need clearer characterisation and evidence-based assessment. Indeed, because of their imprecise nature, this thesis has avoided using the term food deserts and has focused primarily on the issue of physical access to food and fruits and vegetables in particular, as the main context.

Until this study there has been an almost total lack of empirical evidence supporting the proposition that food access is indeed a rate-limiting step. The studies that have previously looked at physical access to food have not taken into account what happens if physical access is changed. Studies have generally concentrated on two issues, firstly, what stores are available to people in any location (for example Cummins and Macintyre 1998, Donkin et al 1999, 2000a and 2000b, Dowler et al 2001, Guy 1996) and secondly, what is available and at what price in stores that people have physical access to (for example Barratt 1997, Mooney 1990, Sooman et al 1993).

With respect to the issue of physical access, it may be argued that in order to deal with the potential of difficulties with accessing food because of physical constraints it is important to show there is a potential problem in accessing food. A number of approaches have been used thus far, including those of Cummins and Macintyre (1999) who cross-sectionally assessed the number of food stores in a geographical area; Guy (1996) who measured the changes in the number of shops available over a given period of time; and those used by Donkin et al (1999, 2000a and b) and Dowler et al (2001) who determined the provision of food stores within a 500m range of households but also taking into account the range of foods available and their price. The approaches of Donkin and Dowler follow those advocated by the LIPT (Department of Health 1996) in their report on strategies for improvement in low-income areas.

The evidence from these studies is mixed, with Cummins and Macintyre, and Donkin et al suggesting that physical access to food stores may not be a problem, whilst the studies by Dowler et al and Guy concluded that accessing food was a problem. However, a further difficulty unravelling the existing evidence may be one of 'geography' in the fact that towns and cities are different in their make-up and availability of stores, and thus all will face their own inherent problems and difficulties with regards to accessing food. This fact may be borne out if one considers the two studies that tend to indicate that physical access is not a problem.

These studies were conducted in Glasgow (for the Cummins study) and London (for the Donkin study) and may not therefore be representative of smaller towns and cities.

It also appears that the issue of physical access is particularly pertinent for people living in low-income areas. These are the areas that have seen the major changes in retail store provision by the expansion of out-of-town superstores, the closing down of local stores, the opening of limited range/budget stores, and the often seen inflated food prices (Acheson 1998, National Food Alliance 1997, Project Action Team 13 2000, Wrigley 1999b). Furthermore, inhabitants in low-income areas are less likely to have access to a car or van of their own, and so accessing out-of-town stores is further compounded (Acheson 1998, Office of Population Censuses and Surveys 1993).

This study was designed to assess the impact on fruit and vegetable consumption levels of the opening of a large superstore in a highly deprived area of Leeds that previously had limited food access. Potential respondents were to be recruited and analysed before the opening of the superstore (wave one/baseline) and then followed-up after the opening of the superstore (wave two). One thousand and nine respondents were recruited into the study at baseline/wave one and 61% (n=615) were then subsequently followed-up (wave two).

The overall change in fruit and vegetable consumption between the two waves of data collection (i.e. before and after the opening of the superstore) was an increase of 0.04 portions per day to 2.92 portions per day (t=-0.591, p=0.555). Of the 615 respondents in wave two of data collection 218 started using the new superstore as their main fruit and vegetable source, but the impact on their fruit and vegetable consumption was minimal (an increase of 0.15 portions per day to 2.75 portions per day, t=-1.207, p=0.229). Furthermore, within the framework of consumption, positive changes in the perceived availability, affordability, attitude and other factors with regards to fruit and vegetables did not lead to a significant change in fruit and vegetable consumption levels.

Whilst there were no overall changes in fruit and vegetable intake at the population level, those respondents who had lower intakes of fruits and vegetables (two or fewer portions per day) before the opening of the store did experience a statistically significant upward shift in their consumption levels albeit to a level that still needs to be dramatically improved in order to meet nutritional targets of at least five portions of fruits and vegetables a day. However, this increase in consumption was irrespective of changes in physical access, and the results may be due to regression to the mean.

The distance lived from a store appears to be a determining factor in whether a store is used or not (Caraher et al 1998, Ellaway and Macintyre 2000, Robinson et al 2000). In this study it was found that respondents using the new superstore lived significantly closer to it compared either to the store they previously used for fruit and vegetable shopping or to those respondents not using the new store. Indeed it must be remembered that accessing superstores is not just about accessing foods such as fruits and vegetables but also making life easier for people to shop – particularly for older people, those with mobility problems and those people with young children (and in particular lone parents). Food shopping can be stressful, time-consuming, tiring and expensive if physical access to food is poor and so the potential for reducing these problems by making access to food easier must not be discounted (Bostock 2001, Leather 1995, Piachaud and Webb 1996, Wylie et al 1999).

However, as has been demonstrated in this study physical access alone does not appear to be a major rate-limiting step in the consumption of fruits and vegetables. Furthermore, the way in which the consumption of fruits and vegetables can be increased is complicated by issues such as availability, affordability, attitudes as well as other factors that individuals often do not have control over.

One possible explanation why there was no change in consumption levels may be due to the cost of fruit and vegetables, and the ability of respondents to be able to afford them. Whilst changes in annual household income and household deprivation marker (HDM) scores in this study were used as a proxy measure for changes in the affordability of fruits and vegetables, it does not actually measure whether there is any more money either for food in general or fruits and vegetables in particular. Furthermore, it is possible that even though fruits and vegetables are available in the new superstore, there is no evidence that they are sold at an affordable price for the respondents shopping there. As shown in this study there is some evidence that those people shopping in greengrocers or markets have higher intakes of fruits and vegetables, whilst it has also been shown that these sources are often a cheaper source of fruits and vegetables (Sustain 2000), although in this study it is not possible to establish the price differential.

As a number of studies have shown the cost of food and the relative cost of a healthy diet may be a major determinant in whether fruits and vegetables are bought (Anderson et al 1993, Brug et al 1995, Cox et al 1998, Thompson et al 1999, Wandel 1995). Studies have also shown that families on lower incomes spend more as a percentage of income but less in absolute terms on food than those families with higher incomes (Dowler and Calvert 1995a, 1995b, Nelson and Peploe 1990). Therefore, if there is no real change in the affordability of fruits and vegetables regardless of having increased physical access then an increase in the buying and consumption of fruits and vegetables is unlikely. Following the opening of the new superstore, over 74% of respondents continued to cite the 'cost of food/my food budget' as being a major factor affecting their choice of foods bought – in fact it was the most cited factor. Indeed, analysis of the Pan-European survey on attitudes to food, nutrition and health revealed that for unemployed people and those with lower educational attainment were more likely to choose price as an indicator of influence of food choice (Lennernäs et al 1997). Considering that only 38.2% and 28.3% of the respondents in this study were economically active or had an educational attainment of at least 'A' levels respectively, then price may well be perceived as being a major factor in determining whether fruits and vegetables were bought.

Also, over 60% of the sample had been on state benefits of some sort for at least one year. As has been shown the amount of money available for food for somebody on benefits may be limited and often ensuring a sufficient energy intake is seen as more important than the intake of foods such as fruits and vegetables (Lang et al 1984, Nelson and Peploe 1990, Travers 1996), especially as fruits and vegetables have become disproportionately more expensive compared to many 'non-healthy' items (Food Magazine 2000). Additionally, as suggested by Barratt (1997), some people on low-incomes may feel that they cannot be tempted away from their usual pattern of food purchasing/consumption without potentially wasting money in the process. This imbalance of quality of diet (the consumption of healthier foods) and quantity also reflects the findings from the United States on the lower fruit and vegetable intakes but higher rates of obesity in people from food insecure households (for example Cristofar and Basiotis 1992, Dixon et al 2001, Tarasuk and Beaton 1999). Indeed, this issue might be relevant to the study population (Margetts et al 2002).

The issue of an individual's attitude towards healthy eating has also been hypothesised as being an important factor in the choice of foods made (Murcott 1998). Whilst a change in the direction of a more positive attitude towards healthy eating did not have a significant effect on fruit and vegetable consumption, those respondents who had a more positive attitude had significantly higher intakes of fruits and vegetables at both baseline and follow-up. Indeed there is evidence that those people with a better attitude towards healthy eating consume significantly better diets (Thompson et al 1999).

However, at follow-up 74.1% of respondents claimed to agree with the statement 'I mostly eat a healthy diet nowadays' (including 70.2% of Tesco Seacroft shoppers) and 78.4% claimed to disagree with the statement 'I don't really care what I eat' (including 78.0% of Tesco Seacroft shoppers). Therefore, the perception may be that the respondents think they eat a healthy enough diet already and do not therefore need to change. Other examples of this type of thinking have been found elsewhere, including Kearney et al (1997) who found that 62% of UK respondents agreed with the statement 'I do not need to make changes to the food I eat, as it is already healthy enough'. Furthermore, Anderson et al (1993) and Parmenter et al (2000) both found that over 50% of people who consumed less than two/three portions of fruits and vegetables per day respectively believed they were consuming enough.

A question therefore is do people perceive fruits and vegetables to be part of a healthy diet and do they know to eat them? Parmenter et al (2000) hypothesises that for a person to select a healthy diet they must at a minimum know the recommendations for a healthy diet and to understand the necessity to select certain foods in order to meet those recommendations, whilst Kearney et al (2001) suggest that in order for people to change their diets they first need to know that they actually need to change them. Evidence seems to suggest that most people perceive a healthy diet to include fruit and vegetables. Margetts et al (1997) found that across Europe, fruit and vegetables (42%) was second only to low fat (49%) as perceived components of a healthy diet and that over 80% mentioned either of these, including 91% of UK respondents. Moreover, Povey et al (1998) in the UK found that eating fruit and eating vegetables, along with eating a balanced diet were perceived to be the most important part of healthy eating. Parmenter et al (2000) examined a cross-section of the UK population for their nutrition knowledge related to factors including current dietary recommendations and healthy food choices. Although more than 90% of respondents were aware of the recommendations including to increase fruit and vegetable consumption, 70% did not know that the recommendations actually specified the consumption of at least five portions daily. Furthermore, over 40% of the respondents were unaware of a link between low intake of fruit and vegetables and health problems, whilst a minority of people - 42% and 47% were aware of the link between low fruit and vegetable consumption and cancer and cardiovascular disease risk respectively. With respect to respondents knowing that they should be consuming higher quantities of fruits and vegetables, a possible solution would be to use the superstore setting for nutrition education (see chapter 7.5).

However, there is some evidence that individuals will only begin to consider changes to their diet because of illness to either themselves or somebody they know. Buttriss (1997) found that personal ill health or ill health of a close friend or family member was perceived by general practitioners or practice nurses as being the key motivator for their patients to change their dietary habits, and that apathy was the main obstacle. Furthermore, research from Zunft et al (1997) and Satia et al (2001) may indicate that healthy eating and its potential benefits may be considered as a theoretical issue without personal relevance whilst in addition many people feel little social pressure to change (Cox et al 1998, Satia et al 2001).

Linked to an individuals attitude and another possible explanation why there might not have been a significant increase in consumption levels with increased physical access may be the issues of the intention and behaviour patterns of the respondents at that time. In order for an individual to change their eating patterns they must want to change – i.e. it must be their intention to change. A number of models and theories have been developed that help describe and understand behaviour change, but those that have been particularly applied to health-related behaviour change include the Health Belief Model, the Theory of Reasoned Action and the Theory of Planned Behaviour, as well as the Transtheorectical Model of Behaviour Changes (i.e. the stages of change model) (Ní Mhurchú 1997).

Dittus et al (1995) found that those individuals from low-income and low-education groups (as well as males) were significantly more likely to find barriers to consuming higher intakes of fruits and vegetables than those from higher income and education groups. Therefore, the group in this study may be unwilling to change their consumption of fruits and vegetables. Likewise, Treiman et al (1996) in a study of low-income women found that barriers to consumption (other than cost and availability) that might encroach on the decision to increase consumption included, not liking fruits and vegetables, preferring other things, sticking to what is known and liked, time and effort to prepare, and issues of spoilage and wastage.

However, taking into consideration all these factors and the framework of consumption developed, it must be concluded that within the context of this study and for the population studied, that increased physical access to fruit and vegetables through the opening a locally accessible superstore has not significantly affected the consumption of fruits and vegetables. Therefore, it may also be concluded that physical access to fruit and vegetables in this population is not a rate-limiting step in their increased consumption and may not an effective means of trying to improve health status. However, physical access may still be important in order for all people to have access to a healthy diet in order that changes may be made.

7.4 Limitations of the study

There are a number of possible limitations to the study that could affect the results and subsequent conclusions. Each of these limitations is highlighted and discussed with respect to potential effects on the results.

7.4.1 Study design

A possible limitation with the study design may have been the time between the opening of the superstore (November 2000) and the administration of the follow-up interviewer administered questionnaire and the self-administered seven-day food checklist (June/July 2001). This period of time might not have been long enough for there to have been significant changes in factors within the framework of consumption, and for subsequent effect on fruit and vegetable consumption, although the period of time that is needed to change behaviour is not clear (Shepherd 2002). The study was originally designed with the expectation that the superstore was to open no later than August 2000 and so would have allowed a much longer period for possible changes in consumption levels to occur.

7.4.2 Issues of potential bias and characteristics of the respondents

When considering the potential biases in a sample, it is important to distinguish between random and differential bias. Random bias in general will lead towards a 'null' result, as the effect of the bias will be 'spread' throughout the sample population. However, if the bias is differential and only affects a certain group(s) within the sample population, this will generally lead to either an over or underestimation of the study result.

These issues are particularly relevant to potential information and selection bias. In terms of information bias this will relate to the way exposure and outcomes are collected and measured in the study group. A potential source of bias could be due to having a number of different interviewers collecting the data from the questionnaire. Whilst a standard questionnaire was used for all respondents the way in which the data was entered onto the questionnaire and how pressed the respondent was to give an answer may have differed between interviewers. Furthermore, whilst the seven-day checklist was self-administered by each respondent, it was the responsibility of the interviewer to verify the completeness of the checklist on collection. However, as the outcome measure was fruit and vegetable consumption, which was recorded by the study respondent independently of the interviewer, this is more likely to be a random bias rather than a differential bias.

However, related to the possible biases in the recording of fruit and vegetable intake in the seven-day checklist is the issue of social desirability (Hebert et al 2001). This is where an individual wishes to convey a desirable image, or to convey an image in keeping with social norms, and in the case of fruits and vegetables may lead to the over-estimation of consumption levels. However, in this study changes in consumption were being examined rather than absolute consumption levels and so over-estimation of intake may not be perceived to be such a problem in this study.

Furthermore, the person recruited into the study was the person principally responsible for domestic arrangements in the household, which in both this and previous studies has normally been shown to be a woman. However, several studies have shown that when food or money for food is scarce it is normally the woman in the household who either cuts-down or skips meals to ensure there is enough for the rest of the family (e.g. Cade 1992, Dowler and Calvert 1995a and 1995b). It is possible that whilst there were no changes in self-reported intake by the respondents in this study, other members of the household may have increased their consumption of fruits and vegetables as a result of changes in physical access associated with the opening the new superstore. Unfortunately there is no measure of intake changes in other members of the household. Therefore, in some households in the study the cutting down or skipping of meals may have occurred and indeed other members may have increased their consumption of fruits and vegetables preferentially in comparison to the woman in the household. However, in single person households (n=103), there was no greater increase in intake than for other household sizes.

In terms of selection bias, it is necessary to examine the characteristics of the sample population. As has been shown in terms of socio-demographic variables the (random) selection of respondents appear to be representative of the sample from which they were drawn –i.e. of the wards of Seacroft and Whinmoor. However, the respondents who agreed to initially participate in the study were only 33% (n=1009) of the people contacted by the interviewers, meaning that 67% of people refused to participate. If the dietary and shopping habits were different between those in the study and those not in the study, this may affect the generalisability of study i.e. the result could be either an over or under estimation of the true effect of changes in physical access to fruit and vegetables.

With respect to the issue of the derived household deprivation score and how representative it is of the population, may be questioned. Household deprivation has usually been defined using population level data, from local level census data. The applicability of measures used at a population level to define deprivation at an individual level have not been formally tested. It may be that the way deprivation has been defined in this study does not adequately capture the essence of the impact of deprivation as it occurs in this population. Particularly two of the four measures used may be problematic. Firstly, for the distribution of work status, a large percentage of people classified themselves as either a housewife/househusband or retired, in comparison to the number who classified themselves as unemployed, and thus would have a lower deprivation score. Furthermore, with respect to overcrowding a proxy measure of the number of people living in the household in comparison to the number of bedrooms in the household was made. However, this does not take into account family/relationship interactions and thus may over-represent the scale of overcrowding in this population. This is particularly true if the percentage of household in the study sample (17.6%) are compared to 1991 Ward level data for Seacroft and Whinmoor where the figures are 2.9% and 1.8% respectively. This would have the effect of increasing the household deprivation marker score (i.e. making the household more deprived).

7.4.3 Sample size

As shown in chapter 3.7.1, the number of subject required for the study was calculated and was found to be in the range of 12 to 458 subjects (per group) depending on the power, the level of statistical significance required and the expected change in daily fruit and vegetable consumption. The overall change in fruit and vegetable consumption between the two waves of data collection (i.e.

before and after the opening of the superstore) was an increase of 0.04 portions per day to 2.92 portions per day (t=-0.591, p=0.555). As is shown in the calculation below (figure 7.2), to pick up such changes in this study at a statistically significant level would have required a sample size of over 31,000 respondents.

Figure 7.2: Calculation of sample size dependent on study results

$$n=2\frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2}{(d^*/\sigma)^2}$$

Where:
d^* is the difference between the groups to be detected – in this case x portions of fruit and vegetables per day
σ is the standard deviation of fruit and vegetable consumption per day
α is the significance level
$1-\beta$ is power
n is the number of respondents

For the changes found in the study what number of respondents would have been necessary?
For overall changes, in the sample n=615, d*=0.04 portions per day, σ=1.79 and assuming 5% statistical significance and 80% power (from Cole 1997 known to be 7.8).

$$n=2\frac{(7.8)}{(0.04/1.79)^2}$$

n=31,200 respondents

If the changes for Tesco Seacroft fruit and vegetable shoppers (n=218) only are considered based on d*=0.15 portions per day, σ=1.92 and assuming 5% statistical significance and 80% power (from Cole 1997 known to be 7.8), it can calculated that 2600 respondents would have been required to pick up such changes at a statistically significant level. It can therefore be established that the sample was not large enough to pick up such small changes but based on the sample sizes obtained, what was the power of the study?

$$n=2\frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2}{(d^*/\sigma)^2}$$

For overall changes, n=615, $Z_{1-\alpha/2}$ (statistical significance) is assumed to be 5% (from Cole 1997, value known to be 1.96), d*=0.04 portions per day and σ=1.79.

$$615 = \frac{(1.96 + Z_{1-\beta})^2}{(0.04/1.79)^2}$$

$Z_{1-\beta} = -1.57$

As the value is negative, the power of the study is under 50%.

For Tesco Seacroft fruit and vegetable shoppers only, n=218, $Z_{1-\alpha/2}$ (statistical significance) is assumed to be 5% (from Cole 1997, value known to be 1.96), d*=0.15 portions per day and σ=1.92.

$$218 = \frac{(1.96 + Z_{1-\beta})^2}{(0.15/1.92)^2}$$

$Z_{1-\beta} = -1.15$

As the value is negative, the power of the study is under 50%.

Therefore, it can be concluded, that the changes in fruit and vegetable consumption at the level found in this study may be due to chance and not necessarily the effect of increased physical access to fruit and vegetables.

7.4.4 Factors in the framework of consumption

The study aim was to investigate the effect of the opening of a locally accessible retail store selling fruits and vegetables within a framework of changes related to physical access to fruit and vegetables, in the availability of fruits and vegetables, in the affordability of fruits and vegetables, in attitudes towards healthy eating and in other factors impinging on the buying and consuming of fruits and vegetables. Within this framework it is possible to be in one of 32 different cells depending on the combination of factors found, therefore this has implications for the power of the study. It may be postulated that an increase in consumption of fruits and vegetables would only be found in those respondents who had an increase in their physical access to fruit and vegetables, their availability and affordability, had the appropriate attitude towards healthy eating and did not have other factors impinging on their buying and consumption of fruits and vegetables. The study showed that there were only six respondents who were found to have fulfilled these criteria and so it is virtually impossible to make any conclusions regarding their change in fruit and vegetable consumption.

A further limitation associated with the factors in the framework may be due to the nature of some of the questions used to derive the data. Prime examples of this were the perception questions used to investigate changes in the availability of fruits and vegetables. The questions used were: 'thinking about your main food store, do you think it's better, the same or worse compared with other food stores around here that you can easily get to' (with regards to):

- Availability of fresh fruits and vegetables,
- The range of fresh fruits and vegetables,
- The quality of fresh fruits and vegetables.'

First of all the perception of what is better, the same or worse between respondents may be different. Secondly, with regards to this thesis, a question like this is restricted to those respondents who have the same main store and main fruits and vegetables store. Thirdly, bearing in mind the difficulties in answering these questions, the responses will have an implication on the subsequent factors in the framework of consumption.

Finally, the use of a linear framework model to explore changes in physical access to fruit and vegetables must be questioned. A number of models, for example that proposed by the Low Income Project Team (Department of Health 1996) have been developed to explore the complex links between factors that influence physical and economic access (macro-level) and factors that affect consumption at the individual level (micro-level). These models include feedback loops and allow for the exploration of complex interactions. In order to construct a theoretical framework to guide the approach to analysis in this thesis, a linear model was used. This was never meant to imply a simple linear causal pathway, but was more a framework in which to ask a series of logical questions leading from physical access through to consumption. Having used this linear model to guide the development of the analysis in this thesis, it may have been more helpful to have used another model that acknowledged this complexity and thus help explain the impact of physical access on consumption. A linear model, although easier to use, was perhaps too simplistic, or perhaps tried to reduce a complex pathway into a simpler more testable pathway that restricted the approach to analysis that may have revealed some important, but subtle interactions.

7.4.5 Validity of the checklist and sensitivity of the questionnaire

As has been previously noted in chapter 3, the lack of a valid checklist may be a fundamental problem of the study. Validity is the degree to which a measurement (in this case the checklist) is a true and accurate measure of what it purports to measure (Nelson 1997). In an ideal situation, the checklist would be measured against another dietary assessment instrument (a standard) such as a seven-day weighed record (or a biological marker if appropriate) in order to test how 'well' the checklist measured fruit and vegetable consumption – i.e. to assess the degree of agreement between the two measures. Consequently, the underlying issue here is whether the data derived from the checklist can be believed or not, and therefore in this study it can only be assumed that results are an accurate representation of what is actually consumed.

However, whilst the lack of a valid checklist may have implications for the generalisability of the study, the highly repeatable nature of the checklist as shown by the repeatability study (chapter 4) may indicate that any internal comparisons within the study group are likely to be rigorous. This is particularly important in such a study where changes in fruit and vegetable consumption between the two waves of data collection are assessed within as well as between respondents. However, the period of administration between the wave two checklist and the repeatability checklist was very short and may have led to a 'learning effect' and thus in-turn lead to an over-estimation of the degree of repeatability of the measure (Block and Hartman 1989).

With respect to the questionnaire, sensitivity is the proportion of respondents who answered yes to a question and for whom this is the 'true' answer. The repeatability study showed that some questions lacked a degree of sensitivity – i.e. those respondents who answered yes in wave two did not necessarily answer yes for the repeat measure. If a question used in the framework lacks sensitivity then this would have implications on whether there had been any true change in circumstances in the framework and whether these affected fruit and vegetable consumption. This would be particularly true for the determination of the main store where fruits and vegetables were bought (i.e. whether it was Tesco Seacroft or not), as this is the key question to which all subsequent changes in fruit and vegetable consumption and other factors in the framework of consumption are related.

7.4.6 Physical access to fruit and vegetables

This study is based on the hypothesis that changes in physical access to fruit and vegetables will affect fruit and vegetable consumption. It is therefore important to assess whether the study has measured physical access to fruit and vegetables. Overall, the straight-line distance travelled to where fruits and vegetables were bought fell significantly by 0.5km ($p<0.001$) between waves one and two, although most of this change is due to those people switching to Tesco Seacroft who saw the distance they have to travel to access fruits and vegetables fall dramatically by well over 1km. However, the mean distance of 0.95km that Tesco Seacroft shoppers have to travel is still beyond the 0.5km distance advocated by the UK Government. It may therefore be argued that whilst physical access to fruit and vegetables has improved to a degree it is not to the extent that may be necessary to have a greater change on fruit and vegetable consumption. Indeed there may be a distance threshold for affecting fruit and vegetable consumption.

7.4.7 Fruits and vegetables rather than food patterns?

For the purposes of this thesis, fruits and vegetables were analysed as a single food group but it may be useful to analyse them separately. A rationale for this would be the drivers or potential determinants of whether increased amounts of fruits or vegetable were consumed may differ. An example for vegetables may be with respect to issues of cooking and preparation where skills, confidence, and time to prepare are often seen as major rate-limiting steps in their increased consumption (e.g. Anderson et al 1994, Brug et al 1995a and b, Caraher et al 1998, 1999, Treiman et al 1996).

Furthermore, whilst this study has concentrated on looking at changes in fruit and vegetable consumption, but it may be that other aspects of dietary intake need to be investigated. As set out in chapter 2.1.1 the nutritional guidelines for the UK include 'enjoy a variety of foods', which may advocate the need to assess the dietary patterns of individuals. Foods are generally consumed in a number of combinations providing a range of nutrients that interact with each other in a complex manner (Wirfaelt 2000), but also tend to occur as people consciously consume patterns of food rather than individual nutrients (Williams et al 2000). However, fruits and vegetables and their increased consumption are often seen as the major nutritional public health message in both the UK and the developed world as a whole (for example Eurodiet, COMA and WHO). It was for this reason that fruits and vegetables were the main focus for this thesis rather than assessing overall changes in food patterns through the opening of a locally accessible superstore. However, future work may concentrate on possible changes in other aspects of the diet including dietary patterns.

7.5 Implications of the study

This study investigated the effect of increased physical access to fruit and vegetables through retail means on the consumption of fruits and vegetables. However, the final goal is not to increase fruit and vegetable consumption per se but to improve health status through the increased consumption of fruits and vegetables. Nonetheless, it is important to assess whether physical access to fruit and vegetables is a rate-limiting step in their consumption.

The opening of this superstore in a highly deprived geographical area and the subsequent 'improved' physical access does begin to tackle some of the issues highlighted in reports such as that of Acheson (1998). His report into inequalities in health recommended that there should be an increase in the availability and accessibility of foodstuffs to supply an adequate and affordable diet (recommendation 20), and the subsequent development of policies to ensure the adequate retail provision of food to those who are disadvantaged (recommendation 20.1). The theme of these recommendations is in-line with other published reports such as that of the Low Income Project Team (Department of Health 1996, Nelson 1997), the Social Exclusion Unit (2000, 2001), The Department of Social Security (1999) and the Competition Commission (2000) whereby the increased physical access to food stores (and its subsequent impact on health) particularly in neighbourhoods of relative disadvantage is advocated.

If the results of this study are valid, physical access to fruits and vegetables may play a role in the changing of fruit and consumption levels but it is not necessarily the major rate-limiting step. Therefore, it is important to look at both the population and individual based approaches that could be used to help improve consumption levels. This is particularly true if the heterogeneity of the population in terms of their fruit and vegetable consumption is considered – even at baseline when physical access was perceived to be an issue restricting fruit and vegetable intake, over 11% of the sample consumed at least five portions of fruit and vegetables per day. What this result also highlights is the fact that even within a highly deprived area the population is not homogeneous in their consumption patterns and many people are able to consume higher levels of fruits and vegetables.

It would be sensible to advocate a strategy that integrated both population and individual based initiatives in order to increase fruit and vegetable consumption. A population based approach is needed, as Lang and Caraher (1998, p203) observed *'There is little point in encouraging low-income consumers to eat more healthily if their district has inadequate local food suppliers and if shops which do offer a choice are located inconveniently for socially disadvantaged groups such as single parents, women, the elderly, disabled individuals and the poor who tend to have worst access to cars and transport'*. Policies are needed that incorporate strategies that balance population (macro-level) and household/individual (micro-level) needs in order to encourage promote and implement increases in fruit and vegetable consumption.

With respect to population-based approaches, the improvement of physical access should be encouraged, but the building of superstores must not be seen as the only option for improving physical access (or fruit and vegetable consumption). Physical access is important because without it people will not have the opportunity either to access fruits and vegetables or exact changes in their diets with regards to increasing consumption levels. Changes in the planning regulations through Planning Policy Guidance Note 6 (PPG 6) Shopping Centres and their

Development and PP13 on Transport should mean that in future there will be more development of superstores in more deprived areas. Tesco is an example of this – other than the development of the store in Seacroft, they have/are developing 11 further sites across the UK (McHardy 2001). As a side issue, the development of stores in such areas by Tesco led to the creation of a large number of job opportunities for local residents living in areas with high unemployment rates (Brindle 1999, McHardy 2001) – indeed 10 respondents in the sample now worked at the new store, although Monbiot (2001) argues this is only the re-creation of jobs that were originally destroyed by the superstores moving to out-of-town sites.

However, unlike the study area, not all deprived communities with poor access to food will be fortuitously advantaged through the opening of a superstore and so alternative propositions and initiatives must be put in place. Possible options and alternatives for the easier access to foods, particularly for lower income areas include the use of small community business' or food projects/co-operatives/local food partnerships, either in collaboration with superstores or independently. Indeed, following the consultation report of Project Action Team 13, the Social Exclusion Units reports (2001) advocate bringing together local-community based and small-scale retailer based schemes in order to help tackle the problem of in-access to food stores.

In a review of food projects and how they work by McGlone et al (1999), food projects were broadly defined as a range of initiatives that operate in a given community, or which have arisen from a local group within a community and are generally associated with lower income communities. However, to set up these types of initiatives can be time-consuming, complex and difficult to sustain, although as the report by the LIPT recommends a food project network should be instigated to support the process (Department of Health 1996). Further to this, Dowler et al (2001) points out that the wider benefits of such food project schemes are numerous and include strengthening social networks, providing potential physical improvements in health (as a result of dietary change), and developing a strong lobbying voice. However, there is need to establish the effectiveness of these kind of initiatives on fruit and vegetable consumption, in the same way changes in fruit and vegetable consumption have been assessed in this study through the opening of a major superstore.

Nonetheless, as has been highlighted earlier in this chapter, it must be remembered that improving physical access to superstores is not just about accessing foods such as fruits and vegetables but also making life easier for people to shop – particularly for older people, those with mobility problems and those people with young children (and in particular lone parents). Indeed, in this study some of the major limitations on food choice included 'ability to carry and transport foods home' 'difficult to get to shops with children' and 'difficult to get to shops because of age or disability'. Food shopping can be stressful, time-consuming, tiring and expensive if physical access to food is poor and so the potential for reducing these problems by making access to food easier must not be discounted. Women generally are the people responsible for domestic arrangements in households but are less likely to have access to a car than their male counterparts, whilst car ownership also decreases with decreasing socio-economic status (Office of Population Censuses and Surveys 1993). Therefore, there is a need for a clear transport policy to enable people without access to a car to have transport to food stores if so required.

Within this study, apart from socio-demographic variables such as age and educational attainment, the strongest predictors of fruit and vegetable consumption were shown to be smoking status and attitudes towards healthy eating. Furthermore, issues around cooking skills and other factors impinging on the preparation of fruits and vegetables are still relevant to a sizeable proportion of the population. Consequently it appears there may still a role for influencing individuals in the decision making process in order to increase the amounts of fruits and vegetables bought and subsequently consumed, i.e. there is a need for individual based initiatives to encourage such a process. Therefore, an integrated nutrition policy including educational aspects that may help individuals to increase consumption should be advocated, particularly as has been highlighted before the existence and importance of local level heterogeneity – small pockets of people within the deprived area relatively better and worse off in terms of diet and risk of poor health. In turn this argues the need to balance area-based with targeted individual-based policy responses. Any approach that ignores this local heterogeneity is likely to fail in improving diet related health. Equally, any approach that shifts responsibility for action solely on to the individual, and assumes that change can be achieved by encouraging people to eat a healthy diet through nutrition education (in the narrowest sense of the term) alone has the potential to fail. Indeed, the inability of health promotion in the UK over the past decade to achieve any substantial beneficial change in dietary patterns as well as the consumption of fruits and vegetables of the worst off groups in society is evidence that this approach has not been effective. Rather, it has been most successful in helping to improve the diets of those already better off, thereby contributing to widening social inequalities in diet related health (Acheson 1998). Furthermore, as has been previously highlighted (chapter 2.4.3) individuals must be in a position to want to change their behaviour and thus alter their intentions towards the buying and consuming of increased amounts of fruits and vegetables.

A possible amalgamation of population and individual based initiatives could be the use of the superstore or other retail source as a possible setting for the promotion of healthy eating. Two small studies from the United States have attempted to investigate this as an option – the Eat for Health programme (Brown Rodgers et al 1994, Light et al 1989) and a programme as part of the Demonstration Cancer Control Project for Iowa Farmers (Kristal et al 1997). Common elements of the programmes included the use of leaflets, recipe cards, in-store news bulletins and shelf labels, whilst in the study by Kristal et al (1997) participants were also able to attend demonstration sessions and talks on the benefits of consuming more fruits and vegetables. The benefits of these interventions were not clear although the authors do acknowledge that this type of point of purchase interventions are difficult to implement and evaluate, and that a more powerful intervention is probably necessary in order to induce shoppers to purchase and consume more fruits and vegetables.

In a different type of study intervention, Anderson et al (2001) used a superstore as a site for shoppers to use a self-administered computer based programme to evaluate changes of fruits and vegetables and other food groups. The programme used personalised information, behavioural strategies and incentives for change as well as a vehicle for planning and receiving feedback on personal behaviour change goals. The computer programme guided participants to increase amongst others fruits and vegetables in their purchases and consumption. Indeed, results appeared positive with those people in the intervention arm of the study significantly increasing their fruit and vegetables intakes.

However, irrespective of the type of intervention, if individuals see the cost of fruits and vegetables as the major barrier to consumption then this is an issue that needs to be addressed. Whether increased money available for food is the answer is not clear but the perceived and relative cost of 'healthy' food must not be understated. These latter issues can only be addressed through food policy but will ultimately have an effect on an individual's consumption of fruits and vegetables and in turn their health status.

However, to conclude, the work of Reisig and Hobbiss (2000) should be examined. They investigated the response of one city (indeed it was Leeds) to the problem of in-access to food, and highlighted that for many agencies that may play a role in trying to deal with the issue there was either little or no action plan or 'cross-directory' workings. In addition what the authors did find was that there was an over-reliance on community development schemes, which had the additional problem of adequate funding. With regards to this last point, Reisig and Hobbiss (2000, p147) conclude that *'although community involvement is vital to community development, it cannot be left to communities to organise their access to good-quality affordable food, as enjoyed by the rest of society'*. For this reason, a multi-sectorial approach involving communities, as well as both the public and private sectors is warranted (an approach that was used for the building of the new store in this study). Furthermore, this underlines the point made previously that any approach to increase fruit and vegetable consumption must strike a balance between 'macro-level' policies that are generated at a population level and those at a 'micro-level' that target individual households and people. Policies are needed that incorporate strategies that balance population (macro-level) and household/individual (micro-level) in order to encourage, promote and implement increases in fruit and vegetable consumption. Physical access on its own may not be a rate-limiting step in the increased consumption of fruits and vegetables for all in the population, but is important because without it people will not have the opportunity either to access fruits and vegetables or exact changes in their diets with regards to increasing consumption levels.

7.6 Future work

This is the first study to investigate the effect on food consumption (in this case fruit and vegetable consumption) of changes in physical access to fruit and vegetables through the opening of a superstore. Results showed that increased physical access to fruit and vegetables had little or no effect on the majority of the population. However, fruits and vegetables are only one aspect of the diet and it might therefore be important to assess changes in other parts of the diet. Whilst the data may not be used for the assessment of nutrient intake, the data could be used to look for changes in the overall dietary pattern of the respondents and assess whether there are changes following the opening of the superstore. Additionally, it might be necessary to undergo another wave of data collection in order to assess if there have been any longer term changes either in fruit and vegetable consumption or in dietary patterns following the opening of the superstore.

One of the most evident recommendations for future work would centre on the need for the study to be repeated in another area. It is possible that the study population and the area of study are not representative of the wider population of the UK and differences across the country may be found. A variation on this work could be to assess the impact of the opening of food projects/co-operatives/local food partnerships. This latter point may be particularly pertinent considering the evidence from previous work (as well as this study) suggesting that cost may still be the most important factor in whether certain foods and in particular fruits and vegetables are eaten or not. A further extension could be an evaluation of the changes for example in the cost of a basket of food in order to assess to see if the price structure and thus the affordability of the diet had changed – a strategy adopted by the Family Budget Unit (1998).

The ultimate aim of changing food access is to help improve the health status of the population. Therefore, future work must aim to assess the impact on health by changes in physical access. Indeed, following this line a new study in Glasgow and funded by the Department of Health has been set up in order to assess self-reported health, self-esteem and general well-being following the opening of a superstore in an area of poor physical access.

8 CONCLUSION

This study has assessed the changes in fruit and vegetable consumption with respect to changes in physical access to fruit and vegetables through the opening of a superstore. The hypothesis for this study was 'People with poor physical access to fruit and vegetables, who have an increase in physical access to fruit and vegetables as a result of the opening of a superstore (exposure) will increase their consumption of fruit and vegetables by 20%, from an average of 2.88 portions per person per day to 3.46 portions per person per day (outcome)'. As fruit and vegetable consumption increased by 0.04 portions per day (1.4%) for the sample population ($t=-0.591$, $p=0.555$, $n=615$) and by 0.15 portions per day ($t=-1.207$ $p=0.229$, $n=218$) (5.8%) for those using the new superstore for fruits and vegetables shopping following its opening, the hypothesis should be rejected and it should be concluded that physical access to fruit and vegetables is not a rate-limiting step.

Whilst the improvement of physical access to fruit and vegetables on its own may not be an effective strategy to improve fruit and vegetable consumption and thus health status, policies are needed that incorporate strategies that balance population and household/individual needs in order to encourage, promote and implement increases in fruit and vegetable consumption. With respect to population-based approaches, the improvement of physical access should be encouraged, but the building of superstores must not be seen as the only option for improving physical access (or fruit and vegetable consumption). Physical access is important because without it people will not have the opportunity either to access fruits and vegetables or exact changes in their diets with regards to increasing consumption levels.

A framework of consumption involving changes in physical access to fruit and vegetables, and associated changes in the availability of fruits and vegetables, the affordability of fruits and vegetables, attitude towards healthy eating, and other factors affecting the buying and consumption of food was developed to try and help understand the process by which respondents could potentially change their diets. The results showed that positive changes in any of these factors did not have a significant effect on the consumption levels of fruits and vegetables. Indeed, assessment of those who increased their consumption by more than 0.5 portions per day compared to those who decreased their consumption by at least 0.5 portions per day revealed that there were few significant differences between the groups that may have led to a change in consumption levels. However, there may well be other factors that determine whether fruits and vegetables are bought or not that have not been examined within this study. Physical access might play a role in increased consumption but it does not appear to be a major factor on its own or in association with the factors in the framework. However, this is not to say that physical access is unimportant in trying to increase the consumption of fruits and vegetables.

However, the intervention did have a positive effect on some sub-groups within the population. Those respondents who consumed lower amounts of fruits and vegetables (two or fewer portions per day) before the opening of the superstore saw a significant increase in their consumption levels ($t=-7.039$, $p<0.001$, $n=239$).

Although the mean distance travelled by respondents to the new superstore was beyond the 500m that has been proposed by the Government and other organisations as a maximum distance for food shopping, this is the first study that has attempted to assess the impact of changes in physical access to food through the opening of a food store and so lessons may still be learnt. A change in physical access to a superstore has the potential to influence consumption, but it must also be remembered that accessing superstores is not just about accessing foods such as fruits and vegetables but also making life easier for people to shop – particularly for older people, those with mobility problems and those people with young children (and in particular lone parents). Food shopping can be stressful, time-consuming, tiring and expensive if physical access to food is poor and so the potential for reducing these problems by making access to food easier must not be discounted.

However, as with all studies there are possible study limitations that may affect the results and thus the conclusions. Firstly, the period of time between the opening of the superstore and the collection of wave two data may not have been long enough for changes in either the factors in the framework or levels of fruit and vegetable consumption to manifest themselves. Secondly, whilst the change in fruit and vegetable consumption was negligible the sample size may not been large enough to pick up significant changes. Thirdly, there are issues regarding the validity of the self-administered prospective seven-day checklist used to assess fruit and vegetable consumption and the sensitivity of the self-administered and interviewer-administered questionnaires used to assess socio-demographic and other factors related to the respondents.

APPENDIX I

Wave one and wave two self-completed seven-day checklist

HOW TO COMPLETE THIS DIARY

PLEASE READ THESE INSTRUCTIONS AND LOOK AT THE EXAMPLE (on pages 4 & 5) BEFORE YOU START TO FILL IN THE DIARY

- You'll see that the diary has pages for 7 days. The day number is shown in the top left corner of each page, and there is space next to it for you to write in the name of the day.
- **Fill in the diary for 7 days in a row**. Let us know on which day of the week you start (on the front cover).
- For each day, record everything **you yourself ate and drank**. This is very easy, you do it by just ticking boxes.
- Record what you ate and drank away from home, as well as at home.
- We have split the day into four parts:

  breakfast time

  lunchtime

  tea time/evening meal

  all other times.

You must tell us about each of these for every one of the 7 days.

Did you eat/drink?

This is the first question - answer it for each of the four day parts.

- Tick 'no' only if you had no food or drink at all.
- If you did eat or drink, tick 'Yes, at home', or 'Yes, away from home' (tick both, if they both apply). Then let us know what you ate/drank.

If yes, ... what did you eat/drink?

This is the second question, and there can be lots of answers to it.

- Look down the list of foods/drinks. For each that you ate/drank put a tick under 'Small', 'Medium' or 'Large' in the day part in which you ate/drank it. This is to give an indication of how much you consumed of the particular food.

- What is small, medium or large, is entirely up to what you think; there's no exact measure. For cases where you are not sure, tick 'Medium'.

- We've tried to group the foods so that they are easy to identify, but you may have to look carefully to find some. (For example, tomatoes are under vegetables; yoghurt and fromage frais are under desserts).
- Milk is under drinks, you should tick it if you have it as a drink; or add it to tea, coffee, or a cereal; or use it in cooking
- If you can't find the exact description of a food or drink you have eaten, tick the most similar to it on the list, or the group of which it is a part (for example for liver or kidneys tick 'Meat')
- We are not interested in, and you should not record, sugar, salt, pepper, herbs, spices etc. and condiments such as tomato ketchup, mayonnaise/salad cream, mustard, pickle, etc.
- Finally, if there are dishes you prepare where a number of ingredients are all put in to one pot (e.g. casseroles, bolognese, curry, shepherd's pie etc.) you should tick as many of the ingredients as you can from the list.

The last 2 pages

There are some additional questions on pages 21 & 22 at the back. You can fill them in at any time in the week, but please do so before the interviewer calls to collect your diary, as it is not complete without them

If at any time you are not sure what to do, please call Emily Peters' free phone number 0500 300060 and quote reference FDP.

PLEASE USE BLUE OR BLACK BIRO TO FILL IN THE DIARY AND TICK EACH BOX NEATLY.

If at any time you realise you have ticked a wrong box, fill it in completely (as if you were doing the lottery), and tick the correct one.

Do not use tippex or any kind of correcting fluid.

PLEASE DO NOT WRITE COMMENTS ON THE TICK BOX PAGES.
Write them on the blank page 19, or tell them to the interviewer

THANK YOU FOR YOUR HELP

EXAMPLE

THIS IS AN EXAMPLE OF HOW TO COMPLETE A DIARY PAGE, PLEASE LOOK AT IT CAREFULLY.

DAY 1 TUESDAY **please write in name of day**

DID YOU EAT/DRINK?
tick for each of the 4 occasions)

	Breakfast Time	Lunch Time	Teatime/ Evening Meal	All other Times
No, tick here ⇒				
Yes, at home, tick here ⇒	✓		✓	
Yes, away from home, tick here ⇒		✓		✓

IF YES…………
WHAT DID YOU EAT/DRINK?

	Breakfast Time			Lunch Time			Teatime/ Evening Meal			All other Times		
Drinks	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Water								✓		✓		
Any hot drink *(e.g. tea,coffee etc)*			✓		✓						✓	
Milk-full fat												
Milk – semi-skimmed or skimmed												
Evaporated Milk/Condensed Milk												
Fizzy Drinks – diet/low cal												
Fizzy Drinks - normal											✓	
Real (100%) Fruit Juice												
Fruit Drinks and Squashes		✓										
Beer/Lager								✓				
Wine												
Any other Drinks												
Cereals/Breads	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Muesli/ Bran/ Wheat Cereal												
Other Cereal-*(e.g. Cornflakes/Rice/Krispies)*		✓										
Brown Bread/Toast/Rolls etc.												
White Bread/Toast/Rolls etc.	✓				✓							
Eggs/Dairy Products/Marg/Fats	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Margarine - low fat												
Margarine - normal					✓							
Butter												
Lard/ Dripping												
Cooking Oil							✓					
Cream												
Eggs	✓											
Cheese					✓							
Jam/Spreads	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Sweet spreads-*(e.g. jam, chocolate spread)*												
Savoury spreads - *(e.g. peanut butter. pastes)*												
Fruits	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Appies. Pears											✓	
Oranges, Tangerines, Lemons												
Bananas												
Peaches												
Other Fruit							✓					
Dried Fruit												

EXAMPLE PAGE CONTINUED/.............

DAY 1 CONTINUED/...........

	Breakfast Time			Lunch Time			Teatime/ Evening Meal			All other Times		
Meat/Fish/Other Main Food/Soup	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Take Away/Restaurant Indian or Chinese												
Pre-prepared ready meal *(e.g. bought from supermarket)*												
Pizza												
Meat Pies/ Sausage Rolls/ Pasties/ Other Savoury Pastry												
Vegetable Pasties/ Quiche/ Other Vegetable Pastry												
Poultry *(e.g. chicken/turkey)*								✓				
Processed poultry *(e.g. in breadcrumbs, nuggets, KFC etc)*												
Meat *(e.g. beef lamb, pork)*												
Processed red meat *(e.g. ham, bacon, sausage, burger, tinned meat)*												
Battered fish												
Processed fish *(e.g. fish fingers, canned fish etc.)*												
Other fish												
Soup												

Potatoes/Rice/Pasta/Baked Beans	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Boiled/Mashed Potatoes												
Chips									✓			
Roast Potatoes												
Rice												
Pasta/Spaghetti Hoops/Other Tinned Pasta												
Baked Beans												

Vegetables (except potatoes)	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Carrots							✓					
Peas, Beans							✓					
Brocolli, Cauliflower, Cabbage												
Tomatoes				✓								
Salad/Raw Vegetables												
Processed Vegetables *(e.g. curried, mushy peas etc.)*												
Other Vegetables												

Desserts/Sweet Snacks/Confectionery	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Fruit Pudding, e.g. fruit crumble, pie sponge												
Other Pudding (no fruit)												
Ice-Cream/Lollies/Sorbet												
Packet Mix Dessert												
Yoghurt/Fromage Frais – low fat								✓				
Yoghurt/Fromage Frais - normal												
Cakes/Pastries												
Sweet Biscuits (not chocolate)										✓		
Chocolate Biscuits												
Chocolate										✓		
Other Sweets												

Savoury Snacks	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Crackers/Crispbreads												
Crisps/Peanuts/Other `Bag` Snacks					✓							

DAY 1 [ ] **please write in name of day**

DID YOU EAT/DRINK?

tick for each of the 4 occasions)

	Breakfast Time	Lunch Time	Teatime/ Evening Meal	All other Times
No, tick here ➾				
Yes, at home, tick here ➾				
Yes, away from home, tick here ➾				

IF YES............
WHAT DID YOU EAT/DRINK?

	Breakfast Time			Lunch Time			Teatime/ Evening Meal			All other Times		
Drinks	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Water												
Any hot drink *(e.g. tea,coffee etc)*												
Milk-full fat												
Milk – semi-skimmed or skimmed												
Evaporated Milk/Condensed Milk												
Fizzy Drinks – diet/low cal												
Fizzy Drinks - normal												
Real (100%) Fruit Juice												
Fruit Drinks and Squashes												
Beer/Lager												
Wine												
Any other Drinks												

Cereals/Breads	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Muesli/ Bran/ Wheat Cereal												
Other Cereal-*(e.g. Cornflakes/Rice/Krispies)*												
Brown Bread/Toast/Rolls etc.												
White Bread/Toast/Rolls etc.												

Eggs/Dairy Products/Marg/Fats	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Margarine - low fat												
Margarine - normal												
Butter												
Lard/ Dripping												
Cooking Oil												
Cream												
Eggs												
Cheese												

Jam/Spreads	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Sweet spreads-*(e.g. jam, chocolate spread)*												
Savoury spreads - *(e.g. peanut butter, pastes)*												

Fruits	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Apples, Pears												
Oranges, Tangerines, Lemons												
Bananas												
Peaches												
Other Fruit												
Dried Fruit												

Meat/Fish/Other Main Food/Soup	Breakfast Time			Lunch Time			Teatime/ Evening Meal			All other Times		
	Small	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Take Away/Restaurant Indian or Chinese												
Pre-prepared ready meal *(e.g. bought from supermarket)*												
Pizza												
Meat Pies/ Sausage Rolls/ Pasties/ Other Savoury Pastry												
Vegetable Pasties/ Quiche/ Other Vegetable Pastry												
Poultry *(e.g. chicken/turkey)*												
Processed poultry *(e.g. in breadcrumbs, nuggets, KFC etc)*												
Meat *(e.g. beef lamb, pork)*												
Processed red meat *(e.g. ham, bacon, sausage, burger, tinned meat)*												
Battered Fish												
Processed fish *(e.g. fish fingers, canned fish etc.)*												
Other fish												
Soup												

Potatoes/Rice/Pasta/Baked Beans	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Boiled/Mashed Potatoes												
Chips												
Roast Potatoes												
Rice												
Pasta/Spaghetti Hoops/Other Tinned Pasta												
Baked Beans												

Vegetables (except potatoes)	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Carrots												
Peas, Beans												
Brocolli, Cauliflower, Cabbage												
Tomatoes												
Salad/Raw Vegetables												
Processed Vegetables *(e.g. curried, mushy peas etc.)*												
Other Vegetables												

Desserts/Sweet Snacks/Confectionery	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Fruit Pudding, e.g. fruit crumble, pie sponge												
Other Pudding (no fruit)												
Ice-Cream/Lollies/Sorbet												
Packet Mix Dessert												
Yoghurt/Fromage Frais – low fat												
Yoghurt/Fromage Frais - normal												
Cakes/Pastries												
Sweet Biscuits (not chocolate)												
Chocolate Biscuits												
Chocolate												
Other Sweets												

Savoury Snacks	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Crackers/Crispbreads												
Crisps/Peanuts/Other 'Bag' Snacks												

Job No. 388224

APPENDIX II

Wave one interviewer administered questionnaire

Food and Drink Survey (Leeds)

JOB NUMBER						INTERVIEWER NO.	RESPONDENT/ ASSIGNMENT NO.	SAMPLE NO.
3	8	8	2	2	4			

Are you the person mainly responsible for buying and preparing food in this household?

Yes – Explain and place diary and conduct interview
No – Ask for person who is

Time at which interview started: ☐☐:☐☐

Time at which interview ended: ☐☐:☐☐

Today's date: ☐☐:☐☐

SURNAME: MR/MRS/MISS ____________________

ADDRESS: ____________________

POSTCODE: ____________ PHONE NO: ____________

SEX
☐ Male
☐ Female

AGE
☐ 17-24
☐ 25-34
☐ 35-44
☐ 45-64
☐ 65+

HOUSEHOLD SIZE
☐ One
☐ Two
☐ Three
☐ Four
☐ Five (and over)

CHILDREN IN HOUSEHOLD
(Aged 0-15)
☐ Yes
☐ No

CONFIRMATION DIARY PLACED ☐

DAY OF WEEK DIARY STARTED
☐ Monday
☐ Tuesday
☐ Wednesday
☐ Thursday
☐ Friday
☐ Saturday
☐ Sunday

DATE DIARY WILL BE STARTED
DAY: ☐☐
MONTH: ☐☐

Time and date arranged for diary collection: Time: ☐☐:☐☐ Date: ☐☐:☐☐

I certify that this interview has been personally carried out by me with the informant in home and conducted within the Market Research Society Code of Conduct. I further certify that the informant is not a friend or of mine, and I have not interviewed him/her on any survey in the last six months.

: ____________________ Date: ____________________

Q.1. At which shop do you do your main food shopping, and where is it situated?

(TICK ONE BOX ONLY)

SHOW CARD A	Where situated?	Main Store
Asda	Killingbeck Retail Park	☐01
Co-op	South Parkway Village Store	☐02
Co-op Superstore	Halton	☐03
Jack Fulton	Seacroft	☐04
Jack Fulton	Crossgates Centre	☐05
Iceland	Any Store	☐06
Kwik-Save	Crossgates Centre	☐07
Kwik-Save	Harehills Corner	☐08
Lidl	Oaktree Drive, Gipon	☐09
Morrisons	Merrion Centre	☐10
Netto	York Road (Near the Ring-road)	☐11
Netto	Halton	☐12
Safeway	Oakwood	☐13
Sainsburys	Whitkirk	☐14
Tesco	Crossgate Centre	☐15
Tesco	Roundhay Road, Oakwood	☐16
____________	____________________	☐17
Other (write in)		

Q.2. Which of these stores is most often used to buy each of the following types of food for your household? *(Interviewer: write in store code from above list, and how many times in the last week each has been bought. If not on the list e.g. a local butchers for meat, milkman for milk etc., - use the code 88).*

	Store Code	Number of times
Bread	☐☐	☐
Milk	☐☐	☐
Eggs/butter	☐☐	☐
Meat	☐☐	☐
Fish	☐☐	☐
Fruit/vegetables	☐☐	☐
Tins/jars/packet foods	☐☐	☐
Cakes	☐☐	☐
Biscuits	☐☐	☐
Confectionery	☐☐	☐

Q.3. a) Do you work at any of the following food stores?
b) What about anyone else in the household?
SHOW CARD B **(TICK AS MANY AS APPLY)**

	You	Other member of household
Asda	☐	☐
Co-op	☐	☐
Jack Fulton	☐	☐
Iceland	☐	☐
Kwik Save	☐	☐
Lidl	☐	☐
Marks & Spencer	☐	☐
Morrisons	☐	☐
Netto	☐	☐
Safeway	☐	☐
Sainsbury	☐	☐
Tesco	☐	☐
City Centre Market Stalls	☐	☐
City Centre Food Shop	☐	☐
Corner Shop	☐	☐
Green Grocer	☐	☐
Other Food Store (write in)____________	☐	☐
None of the above	☐	☐

Q.4. A)Thinking about the household's main/weekly food shopping, what is the form of transport most often used to get to (*name of main store from question 1)*?
B) To get back from *(name of main store from question 1)?*
SHOW CARD C **(TICK ONE BOX 'TO' AND ONE BOX 'FROM')**

	To	From
Household's Own Car	☐	☐
Lift in Someone Else's Car	☐	☐
Taxi	☐	☐
Normal paying Bus	☐	☐
Stores Free Bus Service	☐	☐
Train	☐	☐
Walk	☐	☐

Q.5. Thinking about (*name of main store and location from question 1*), do you think it's better, the same or worse compared with other food stores around here that you can easily get to, as regards the following?
READ OUT

(TICK ONE BOX FOR EACH STATEMENT)

	Better	The same	Worse	Don't Know
Availability of fresh fruit and vegetables	☐	☐	☐	☐
The range of fresh fruit and vegetables	☐	☐	☐	☐
The quality of fresh fruit and vegetables	☐	☐	☐	☐
Ease of getting to	☐	☐	☐	☐
Value for money	☐	☐	☐	☐
Information about healthy eating	☐	☐	☐	☐
Friendliness of Staff	☐	☐	☐	☐

Q.6. Thinking about the a)fruit and b)vegetables that you eat, are they mostly tinned, frozen or fresh?
READ OUT

(TICK ONE ANSWER FOR EACH COLUMN)

	a)Fruit		b)Vegetables
Tinned	☐	Tinned	☐
Frozen	☐	Frozen	☐
Fresh	☐	Fresh	☐

ABOUT YOUR HOME

Q.7. Do you and/or your partner own this home?
READ OUT

Own out-right (no mortgage)	☐
Own (paying off mortgage)	☐
Rent	☐

Q.8. How many separate bedrooms does your home have?

1	☐
2	☐
3	☐
4+	☐

Q.9. Which of these does your household have use of?
SHOW CARD D

(TICK AS MANY AS APPLY)

Cooker with four rings or more	☐
Cooker with one, two or three rings	☐
Oven	☐
Grill	☐
Deep Fat Fryer	☐
Microwave oven	☐
Combined fridge-freezer	☐
Fridge	☐
Separate freezer	☐
None of these	☐

Q.10. Do you or any other member of your household have use of a car/van on a regular basis?

Yes	☐
No	☐

ABOUT YOU

Q.11. Do you have any long-term health problems which affect your ability to shop for yourself?

(TICK ONE ANSWER ONLY)

No	☐
Yes, affect a great deal	☐
Yes, affect somewhat	☐

Q.12. a) Do you have to watch what is eaten because of any of the following?
b) What about anyone else in the household?
READ OUT

(TICK AS MANY AS APPLY)

	You	Other member of household
No	☐	☐
Yes because of........		
Illness/allergy	☐	☐
Trying to lose weight	☐	☐
Personal beliefs (e.g. religious/cultural/vegetarianism)	☐	☐
Other (write in) ______________________	☐	☐

Q.13. How strongly do you agree or disagree with each of the following statements?
SHOW CARD E **(TICK ONE BOX FOR EACH STATEMENT)**

READ OUT	**Strongly agree**	**Tend to agree**	**Neither agree nor disagree**	**Tend to disagree**	**Strongly disagree**	**Don't Know**
Healthy eating is just another fashion	☐	☐	☐	☐	☐	☐
I mostly eat a healthy diet nowadays	☐	☐	☐	☐	☐	☐
It's not very easy to eat healthy foods if you eat out	☐	☐	☐	☐	☐	☐
Eating healthy food is expensive	☐	☐	☐	☐	☐	☐
Healthy foods are enjoyable	☐	☐	☐	☐	☐	☐
The tastiest foods are the ones that are bad for you	☐	☐	☐	☐	☐	☐
I don't really care what I eat	☐	☐	☐	☐	☐	☐
I get confused over what's supposed to be healthy and what isn't	☐	☐	☐	☐	☐	☐
Experts never agree about what foods are good for you	☐	☐	☐	☐	☐	☐

ABOUT YOUR HOUSEHOLD

Q.14. How many people live in your household including yourself?

(TICK ONE ANSWER ONLY)

1 ☐
2 ☐
3 ☐
4 ☐
5+ ☐

Q 15. *Interviewer: for each person in the household please fill in the following details:*

(COMPLETE FOR EACH MEMBER OF THE HOUSEHOLD)

	You/ Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
First name (write in.....)								
a) What sex is each person?								
Male	☐	☐	☐	☐	☐	☐	☐	☐
Female	☐	☐	☐	☐	☐	☐	☐	☐
b) What age is each person? **SHOW CARD F**								
0-5	☐	☐	☐	☐	☐	☐	☐	☐
6-10	☐	☐	☐	☐	☐	☐	☐	☐
11-16	☐	☐	☐	☐	☐	☐	☐	☐
17-24	☐	☐	☐	☐	☐	☐	☐	☐
25-34	☐	☐	☐	☐	☐	☐	☐	☐
35-44	☐	☐	☐	☐	☐	☐	☐	☐
45-64	☐	☐	☐	☐	☐	☐	☐	☐
65+	☐	☐	☐	☐	☐	☐	☐	☐
c) What is the work status of each person? **SHOW CARD G**								
Full Time (30 hours or more)	☐	☐	☐	☐	☐	☐	☐	☐
Part Time (up to 30 hours)	☐	☐	☐	☐	☐	☐	☐	☐
Unemployed	☐	☐	☐	☐	☐	☐	☐	☐
Retired	☐	☐	☐	☐	☐	☐	☐	☐
Pre-school	☐	☐	☐	☐	☐	☐	☐	☐
Full time education	☐	☐	☐	☐	☐	☐	☐	☐
Housewife/ House-husband	☐	☐	☐	☐	☐	☐	☐	☐
d) What are the qualifications of each person? **SHOW CARD H**								
A	☐	☐	☐	☐	☐	☐	☐	☐
B	☐	☐	☐	☐	☐	☐	☐	☐
C	☐	☐	☐	☐	☐	☐	☐	☐
D	☐	☐	☐	☐	☐	☐	☐	☐
E	☐	☐	☐	☐	☐	☐	☐	☐
F	☐	☐	☐	☐	☐	☐	☐	☐
G	☐	☐	☐	☐	☐	☐	☐	☐

e) What benefits are received by each person a) currently & b) been getting for more than 12 months?
SHOW CARD I

	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months
A	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
E	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
F	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
G	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Q.16. Approximately what is the weekly/monthly or annual income of the household before tax? (*Interviewer: tick weekly/monthly or annually – which ever is easiest for respondent)*

SHOW CARD I

(PLEASE TICK ONE ANSWER ONLY)

Weekly		Monthly		Annual	
A	☐	G	☐	M	☐
B	☐	H	☐	N	☐
C	☐	I	☐	O	☐
D	☐	J	☐	P	☐
E	☐	K	☐	Q	☐
F	☐	L	☐	R	☐

APPENDIX III

Wave one self-completed additional questions

ABOUT YOUR HOUSEHOLD'S FOOD SHOPPING

Q.1. When you go food shopping, which of these affects the choice of foods you buy?
(TICK EACH THAT AFFECTS YOUR CHOICE)

	Yes, affects my choice
The costs of food/my food budget	☐
Not eating certain foods because advised not to by health professionals	☐
What my spouse/partner will eat	☐
What my child/children will eat	☐
Trying to eat a healthy balanced diet	☐
The kinds of food I like eating	☐
Convenience	☐
Whether my spouse/partner is with me	☐
Whether my child/children are with me	☐
Packaging/display	☐
Food advertising	☐
Programmes/news items about food in the media (TV/magazines, etc)	☐
The kinds of food my friends buy	☐
The kinds of food my relatives buy	☐
Whether I'm hungry or not	☐
Personal beliefs (e.g. religious/cultural/vegetarianism)	☐

Q.2. Other than cost, what limits the choice of food you buy?
(TICK EACH THAT LIMITS YOUR CHOICE)

	Yes, limits my choice
What is available in the store that I can get to	☐
Not much space to store food at home	☐
Small or no fridge	☐
Limited cooking facilities	☐
Don't know how to cook some foods	☐
Ability to carry and transport foods home	☐
Food goes off before it's eaten	☐
Difficult to get to shops with children	☐
Difficult to get to shops because of age or disability	☐

NOW, SOME QUESTIONS ABOUT YOURSELF

Q.3. Approximately how tall are you?

Please write in:- Ft ☐ . ins ☐☐ or Metres ☐ . ☐☐

Q.4. Approximately how much do you weigh?

Please write in:- Stones . lbs or Kgs

☐☐ . ☐☐ ☐☐☐

Q.5. Do you smoke?

(PLEASE TICK ONE BOX ONLY)

No, never smoked	☐
No, but I used to	☐
Yes, but less than one cigarette a day	☐
Yes, current smoker 1-12 cigarettes per day	☐
Yes, current smoker 13-25 cigarettes per day	☐
Yes, current smoker more than 25 cigarettes per day	☐

Q.6. Approximately how much alcohol do you drink in a normal week?

(PLEASE TICK ONE BOX FOR EACH TYPE OF DRINK)

	None	1-2 units	3-5 units	6-10 units	11-15 units	16-20 units	Over 20 units
Beer/ Lager (1 unit = 1/2 pint)	☐	☐	☐	☐	☐	☐	☐
Wine (1 unit = I glass)	☐	☐	☐	☐	☐	☐	☐
Mixed drinks (1 unit = 1 glass)	☐	☐	☐	☐	☐	☐	☐
Other alcohol/spirits (1 unit = 1measure)	☐	☐	☐	☐	☐	☐	☐

Q.7. Approximately how many hours do you spend doing each of these activities:

a) on a typical weekday

b) on a typical weekend day

(WRITE IN THE NUMBER OF HOURS FOR EACH ACTIVITY)

	Typical Weekday	**Typical Weekend Day**
Doing sports or other exercise (e.g. aerobics, gym, football, swimming etc.)		
Walking Outdoors (e.g. to work, at the shops, for exercise etc.)		
Doing gardening		
Doing housework		
Standing, but not moving around much (e.g. cooking, working machinery etc.)		
Sitting down (whether at work, or at home, or in the car/bus/train, or wherever)		
Lying down but not sleeping (e.g. in front of the telly, reading in bed etc.)		
Sleeping		

APPENDIX IV

Wave two interviewer administered questionnaire

Food and Drink Survey (Leeds)

ALL NUMBERS MUST BE CORRECTLY AND CLEARLY FILLED IN.

COPY FROM CONTACT LIST ↓

JOB NUMBER						INTERVIEWER NO.					RESPONDENT ASSIGNMENT NO.							SAMPLE NO.							UNIQUE ID NO.			
3	8	8	3	0	4																							

THE RESPONDENT MUST BE THE INDIVIDUAL NAMED ON THE CONTACT LIST.

Time at which interview started: ☐☐:☐☐

Time at which interview ended: ☐☐:☐☐

Today's date: ☐☐:☐☐

SURNAME: MR/MRS/MISS ____________________

ADDRESS: ____________________

POSTCODE: __________ PHONE NO: __________

SEX

☐ Male
☐ Female

AGE

☐ 17-24
☐ 25-34
☐ 35-44
☐ 45-64
☐ 65+

HOUSEHOLD SIZE

☐ One
☐ Two
☐ Three
☐ Four
☐ Five (and over)

CHILDREN IN HOUSEHOLD (Aged 0-15)

☐ Yes
☐ No

CONFIRMATION DIARY PLACED ☐

DAY OF WEEK DIARY STARTED

☐ Monday
☐ Tuesday
☐ Wednesday
☐ Thursday
☐ Friday
☐ Saturday
☐ Sunday

DATE DIARY WILL BE STARTED

DAY: ☐☐

MONTH: ☐☐

Time and date arranged for diary collection: Time ☐☐:☐☐ Date ☐☐:☐☐

I certify that this interview has been personally carried out by me with the informant in home and conducted within the Market Research Society Code of Conduct. I further certify that the informant is not a friend or relative of mine, and I have not interviewed him/her on any survey in the last six months.

Signed : ____________________ Date: ____________________

Q.1. At which shop do you do your main food shopping, and where is it situated?
SHOW CARD A.

STORE	(TICK ONE BOX ONLY)	LOCATION
Asda	☐	Killingbeck Retail Park
Co-op	☐	South Parkway Village Store
Co-op Superstore	☐	Halton
Jack Fulton	☐	Seacroft
Jack Fulton	☐	Cross Gates Centre
Iceland	☐	Any Store
Kwik-Save	☐	Cross Gates Centre
Kwik-Save	☐	Harehills Corner
Lidl	☐	Oaktree Drive, Gipton
Morrisons	☐	Merrion Centre
Netto	☐	York Road (Near the Ring-road)
Netto	☐	Halton
Safeway	☐	Oakwood
Sainsburys	☐	Whitkirk
Tesco	☐	Cross Gates Centre
Tesco	☐	Roundhay Road, Oakwood
Tesco (Extra)	☐	Seacroft Green
Other than any of these	☐	*(Please write in store name below)* ______________

Q.2. Where do you mainly buy your fruit and vegetables? **SHOW CARD B.**

STORE	(TICK ONE BOX ONLY)	LOCATION
Asda	☐	Killingbeck Retail Park
Co-op	☐	South Parkway Village Store
Co-op Superstore	☐	Halton
Jack Fulton	☐	Seacroft
Jack Fulton	☐	Cross Gates Centre
Iceland	☐	Any Store
Kwik-Save	☐	Cross Gates Centre
Kwik-Save	☐	Harehills Corner
Lidl	☐	Oaktree Drive, Gipton
Morrisons	☐	Merrion Centre
Netto	☐	York Road (Near the Ring-road)
Netto	☐	Halton
Safeway	☐	Oakwood
Sainsburys	☐	Whitkirk
Tesco	☐	Cross Gates Centre
Tesco	☐	Roundhay Road, Oakwood
Tesco (Extra)	☐	Seacroft Green
	☐	Leeds Market
	☐	City Centre Shops
	☐	Local Shops at Skeltonwoods or Red Hall Parade, Whinmoor
	☐	Local Shops at Staging Post, Stanks Parade, or Swarcliffe Parade, Swarcliffe
	☐	Local Shops at Cross Gates
	☐	Local Shops by Tesco Seacroft (NOT Jack Fulton)
	☐	Other Corner Shop
	☐	Petrol Station Shop
	☐	Other than any of these (*Write in* ______________________)
	☐	I do not buy any fruit and vegetables

Q.3. How often have you bought fruit and vegetables in the last week?

☐☐ Write actual number *Interviewer: if 'none' write* 0 0

Please use leading zeros (e.g. 0 8 0 2 *etc).*

THINKING ABOUT YOUR MAIN FOOD SHOP AT ....
(Interviewer: name of main food store and location from question 1)

Q.4a. A)Thinking about the household's main/weekly food shopping, how do you usually get to.............. (*Interviewer: name of main store and location from question 1)*? B) And how do you usually get back from.......... *(Interviewer: name of main store from question 1)?*

SHOW CARD C

(TICK ONE BOX 'TO' AND ONE BOX 'BACK')

	To	Back
Household's Own Car	☐ → 4b	☐ → 4b
Lift in Someone Else's Car	☐	☐
Taxi	☐	☐
Normal Paying Bus	☐	☐
Stores Free Bus Service	☐	☐
Train	☐	☐
Walk	☐	☐

ONLY ASK 4b OF THOSE WHO HAVE ANSWERED "HOUSEHOLD'S OWN CAR".

Q.4b. Who normally drives the car?

You	☐
Somebody else	☐

Q.5. Thinking about (Interviewer: *name of main store and location from question 1),* do you think it's better, the same or worse compared with other food stores around here that you can easily get to, as regards the following? **READ OUT.**

(TICK ONE BOX FOR EACH STATEMENT)

	Better	The same	Worse	Don't Know
Availability of fresh fruit and vegetables	☐	☐	☐	☐
The range of fresh fruit and vegetables	☐	☐	☐	☐
The quality of fresh fruit and vegetables	☐	☐	☐	☐
Ease of getting to	☐	☐	☐	☐
Value for money	☐	☐	☐	☐
Information about healthy eating	☐	☐	☐	☐
Friendliness of Staff	☐	☐	☐	☐

NOW THINKING ABOUT OTHER PLACES YOU SHOP AT

Q.6. Where else other than *(Interviewer: name of main store and location from question 1)* do you shop for food at? **SHOW CARD B AGAIN.**

STORE	(TICK ALL THAT APPLY)	LOCATION
Asda	☐	Killingbeck Retail Park
Co-op	☐	South Parkway Village Store
Co-op Superstore	☐	Halton
Jack Fulton	☐	Seacroft
Jack Fulton	☐	Cross Gates Centre
Iceland	☐	Any Store
Kwik-Save	☐	Cross Gates Centre
Kwik-Save	☐	Harehills Corner
Lidl	☐	Oaktree Drive, Gipton
Morrisons	☐	Merrion Centre
Netto	☐	York Road (Near the Ring-road)
Netto	☐	Halton
Safeway	☐	Oakwood
Sainsburys	☐	Whitkirk
Tesco	☐	Cross Gates Centre
Tesco	☐	Roundhay Road, Oakwood
Tesco (Extra)	☐	Seacroft Green
	☐	Leeds Market
	☐	City Centre Shops
	☐	Local Shops at Skeltonwoods or Red Hall Parade, Whinmoor
	☐	Local Shops at Staging Post, Stanks Parade, or Swarcliffe Parade, Swarcliffe
	☐	Local shops at Cross Gates
	☐	Local shops by Tesco Seacroft (NOT Jack Fulton)
	☐	Other Corner Shop
	☐	Petrol Station Shop
	☐	Other than any of these (*Write in* ____________________)
	☐	Do not buy food anywhere else

Q.7. A) Thinking about these other places you shop at, how do you normally get to...... *(Interviewer: name of the answers from question 6)*?
B) And back from them?

SHOW CARD C

	TICK ONE BOX 'TO' AND ONE BOX 'BACK'	
	To	**Back**
Household's Own Car	☐	☐
Lift in Someone Else's Car	☐	☐
Taxi	☐	☐
Normal Paying Bus	☐	☐
Stores Free Bus Service	☐	☐
Train	☐	☐
Walk	☐	☐

Q.8. a) Do you work at Tesco (Extra), Seacroft Green or any other food store, (excluding restaurants/take aways/cafes)?
b) What about anyone else in the household?

	You	Other member of household
Tesco (Extra), Seacroft Green	☐	☐
Any other food store	☐	☐

NOW THINKING ABOUT THE NEW TESCO (EXTRA) AT SEACROFT GREEN

Q.9. Have you ever shopped at the new Tesco (Extra) in Seacroft Green? **READ OUT OPTIONS**

TICK ONE BOX ONLY

Yes, it's now my main food shop *(Interviewer: cross check to Q.1)*	☐	**GO TO Q10 THEN Q12**
Yes, regularly but it's not my main food shop *(Interviewer: approximately once or twice a month)*	☐	
Occasionally	☐	**GO TO Q11**
No, never	☐	

Job No. 388304

Q.10. Why do you shop at Tesco (Extra), Seacroft Green?

SHOW CARD D

TICK AS MANY AS APPLY

Lower price/cost	☐
Easy to get to	☐
Layout of store	☐
Friendly staff	☐
Near to home	☐
Special offers	☐
Quality of food	☐
Range of food	☐
Loyalty points	☐
Person who takes me/shops for me shops at this store	☐
Right size of store	☐
Late opening hours	☐
On my bus route	☐
Free bus to store	☐
Good range of fruit and vegetables	☐
Convenience – all under one roof	☐
Other reasons	☐

Q.11. Why do you not shop regularly at the new Tesco (Extra) in Seacroft Green?

SHOW CARD E

TICK AS MANY AS APPLY

Expensive	☐
Not easy to get to	☐
Don't like layout of store	☐
Too much temptation to spend money	☐
Person who takes me/shops for me does not shop at this store	☐
Not near to home	☐
Not enough special offers	☐
Poor quality of food	☐
Poor range of food	☐
Too big a store	☐
Not on my bus route	☐
Happy with existing routine	☐
Unfriendly staff	☐
Poor range of healthy foods	☐
Not near to lots of other shops	☐
Other reasons	☐

ABOUT YOU

Q.12. Do you or any other member of your household have use of a car/van on a regular basis?

Yes ☐
No ☐

Q.13. Do you have a current driving licence?

Yes ☐
No ☐

Q.14. Do you have any long-term health problems which affect your ability to shop for yourself? **(READ OUT OPTIONS.)**

(TICK ONE ANSWER ONLY)
No ☐
Yes, affect a great deal ☐
Yes, affect somewhat ☐

Q.15. How strongly do you agree or disagree with each of the following statements?
READ OUT EACH STATEMENT IN TURN **(TICK ONE BOX FOR EACH STATEMENT)**

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	Don't Know
Healthy eating is just another fashion	☐	☐	☐	☐	☐	☐
I mostly eat a healthy diet nowadays	☐	☐	☐	☐	☐	☐
I don't really care what I eat	☐	☐	☐	☐	☐	☐
Eating healthy food is expensive	☐	☐	☐	☐	☐	☐

Q.16. Do you smoke? **(READ OUT OPTIONS.)**

No, never smoked ☐
No, but I used to ☐
Yes, but less than one cigarette a day ☐
Yes, current smoker ☐ → How many cigarettes per day?

☐☐ cigarettes per day … *write actual number using leading zeros e.g* 0 8

Q.17. Do you live with other adults? *(by an adult we mean 16 years of age and over)*
READ OUT OPTIONS

(PLEASE TICK ONE BOX ONLY)
No ☐
I live with my husband/partner ☐
I live with other adults but not my husband/partner ☐
I live with other adults and my husband/partner ☐

Q.18. *Interviewer: for each person in the household please fill in the following details:*
(COMPLETE FOR EACH MEMBER OF THE HOUSEHOLD)

	You/ Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
First name (write in.....)								

a) What sex is each person?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
Male	☐	☐	☐	☐	☐	☐	☐	☐
Female	☐	☐	☐	☐	☐	☐	☐	☐

b) Age in years
use leading zeros if less than 10 e.g. 0 6

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
Age	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐

c) What is the work status of each person?
SHOW CARD F

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
Full Time (30 hours or more)	☐	☐	☐	☐	☐	☐	☐	☐
Part Time (up to 30 hours)	☐	☐	☐	☐	☐	☐	☐	☐
Unemployed	☐	☐	☐	☐	☐	☐	☐	☐
Retired	☐	☐	☐	☐	☐	☐	☐	☐
Pre-school	☐	☐	☐	☐	☐	☐	☐	☐
Full time education	☐	☐	☐	☐	☐	☐	☐	☐
Housewife/ House-husband	☐	☐	☐	☐	☐	☐	☐	☐

d) At what age did each person leave full time education?
SHOW CARD G

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8
Continuing their education	☐	☐	☐	☐	☐	☐	☐	☐
16 years or less	☐	☐	☐	☐	☐	☐	☐	☐
17 to 18 years	☐	☐	☐	☐	☐	☐	☐	☐
19 years and over	☐	☐	☐	☐	☐	☐	☐	☐

e) What benefits are received by each person a) currently & b) been getting for more than 12 months?
SHOW CARD H

	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months	Currently	More than 12 months
Retirement Pension	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Council Tax Benefit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Housing Benefit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Incapacity or Disablement Benefit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Family Credit or Income Support	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Free School Dinners	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other state allowance/benefit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Q.19. Approximately what is the weekly/monthly or annual income of the household before tax? (*Interviewer: Tick weekly/monthly or annually – which ever is easiest for respondent*). **ASK RESPONDENT TO SAY LETTER MATCHING AMOUNT.**

SHOW CARD I **(PLEASE TICK ONE ANSWER ONLY)**

Weekly		Monthly		Annual	
A	☐	A	☐	A	☐
B	☐	B	☐	B	☐
C	☐	C	☐	C	☐
D	☐	D	☐	D	☐
E	☐	E	☐	E	☐
F	☐	F	☐	F	☐

Q.3. Have any of the following caused you to change what foods you buy over the **last twelve months**?

(TICK AS MANY AS APPLY)

Illness	☐
Difficulty walking	☐
Acquired a household car/van	☐
Loss of household car/van	☐
Less money to spend	☐
More money to spend	☐
Got married/new (live in) partner	☐
Separated from husband/partner	☐
New baby	☐
Kid(s) moved out	☐
Other reasons	☐

ABOUT YOUR EATING PATTERNS

Q.4. Thinking about the a)fruit and b)vegetables that you eat, are they mostly tinned, frozen or fresh?

(TICK ONE ANSWER FOR EACH COLUMN)

	a)Fruit		b)Vegetables
Tinned	☐	Tinned	☐
Frozen	☐	Frozen	☐
Fresh	☐	Fresh	☐

Q.5. a) Do you have to watch what you eat because of any of the following?
b) What about anyone else in the household?

(TICK AS MANY AS APPLY)

	a) You	b) Other member of household
No	☐	☐
Yes because of.......		
Illness/allergy	☐	☐
Trying to lose weight	☐	☐
Pregnancy	☐	☐
Personal beliefs (e.g. religious/cultural/vegetarianism)	☐	☐
Other (write in)	☐	☐

Q.6. Compared to 12 months ago do you think you consume more, less or the same amount of each of the following? **Tick one box for each item listed.**

	More	Same amount	Less	Do not consume
White bread toast/rolls, etc.	☐	☐	☐	☐
Brown bread/toast/rolls etc	☐	☐	☐	☐
Full fat milk	☐	☐	☐	☐
Semi/skimmed milk	☐	☐	☐	☐
Fruit	☐	☐	☐	☐
Vegetables (except potatoes)	☐	☐	☐	☐
Cakes/biscuits	☐	☐	☐	☐
Meat (excluding chicken)	☐	☐	☐	☐
Chicken	☐	☐	☐	☐
Fish	☐	☐	☐	☐
Alcohol	☐	☐	☐	☐
Cigarettes	☐	☐	☐	☐

YOUR HEALTH

Q.7. Over the last twelve months would you say your health has on the whole been:......

Good? ☐

Fairly good? ☐

Not good? ☐

APPENDIX VI

Additional tables from chapter 6 – wave two (follow up) results

Table number	Table title
1	Stratified fruit and vegetable consumption by changes in physical access to fruit and vegetable
2	Stratified fruit and vegetable consumption by changes in physical access to fruit and vegetable
3	Stratified fruit and vegetable consumption by changes in availability of fruit and vegetable
4	Stratified fruit and vegetable consumption by changes in availability of fruit and vegetable
5	Stratified fruit and vegetable consumption by changes in affordability of fruits and vegetables
6	Stratified fruit and vegetable consumption by changes in affordability of fruits and vegetables
7	Stratified fruit and vegetable consumption by changes in attitude towards healthy eating
8	Stratified fruit and vegetable consumption by changes in attitude towards healthy eating
9	Fruit and vegetable consumption by changes in physical access, availability, affordability and attitudes
10	Stratified fruit and vegetable consumption by changes in factors affecting food choice
11	Stratified fruit and vegetable consumption by changes in factors affecting food choice
12	Stratified fruit and vegetable consumption by changes in factors limiting food choice
13	Stratified fruit and vegetable consumption by changes in factors limiting food choice
14	Fruit and vegetable consumption by changes in specific factors affecting food choice
15	Fruit and vegetable consumption by changes in specific factors limiting food choice
16	Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors affecting food choice
17	Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors affecting food choice
18	Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors limiting food choice
19	Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors limiting food choice

Table 1: Stratified fruit and vegetable consumption by changes in physical access to fruit and vegetable

	Tesco Seacroft fruit and vegetable shoppers			Non Tesco Seacroft fruit and vegetable shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.60±1.67 n=218	2.75±2.47 n=218	t=-1.207 p=0.229	3.04±2.14 n=397	3.02±2.05 n=397	t=0.234 p=0.815	t=-1.340 p=0.181	t=1.135 p=0.257
Age								
17-24 years	1.53±0.15 n=24	1.51±1.02 n=24	t=0.076 p=0.940	1.91±1.20 n=27	1.71±1.20 n=27	t=1.063 p=0.298	t=-0.634 p=0.529	t=0.606 p=0.547
25-34 years	2.10±1.41 n=46	2.21±1.25 n=46	t=-0.803 p=0.426	2.10±1.28 n=73	2.26±1.28 n=73	t=-1.241 p=0.219	t=-0.233 p=0.817	t=-0.328 p=0.744
35-44 years	2.36±1.37 n=53	2.34±1.34 n=53	t=0.185 p=0.854	2.46±1.46 n=92	2.58±1.48 n=92	t=-0.802 p=0.425	t=-0.996 p=0.321	t=-0.729 p=0.467
45-64 years	3.16±1.98 n=60	3.23±1.79 n=60	t=-0.450 p=0.654	3.69±2.27 n=105	3.54±2.28 n=105	t=0.755 p=0.452	t=-0.983 p=0.327	t=0.844 p=0.400
65 years plus	3.40±1.66 n=35	4.13±4.86 n=35	t=-1.105 p=0.277	3.87±2.64 n=100	3.76±2.41 n=100	t=0.493 p=0.623	t=0.428 p=0.671	t=1.202 p=0.236
Smoking status								
Never smokers	3.06±1.80 n=73	3.04±1.58 n=73	t=0.135 p=0.893	3.30±2.40 n=123	3.18±1.71 n=123	t=0.709 p=0.479	t=-0.568 p=0.571	t=0.394 p=0.694
Ex-smokers	2.82±1.88 n=47	3.32±4.14 n=47	t=-1.083 p=0.284	3.38±2.13 n=100	3.21±2.10 n=100	t=0.867 p=0.388	t=0.171 p=0.865	t=1.332 p=0.188
Light smokers	2.50±1.49 n=39	2.64±2.31 n=39	t=-0.494 p=0.624	2.97±2.26 n=63	3.04±2.44 n=63	t=-0.340 p=0.735	t=-0.829 p=0.410	t=0.196 p=0.845
Heavy smokers	1.89±1.15 n=59	2.01±1.26 n=59	t=-0.932 p=0.355	2.48±1.66 n=110	2.66±2.08 n=110	t=-1.355 p=0.178	***t=-2.504 p=0.013****	t=-0.324 p=0.746
Non-smokers	2.97±1.83 n=120	3.15±2.86 n=120	t=-0.866 p=0.388	3.33±2.28 n=223	3.19±1.89 n=223	t=1.112 p=0.268	t=-0.146 p=0.884	t=1.314 p=0.190
All smokers	2.14±1.32 n=98	2.26±1.77 n=98	t=-0.934 p=0.353	2.66±1.91 n=173	2.80±2.22 n=173	t=-1.227 p=0.222	***t=-2.171 p=0.031****	t=-0.063 p=0.950
Educational attainment								
At or below GCSE	2.52±1.70 n=144	2.69±2.75 n=144	t=-0.953 p=0.342	3.03±2.29 n=297	2.95±2.15 n=297	t=0.766 p=0.444	t=-0.988 p=0.324	t=1.206 p=0.229
Above GCSE	2.75±1.62 n=74	2.86±1.79 n=74	t=-0.894 p=0.374	3.05±1.63 n=100	3.20±1.72 n=100	t=-1.006 p=0.317	t=-1.246 p=0.215	t=-0.170 p=0.865

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 2: Stratified fruit and vegetable consumption by changes in physical access to fruit and vegetable

	Tesco Seacroft fruit and vegetable shoppers			Non Tesco Seacroft fruit and vegetable shoppers			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.60±1.67 n=218	2.75±2.47 n=218	t=-1.207 p=0.229	3.04±2.14 n=397	3.02±2.05 n=397	t=0.234 p=0.815	t=-1.340 p=0.181	t=1.135 p=0.257
Number of positive attitudes in wave one								
Zero	1.96±1.33 n=27	1.81±1.27 n=27	t=0.656 p=0.518	1.98±1.31 n=48	1.93±1.32 n=48	t=0.372 p=0.712	t=-0.375 p=0.709	t=-0.353 p=0.726
One	2.18±1.71 n=47	2.63±4.44 n=47	t=-0.910 p=0.368	2.89±2.46 n=62	2.90±2.05 n=62	t=-0.027 p=0.979	t=-0.378 p=0.707	t=0.797 p=0.428
Two	2.62±1.66 n=70	2.89±1.67 n=70	***t=-2.475 p=0.016****	3.00±2.27 n=137	2.96±2.00 n=137	t=0.237 p=0.813	t=-0.265 p=0.791	t=1.616 p=0.108
Three	3.07±1.66 n=74	3.04±1.41 n=74	t=0.178 p=0.859	3.46±1.99 n=150	3.46±2.15 n=150	t=0.035 p=0.972	t=-1.751 p=0.081	t=-0.119 p=0.905
Household deprivation marker score								
Zero– lowest	3.12±1.72 n=61	3.07±1.52 n=61	t=0.327 p=0.745	3.23±2.01 n=98	3.27±1.51 n=98	t=-0.193 p=0.847	t=-0.786 p=0.433	t=-0.351 p=0.726
One	2.83±1.74 n=56	2.81±1.44 n=56	t=0.080 p=0.937	3.18±2.16 n=129	3.02±1.74 n=129	t=0.959 p=0.339	t=-0.866 p=0.388	t=0.498 p=0.620
Two	2.30±1.60 n=67	2.93±3.79 n=67	t=-1.785 p=0.079	3.02±2.23 n=114	3.04±2.38 n=114	t=-0.108 p=0.914	t=-0.218 p=0.828	t=1.594 p=0.114
Three	1.76±1.13 n=29	1.52±1.36 n=29	t=1.671 p=0.106	2.48±2.23 n=46	2.72±2.88 n=46	t=-1.009 p=0.319	***t=-2.430 p=0.018****	t=-1.726 p=0.089
Four - highest	2.43±1.73 n=3	2.48±1.19 n=3	t=-0.066 p=0.953	1.95±1.39 n=6	1.38±1.26 n=6	t=1.852 p=0.123	t=1.276 p=0.266	t=0.790 p=0.492
Number of children in household under the age of 16 years								
Zero	2.93±1.82 n=125	3.16±2.99 n=125	t=-1.068 p=0.287	3.43±2.30 n=251	3.31±2.07 n=251	t=0.990 p=0.323	t=-0.516 p=0.606	t=1.416 p=0.158
One to two	2.17±1.37 n=79	2.26±1.36 n=79	t=-0.824 p=0.413	2.47±1.77 n=115	2.59±2.03 n=115	t=-0.971 p=0.334	t=-1.359 p=0.176	t=-0.194 p=0.846
Three plus	1.99±1.07 n=14	1.87±1.00 n=14	t=0.605 p=0.556	1.91±0.96 n=31	2.15±1.38 n=31	t=-1.436 p=0.161	t=-0.783 p=0.439	t=-1.387 p=0.175

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 3: Stratified fruit and vegetable consumption by changes in availability of fruit and vegetable

	Increase in availability of fruits and vegetables			No increase in availability of fruits and vegetables			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.64±1.57 n=136	2.70±1.46 n=136	t=-0.583 p=0.571	2.71±1.83 n=283	2.77±2.43 n=283	t=-0.485 p=0.628	t=-0.376 p=0.707	t=-0.592 p=0.555
Age								
17-24 years	1.71±1.17 n=15	1.50±1.07 n=15	t=0.887 p=0.390	1.58±0.75 n=24	1.42±0.84 n=24	t=0.771 p=0.449	t=0.241 p=0.812	t=-0.450 p=0.655
25-34 years	1.98±0.94 n=36	2.26±1.17 n=36	t=-1.920 p=0.063	2.17±1.57 n=55	2.09±1.23 n=55	t=0.554 p=0.582	t=0.643 p=0.522	t=0.493 p=0.623
35-44 years	2.54±1.20 n=37	2.60±1.52 n=37	t=-0.320 p=0.751	2.24±1.09 n=64	2.26±1.21 n=64	t=-0.147 p=0.883	t=1.175 p=0.244	t=0.332 p=0.740
45-64 years	3.72±2.25 n=28	3.63±1.47 n=28	t=0.232 p=0.818	3.24±2.10 n=82	3.12±1.71 n=82	t=0.598 p=0.552	t=1.528 p=0.132	t=-0.850 p=0.398
65 years plus	3.16±1.16 n=20	3.24±1.09 n=20	t=-0.452 p=0.656	3.47±2.09 n=58	4.03±4.29 n=58	t=-1.286 p=0.204	t=-1.281 p=0.204	t=-1.095 p=0.280
Smoking status								
Never smokers	3.26±1.89 n=48	3.25±1.51 n=48	t=0.067 p=0.947	2.94±1.86 n=94	2.97±1.77 n=94	t=-0.299 p=0.766	t=0.960 p=0.339	t=-1.367 p=0.176
Ex-smokers	2.51±1.42 n=31	2.84±1.47 n=31	t=-1.640 p=0.112	3.15±2.21 n=68	3.22±3.78 n=68	t=-0.174 p=0.862	t=-0.722 p=0.472	t=0.192 p=0.848
Light smokers	2.02±0.99 n=13	1.64±1.07 n=13	t=1.457 p=0.171	2.61±1.67 n=46	2.71±2.22 n=46	t=-0.363 p=0.718	t=-2.431 p=0.019*	t=-0.957 p=0.342
Heavy smokers	2.22±1.17 n=44	2.31±1.24 n=44	t=-0.576 p=0.568	2.08±1.27 n=75	2.13±1.39 n=75	t=-0.312 p=0.756	t=0.713 p=0.478	t=0.103 p=0.918
Non-smokers	2.97±1.75 n=79	3.09±1.50 n=79	t=-0.765 p=0.446	3.03±2.01 n=162	3.08±2.79 n=162	t=-0.280 p=0.780	t=0.033 p=0.973	t=-1.002 p=0.318
All smokers	2.18±1.13 n=57	2.15±1.23 n=57	t=0.174 p=0.863	2.29±1.45 n=121	2.35±1.77 n=121	t=-0.481 p=0.632	t=-0.870 p=0.386	t=-0.500 p=0.617
Educational attainment								
At or below GCSE	2.64±1.75 n=92	2.58±1.45 n=92	t=0.394 p=0.694	2.67±1.89 n=208	2.78±2.65 n=208	t=-0.705 p=0.481	t=-0.828 p=0.408	t=-1.065 p=0.288
Above GCSE	2.63±1.09 n=44	2.93±1.47 n=44	t=-1.804 p=0.078	2.81±1.67 n=75	2.73±1.68 n=75	t=0.600 p=0.550	t=0.676 p=0.501	t=-0.391 p=0.696

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 4: Stratified fruit and vegetable consumption by changes in availability of fruit and vegetable

	Increase in availability of fruits and vegetables			No increase in availability of fruits and vegetables			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.64±1.57 n=136	2.70±1.46 n=136	t=-0.583 p=0.571	2.71±1.83 n=283	2.77±2.43 n=283	t=-0.485 p=0.628	t=-0.376 p=0.707	t=-0.592 p=0.555
Number of positive attitudes in wave one								
Zero	1.92±1.16 n=15	1.87±1.09 n=15	t=0.163 p=0.873	1.78±1.13 n=39	1.72±1.11 n=39	t=0.444 p=0.660	t=0.435 p=0.667	t=-0.046 p=0.964
One	2.14±1.09 n=25	2.14±0.97 n=25	t=-0.036 p=0.972	2.50±2.38 n=53	2.85±4.28 n=53	t=-0.693 p=0.491	t=-1.151 p=0.254	t=-1.104 p=0.272
Two	2.69±1.29 n=48	2.90±1.48 n=48	t=-1.462 p=0.150	2.60±1.56 n=90	2.60±1.56 n=90	t=0.027 p=0.978	t=1.119 p=0.266	t=0.026 p=0.979
Three	3.07±1.97 n=48	3.04±1.60 n=48	t=0.133 p=0.895	3.28±1.77 n=101	3.27±1.94 n=101	t=0.019 p=0.985	t=-0.793 p=0.430	t=-1.093 p=0.275
Household deprivation marker score								
Zero– lowest	3.04±1.46 n=36	3.23±1.32 n=36	t=-1.084 p=0.286	3.11±2.04 n=79	3.06±1.51 n=79	t=0.245 p=0.807	t=0.616 p=0.540	t=0.908 p=0.365
One	2.94±1.98 n=34	2.95±1.58 n=34	t=-0.028 p=0.978	2.77±1.41 n=86	2.71±1.37 n=86	t=0.467 p=0.642	t=0.773 p=0.443	t=-0.550 p=0.585
Two	2.32±1.35 n=41	2.37±1.25 n=41	t=-0.300 p=0.765	2.80±2.13 n=79	3.13±3.88 n=79	t=-0.998 p=0.321	t=-1.586 p=0.116	t=-1.635 p=0.104
Three	2.13±1.24 n=22	2.00±1.44 n=22	t=0.689 p=0.498	1.55±0.85 n=30	1.50±1.52 n=30	t=0.290 p=0.774	t=1.218 p=0.229	t=-0.638 p=0.526
Four - highest	1.43 n=1	1.71 n=1	-	1.88±1.40 n=6	1.67±1.34 n=6	t=0.529 p=0.620	-	t=-0.717 p=0.506
Number of children in household under the age of 16 years								
Zero	3.15±1.76 n=67	3.09±1.47 n=67	t=0.347 p=0.729	3.05±2.04 n=168	3.16±2.90 n=168	t=-0.577 p=0.565	t=-0.229 p=0.819	t=-1.667 p=0.097
One to two	2.14±1.24 n=58	2.33±1.43 n=58	t=-1.456 p=0.151	2.27±1.39 n=95	2.24±1.32 n=95	t=0.194 p=0.846	t=0.362 p=0.718	t=1.054 p=0.294
Three plus	2.09±0.65 n=11	2.22±0.86 n=11	t=-0.498 p=0.629	1.96±1.02 n=20	1.98±1.31 n=20	t=-0.078 p=0.939	t=0.620 p=0.540	t=-0.610 p=0.546

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 5: Stratified fruit and vegetable consumption by changes in affordability of fruits and vegetables

	Increase in affordability in wave two			No increase in affordability in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.65±1.95 n=174	2.74±1.95 n=174	t=-0.527 p=0.599	2.97±2.02 n=441	3.00±1.89 n=441	t=-0.340 p=0.734	t=-1.706 p=0.098	t=-1.680 p=0.101
Age								
17-24 years	1.70±1.08 n=18	1.37±1.05 n=18	t=1.439 p=0.168	1.75±1.01 n=33	1.75±1.14 n=33	t=-0.023 p=0.982	t=-1.222 p=0.229	t=-1.125 p=0.267
25-34 years	1.91±1.20 n=39	1.98±1.20 n=39	t=-0.388 p=0.700	2.19±1.38 n=80	2.37±1.29 n=80	t=-1.581 p=0.118	t=-1.618 p=0.110	t=-0.493 p=0.624
35-44 years	2.47±1.64 n=42	2.26±1.40 n=42	t=1.247 p=0.220	2.40±1.33 n=103	2.59±1.45 n=103	t=-1.344 p=0.182	t=-1.252 p=0.214	t=-1.815 p=0.073
45-64 years	3.44±2.27 n=45	3.57±2.87 n=45	t=-0.487 p=0.628	3.50±2.16 n=120	3.38±1.76 n=120	t=0.748 p=0.456	t=0.427 p=0.671	t=0.819 p=0.415
65 years plus	3.27±2.38 n=30	3.95±5.09 n=30	t=-0.937 p=0.357	3.88±2.43 n=105	3.83±2.45 n=105	t=0.233 p=0.816	t=0.125 p=0.901	t=0.964 p=0.342
Smoking status								
Never smokers	2.83±2.23 n=46	2.88±1.87 n=46	t=-0.260 p=0.796	3.33±2.18 n=150	3.20±1.59 n=150	t=0.842 p=0.401	t=-1.051 p=0.297	t=0.706 p=0.482
Ex-smokers	3.82±1.92 n=45	3.05±4.23 n=45	t=-0.471 p=0.640	3.37±2.11 n=102	3.33±2.09 n=102	t=0.195 p=0.846	t=-0.421 p=0.675	t=0.509 p=0.613
Light smokers	2.60±1.59 n=31	2.23±1.60 n=31	t=1.874 p=0.071	2.87±2.17 n=71	3.18±2.61 n=71	t=-1.350 p=0.181	***t=-2.241 p=0.028****	***t=-2.251 p=0.027****
Heavy smokers	2.38±1.92 n=52	2.63±2.72 n=52	t=-1.231 p=0.224	2.23±1.31 n=117	2.34±1.32 n=117	t=-1.098 p=0.274	t=0.730 p=0.468	t=0.572 p=0.569
Non-smokers	2.82±2.07 n=91	2.97±3.24 n=91	t=-0.538 p=0.592	3.34±2.15 n=252	3.26±1.81 n=252	t=0.775 p=0.439	t=-0.805 p=0.423	t=0.800 p=0.425
All smokers	2.47±1.79 n=83	2.48±2.36 n=83	t=-0.104 p=0.918	2.47±1.71 n=188	2.66±1.95 n=188	t=-1.742 p=0.083	t=-0.599 p=0.550	t=-0.939 p=0.349
Educational attainment								
At/below GCSE	2.61±2.14 n=127	2.66±3.19 n=127	t=-0.284 p=0.777	2.97±2.12 n=314	2.95±1.93 n=314	t=0.168 p=0.867	t=-0.952 p=0.343	t=0.329 p=0.742
Above GCSE	2.78±1.31 n=47	2.93±1.64 n=47	t=-0.783 p=0.438	2.97±1.74 n=127	3.10±1.80 n=127	t=-1.086 p=0.280	t=-0.597 p=0.552	t=0.056 p=0.955

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 6: Stratified fruit and vegetable consumption by changes in affordability of fruits and vegetables

	Increase in affordability in wave two			No increase in affordability in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.65±1.95 n=174	2.74±1.95 n=174	t=-0.527 p=0.599	2.97±2.02 n=441	3.00±1.89 n=441	t=-0.340 p=0.734	t=-1.706 p=0.098	t=-1.680 p=0.101
Number of positive attitudes in wave one								
Zero	1.88±1.02 n=28	1.73±1.09 n=28	t=0.945 p=0.353	2.03±1.46 n=47	1.97±1.41 n=47	t=0.315 p=0.754	t=-0.820 p=0.415	t=-0.383 p=0.703
One	2.10±1.64 n=30	2.98±5.17 n=30	t=-1.228 p=0.229	2.76±2.35 n=79	2.71±2.23 n=79	t=0.241 p=0.810	t=0.274 p=0.786	t=1.242 p=0.222
Two	2.70±1.97 n=62	2.72±2.46 n=62	t=-0.127 p=0.900	2.94±2.14 n=145	3.03±1.59 n=145	t=-0.628 p=0.531	t=-0.912 p=0.364	t=-0.282 p=0.779
Three	3.31±2.22 n=54	3.13±1.92 n=54	t=0.821 p=0.415	3.34±1.78 n=170	3.38±1.96 n=170	t=-0.299 p=0.765	t=-0.704 p=0.482	t=0.435 p=0.664
Household deprivation marker score								
Zero– lowest	2.75±1.07 n=20	2.62±1.04 n=20	t=0.651 p=0.523	3.25±1.99 n=139	3.27±1.55 n=139	t=-0.171 p=0.864	***t=-2.442 p=0.020****	t=-0.632 p=0.531
One	2.79±1.55 n=48	2.61±1.50 n=48	t=0.846 p=0.402	3.17±2.19 n=137	3.08±1.69 n=137	t=0.567 p=0.572	t=-1.818 p=0.072	t=-0.319 p=0.751
Two	2.63±2.24 n=58	3.13±3.94 n=58	t=-1.284 p=0.204	2.82±1.95 n=123	2.93±2.40 n=123	t=-0.785 p=0.434	t=0.374 p=0.730	t=0.912 p=0.365
Three	2.59±2.38 n=39	2.63±3.10 n=39	t=-0.154 p=0.878	1.77±1.09 n=36	1.85±1.44 n=36	t=-0.405 p=0.688	t=1.421 p=0.161	t=-0.099 p=0.922
Four - highest	2.20±1.49 n=8	1.61±1.30 n=8	***t=2.497 p=0.041****	1.43 n=1	2.86 n=1	-	-	-
Number of children in household under the age of 16 years								
Zero	3.02±1.96 n=101	3.18±3.16 n=101	t=-0.664 p=0.508	3.36±2.23 n=275	3.30±2.08 n=275	t=0.550 p=0.583	t=-0.346 p=0.730	t=0.836 p=0.404
One to two	2.24±1.94 n=59	2.24±2.45 n=59	t=0.013 p=0.990	2.39±1.46 n=135	2.55±1.42 n=135	t=-1.637 p=0.104	t=-0.922 p=0.360	t=-0.780 p=0.437
Three plus	1.78±1.14 n=14	1.63±1.04 n=14	t=0.931 p=0.369	2.00±0.92 n=31	2.26±1.33 n=31	t=-1.414 p=0.168	t=-1.706 p=0.098	t=-1.680 p=0.101

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 7: Stratified fruit and vegetable consumption by changes in attitude towards healthy eating

	Improved positive attitude towards healthy eating			No improved positive attitude towards healthy eating			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	3.15±2.17 n=359	3.09±2.37 n=359	t=0.504 p=0.615	2.51±1.67 n=256	2.68±1.94 n=256	t=-1.925 p=0.055	***t=2.352 p=0.019****	t=-0.207 p=0.838
Age								
17-24 years	1.82±0.97 n=31	1.49±0.87 n=31	t=1.999 p=0.055	1.60±1.12 n=20	1.81±1.42 n=20	t=-0.794 p=0.437	t=-0.923 p=0.364	t=-1.715 p=0.096
25-34 years	2.20±1.31 n=73	2.31±1.15 n=73	t=-1.000 p=0.321	1.95±1.35 n=46	2.12±1.44 n=46	t=-1.100 p=0.277	t=0.744 p=0.459	t=-0.311 p=0.757
35-44 years	2.75±1.44 n=79	2.75±1.52 n=79	t=0.036 p=0.971	2.03±1.30 n=66	2.19±1.27 n=66	t=-1.004 p=0.319	***t=2.422 p=0.017****	t=-0.754 p=0.452
45-64 years	3.74±2.41 n=100	3.63±2.31 n=100	t=0.530 p=0.598	3.09±1.71 n=65	3.12±1.75 n=65	t=-0.130 p=0.897	t=1.630 p=0.105	t=-0.494 p=0.622
65 years plus	4.22±2.68 n=76	4.14±3.53 n=76	t=0.208 p=0.835	3.14±1.92 n=59	3.49±2.72 n=59	t=-1.343 p=0.185	t=1.214 p=0.227	t=-0.963 p=0.337
Smoking status								
Never smokers	3.50±2.22 n=126	3.29±1.61 n=126	t=1.291 p=0.199	2.68±2.06 n=70	2.83±1.72 n=70	t=-0.936 p=0.353	t=1.814 p=0.072	t=-1.576 p=0.117
Ex-smokers	3.41±2.35 n=88	3.27±3.29 n=88	t=0.469 p=0.640	2.89±1.50 n=59	3.22±2.23 n=59	t=-1.720 p=0.091	t=0.101 p=0.920	t=-1.318 p=0.190
Light smokers	3.06±2.28 n=56	2.95±2.31 n=56	t=0.559 p=0.578	2.47±1.58 n=46	2.82±2.50 n=46	t=-1.238 p=0.222	t=0.257 p=0.798	t=-1.335 p=0.185
Heavy smokers	2.43±1.63 n=89	2.73±2.21 n=89	***t=-2.220 p=0.029****	2.10±1.38 n=80	2.10±1.29 n=80	t=0.027 p=0.979	***t=2.313 p=0.022****	t=1.599 p=0.112
Non-smokers	3.46±2.27 n=214	3.28±2.44 n=214	t=1.173 p=0.242	2.78±1.82 n=129	3.01±1.97 n=129	t=-1.874 p=0.063	t=1.116 p=0.265	***t=-2.084 p=0.038****
All smokers	2.67±1.92 n=145	2.82±2.24 n=145	t=-1.237 p=0.218	2.23±1.46 n=126	2.36±1.85 n=126	t=-0.945 p=0.347	t=1.824 p=0.069	t=0.077 p=0.938
Educational attainment								
At/below GCSE	3.18±2.38 n=251	3.04±2.62 n=251	t=0.993 p=0.322	2.44±1.65 n=190	2.63±1.95 n=190	t=-1.798 p=0.074	t=1.874 p=0.062	t=-1.885 p=0.060
Above GCSE	3.06±1.57 n=108	3.21±1.64 n=108	t=-1.126 p=0.263	2.69±1.72 n=66	2.82±1.92 n=66	t=-0.728 p=0.469	t=1.364 p=0.175	t=0.071 p=0.944

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 8: Stratified fruit and vegetable consumption by changes in attitude towards healthy eating

	Improved positive attitude towards healthy eating			No improved positive attitude towards healthy eating			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	3.15±2.17 n=359	3.09±2.37 n=359	t=0.504 p=0.615	2.51±1.67 n=256	2.68±1.94 n=256	t=-1.925 p=0.055	*t=2.352 p=0.019**	t=-0.207 p=0.838
Number of positive attitudes in wave one								
Zero	2.11±1.33 n=56	2.03±1.32 n=56	t=0.541 p=0.591	1.56±1.18 n=19	1.45±1.14 n=19	t=0.508 p=0.618	t=1.840 p=0.074	t=0.127 p=0.900
One	3.10±2.66 n=59	3.20±4.01 n=59	t=-0.220 p=0.827	1.97±1.22 n=50	2.29±2.07 n=50	t=-1.421 p=0.162	t=1.525 p=0.131	t=-0.451 p=0.653
Two	3.27±2.55 n=98	3.15±2.32 n=98	t=0.587 p=0.559	2.52±1.48 n=109	2.75±1.39 n=109	*t=-2.243 p=0.027**	t=1.472 p=0.143	t=-1.554 p=0.122
Three	3.48±1.80 n=146	3.42±1.62 n=146	t=0.501 p=0.617	3.07±2.04 n=78	3.14±2.45 n=78	t=-0.334 p=0.739	*t=2.663 p=0.008***	t=-1.593 p=0.112
Household deprivation marker score								
Zero– lowest	3.43±2.01 n=101	3.39±1.32 n=101	t=0.207 p=0.836	2.77±1.63 n=58	2.85±1.75 n=58	t=-0.560 p=0.578	*t=2.048 p=0.043**	t=-0.505 p=0.614
One	3.51±2.36 n=104	3.14±1.71 n=104	t=1.855 p=0.066	2.51±1.38 n=81	2.73±1.56 n=81	t=-1.496 p=0.139	t=1.710 p=0.089	*t=-2.381 p=0.018**
Two	2.91±2.04 n=97	3.11±3.38 n=97	t=-0.847 p=0.399	2.58±2.04 n=84	2.86±2.43 n=84	t=-1.330 p=0.187	t=0.568 p=0.571	t=-0.267 p=0.790
Three	2.36±2.19 n=49	2.46±2.81 n=49	t=-0.438 p=0.664	1.89±1.21 n=26	1.86±1.61 n=26	t=0.158 p=0.875	t=1.170 p=0.246	t=0.444 p=0.659
Four - highest	2.43±1.67 n=6	1.88±1.41 n=6	t=1.926 p=0.112	1.48±0.36 n=3	1.48±1.22 n=3	t=0.000 p=1.000	t=0.446 p=0.675	t=-0.655 p=0.567
Number of children in household under the age of 16 years								
Zero	3.54±2.32 n=225	3.42±2.54 n=225	t=0.791 p=0.430	2.86±1.83 n=151	3.03±2.19 n=151	t=-1.298 p=0.196	t=1.568 p=0.118	t=-1.448 p=0.149
One to two	2.60±1.80 n=107	2.66±2.06 n=107	t=-0.440 p=0.661	2.03±1.31 n=87	2.22±1.37 n=87	t=-1.440 p=0.154	t=1.772 p=0.078	t=-0.718 p=0.473
Three plus	2.00±1.08 n=27	2.11±1.19 n=27	t=-0.700 p=0.490	1.83±0.85 n=18	2.00±1.41 n=18	t=-0.659 p=0.519	t=0.262 p=0.795	t=-0.207 p=0.838

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 9: Fruit and vegetable consumption by changes in physical access, availability, affordability and attitudes				
Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Tesco user, improved availability, increased affordability, improved attitudes (n=12)	2.63±1.21	2.23±1.08	t=1.771	p=0.104
Tesco user, improved availability, increased affordability, no improved attitudes (n=14)	1.56±0.82	1.50±0.80	t=0.407	p=0.690
Tesco user, improved availability, no increased affordability, improved attitudes (n=29)	3.34±2.19	3.16±1.37	t=0.506	p=0.617
Tesco user, improved availability, no increased affordability, no improved attitudes (n=18)	1.87±0.87	2.56±1.50	***t=-2.321***	***p=0.033****
Tesco user, no improved availability, increased affordability, improved attitudes (n=21)	2.90±1.74	3.78±5.92	t=-0.894	p=0.382
Tesco user, no improved availability, increased affordability, no improved attitudes (n=14)	2.00±1.30	2.35±1.33	t=-1.186	p=0.257
Tesco user, no improved availability, no increased affordability, improved attitudes (n=67)	2.78±1.60	2.58±1.58	t=1.566	p=0.122
Tesco user, no improved availability, no increased affordability, no improved attitudes (n=43)	2.48±1.77	3.01±2.47	***t=-2.014***	***p=0.050****
Not Tesco user, improved availability, increased affordability, improved attitudes (n=19)	3.32±2.92	3.07±3.89	t=0.536	p=0.598
Not Tesco user, improved availability, increased affordability, no improved attitudes (n=16)	2.68±1.41	2.61±1.57	t=0.298	p=0.770
Not Tesco user, improved availability, no increased affordability, improved attitudes (n=54)	3.41±2.77	3.21±1.62	t=0.641	p=0.525
Not Tesco user, improved availability, no increased affordability, no improved attitudes (n=32)	2.86±1.59	2.91±1.30	t=-0.168	p=0.867
Not Tesco user, no improved availability, increased affordability, improved attitudes (n=49)	2.95±1.85	2.91±1.94	t=0.160	p=0.874
Not Tesco user, no improved availability, increased affordability, no improved attitudes (n=29)	2.38±2.41	2.53±2.07	t=-0.583	p=0.564
Not Tesco user, no improved availability, no increased affordability, improved attitudes (n=108)	3.35±2.28	3.38±2.01	t=-0.193	p=0.847
Not Tesco user, no improved availability, no increased affordability, no improved attitudes (n=90)	2.75±1.61	2.77±2.10	t=-0.088	p=0.930

Paired sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 10: Stratified fruit and vegetable consumption by changes in factors affecting food choice

	Less factors affecting food choice in wave two			The same or more factors affecting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.97±2.20 n=254	2.91±2.04 n=254	t=0.547 p=0.585	2.82±1.84 n=361	2.93±2.32 n=361	t=1.137 p=0.256	t=-0.104 p=0.917	t=-0.936 p=0.350
Age								
17-24 years	1.88±1.12 n=14	1.49±0.83 n=14	t=1.433 p=0.175	1.68±1.00 n=37	1.66±1.21 n=37	t=0.066 p=0.948	t=-0.586 p=0.562	t=-1.165 p=0.255
25-34 years	2.12±1.25 n=46	2.14±1.22 n=46	t=-0.155 p=0.878	2.09±1.38 n=73	2.30±1.30 n=73	t=-1.621 p=0.109	t=-0.708 p=0.481	t=-1.097 p=0.275
35-44 years	2.37±1.44 n=62	2.46±1.29 n=62	t=-0.557 p=0.580	2.46±1.42 n=83	2.51±1.54 n=83	t=-0.349 p=0.728	t=-0.212 p=0.833	t=0.219 p=0.827
45-64 years	3.39±2.21 n=76	3.52±2.53 n=76	t=-0.672 p=0.504	3.57±2.16 n=89	3.35±1.70 n=89	t=1.036 p=0.303	t=0.475 p=0.635	t=1.219 p=0.224
65 years plus	4.03±3.01 n=56	3.58±2.23 n=56	t=1.432 p=0.158	3.54±1.90 n=79	4.06±3.75 n=79	t=-1.600 p=0.114	t=-0.935 p=0.351	***t=-2.144 p=0.034****
Smoking status								
Never smokers	3.38±2.58 n=93	3.20±1.54 n=93	t=0.827 p=0.410	3.06±1.77 n=103	3.06±1.76 n=103	t=-0.033 p=0.974	t=0.574 p=0.566	t=-0.730 p=0.467
Ex-smokers	3.05±1.78 n=58	3.06±1.96 n=58	t=-0.034 p=0.973	3.30±2.23 n=89	3.37±3.38 n=89	t=-0.242 p=0.809	t=-0.707 p=0.481	t=-0.206 p=0.837
Light smokers	2.67±2.35 n=35	2.68±2.60 n=35	t=-0.028 p=0.978	2.86±1.82 n=67	3.00±2.28 n=67	t=-0.688 p=0.494	t=-0.624 p=0.535	t=-0.387 p=0.700
Heavy smokers	2.49±1.79 n=67	2.54±2.33 n=67	t=-0.261 p=0.795	2.13±1.31 n=102	2.36±1.48 n=102	t=-1.972 p=0.051	t=0.546 p=0.586	t=-0.943 p=0.347
Non-smokers	3.25±2.31 n=151	3.14±1.71 n=151	t=0.753 p=0.453	3.17±2.00 n=192	3.21±2.64 n=192	t=-0.233 p=0.816	t=-0.257 p=0.797	t=-0.679 p=0.498
All smokers	2.55±1.99 n=102	2.59±2.41 n=102	t=-0.212 p=0.832	2.42±1.56 n=169	2.62±1.86 n=169	t=-1.800 p=0.074	t=-0.111 p=0.912	t=-0.921 p=0..358
Educational attainment								
At or below GCSE	2.94±2.37 n=187	2.84±2.11 n=187	t=0.835 p=0.405	2.80±1.94 n=254	2.89±2.54 n=254	t=-0.672 p=0.502	t=-0.248 p=0.804	t=-1.065 p=0.288
Above GCSE	3.04±1.68 n=67	3.12±1.83 n=67	t=-0.507 p=0.614	2.85±1.60 n=107	3.02±1.71 n=107	t=-1.285 p=0.202	t=0.358 p=0.721	t=-0.430 p=0.668

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 11: Stratified fruit and vegetable consumption by changes in factors affecting food choice

	Less factors affecting food choice in wave two			The same or more factors affecting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	2.97±2.20 n=254	2.91±2.04 n=254	t=0.547 p=0.585	2.82±1.84 n=361	2.93±2.32 n=361	t=1.137 p=0.256	t=-0.104 p=0.917	t=-0.936 p=0.350
Number of positive attitudes in wave one								
Zero	1.89±1.20 n=34	1.73±0.92 n=34	t=0.709 p=0.483	2.04±1.40 n=41	2.01±1.54 n=41	t=0.238 p=0.813	t=-0.973 p=0.334	t=-0.485 p=0.630
One	2.43±2.29 n=37	2.40±2.23 n=37	t=-0.171 p=0.865	2.66±2.15 n=72	2.98±3.71 n=72	t=-0.822 p=0.414	t=-1.010 p=0.315	t=-0.825 p=0.411
Two	3.16±2.62 n=87	3.06±2.16 n=87	t=0.438 p=0.662	2.66±1.58 n=120	2.85±1.68 n=120	t=-1.761 p=0.081	t=0.772 p=0.442	t=-1.161 p=0.248
Three	3.38±1.87 n=96	3.39±1.95 n=96	t=-0.018 p=0.985	3.30±1.91 n=128	3.27±1.95 n=128	t=0.181 p=0.857	t=0.238 p=0.812	t=-1.083 p=0.280
Household deprivation marker score								
Zero–lowest	3.11±1.78 n=66	3.26±1.67 n=66	t=-0.915 p=0.363	3.24±1.99 n=93	3.15±1.40 n=93	t=0.512 p=0.610	t=0.429 p=0.668	t=0.984 p=0.326
One	3.17±2.50 n=86	2.94±1.63 n=86	t=0.927 p=0.357	2.99±1.56 n=99	2.98±1.68 n=99	t=0.128 p=0.898	t=-0.138 p=0.890	t=-0.768 p=0.444
Two	2.87±2.21 n=67	2.74±2.21 n=67	t=0.839 p=0.405	2.69±1.95 n=114	3.14±3.34 n=114	t=-1.892 p=0.061	t=-0.968 p=0.335	***t=-2.053 p=0.042****
Three	2.33±2.16 n=31	2.52±3.16 n=31	t=-0.787 p=0.437	2.10±1.73 n=44	2.07±1.85 n=44	t=0.165 p=0.870	t=0.708 p=0.482	t=0.690 p=0.492
Four - highest	3.67±1.57 n=3	2.57±1.74 n=3	***t=11.5000 p=0.007*****	1.33±0.22 n=6	1.33±0.90 n=6	t=0.000 p=1.000	t=1.158 p=0.343	***t=-2.810 p=0.033****
Number of children in household under the age of 16 years								
Zero	3.35±2.41 n=153	3.17±1.99 n=153	t=1.217 p=0.225	3.21±1.98 n=223	3.33±2.66 n=223	t=-0.813 p=0.417	t=-0.665 p=0.507	t=-1.439 p=0.151
One to two	2.43±1.82 n=81	2.53±2.21 n=81	t=-0.693 p=0.490	2.29±1.47 n=113	2.41±1.44 n=113	t=-1.064 p=0.290	t=0.410 p=0.683	t=-0.124 p=0.902
Three plus	2.21±1.12 n=20	2.50±1.33 n=20	t=-1.378 p=0.184	1.71±0.83 n=25	1.71±1.13 n=25	t=0.000 p=1.000	***t=2.107 p=0.042****	t=1.074 p=0.290

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 12: Stratified fruit and vegetable consumption by changes in factors limiting food choice

	Less factors limiting choice in wave two			The same or more factors limiting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	3.05±2.09 n=175	3.13±0.95 n=175	t=-0.507 p=0.613	2.81±1.96 n=440	2.84±1.83 n=440	t=-0.352 p=0.725	t=1.208 p=0.228	t=-1.673 p=0.104
Age								
17-24 years	1.52±0.75 n=8	1.09±0.50 n=8	t=1.692 p=0.134	1.77±1.07 n=43	1.71±1.17 n=43	t=0.334 p=0.740	***t=-2.486 p=0.020****	t=-1.222 p=0.242
25-34 years	2.27±1.35 n=39	2.22±1.24 n=39	t=0.424 p=0.674	2.02±1.32 n=80	2.25±1.29 n=80	t=-1.891 p=0.062	t=-0.138 p=0.890	t=-1.612 p=0.110
35-44 years	2.39±1.33 n=36	2.42±1.27 n=36	t=-0.139 p=0.890	2.43±1.46 n=109	2.52±1.49 n=109	t=-0.643 p=0.522	t=-0.370 p=0.712	t=-0.231 p=0.818
45-64 years	3.59±2.35 n=54	3.58±2.71 n=54	t=0.060 p=0.953	3.44±2.10 n=111	3.36±1.77 n=111	t=0.467 p=0.641	t=0.541 p=0.590	t=0.202 p=0.840
65 years plus	4.02±2.44 n=38	4.53±4.77 n=38	t=-0.887 p=0.381	3.64±2.43 n=97	3.60±2.31 n=97	t=0.182 p=0.856	t=1.155 p=0.255	t=0.890 p=0.378
Smoking status								
Never smokers	3.38±1.83 n=56	2.93±1.40 n=56	***t=2.184 p=0.033****	3.14±2.33 n=140	3.21±1.75 n=140	t=-0.422 p=0.673	t=-1.147 p=0.254	***t=-2.014 p=0.046****
Ex-smokers	3.00±1.92 n=43	3.46± n=4.35	t=-0.927 p=0.359	3.28±2.12 n=104	3.16±2.05 n=104	t=0.666 p=0.507	t=0.436 p=0.664	t=1.101 p=0.276
Light smokers	3.15±2.78 n=32	3.42±2.97 n=32	t=-0.978 p=0.336	2.63±1.53 n=70	2.65±2.05 n=70	t=-0.104 p=0.918	t=1.319 p=0.194	t=0.703 p=0.485
Heavy smokers	2.62±1.98 n=43	2.89±2.77 n=43	t=-1.323 p=0.193	2.16±1.32 n=126	2.27±1.40 n=126	t=-1.083 p=0.281	t=1.405 p=0.166	t=0.678 p=0.500
Non-smokers	3.22±1.87 n=99	3.16±3.05 n=99	t=0.215 p=0.830	3.20±2.24 n=244	3.19±1.88 n=244	t=0.141 p=0.888	t=-0.073 p=0.942	t=-0.135 p=0.893
All smokers	2.84±2.35 n=75	3.12±2.85 n=75	t=-1.641 p=0.105	2.33±1.41 n=196	2.41±1.66 n=196	t=-0.803 p=0.423	***t=2.021 p=0.046****	t=0.968 p=0.335
Educational attainment								
At or below GCSE	3.12±2.27 n=129	3.23±3.31 n=129	t=-0.557 p=0.579	2.76±2.06 n=312	2.72±1.82 n=312	t=0.404 p=0.686	t=1.645 p=0.102	t=0.678 p=0.498
Above GCSE	2.86±1.46 n=46	2.85±1.54 n=46	t=0.064 p=0.949	2.94±1.69 n=128	3.13±1.82 n=128	t=-1.566 p=0.120	t=-1.012 p=0.314	t=-0.896 p=0.373

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 13: Stratified fruit and vegetable consumption by changes in factors limiting food choice

	Less factors limiting choice in wave two			The same or more factors limiting food choice in wave two			Independent sample t-test for wave two consumption	Independent sample t-test for change in consumption
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test		
All	3.05±2.09 n=175	3.13±0.95 n=175	t=-0.507 p=0.613	2.81±1.96 n=440	2.84±1.83 n=440	t=-0.352 p=0.725	t=1.208 p=0.228	t=-1.673 p=0.104
Number of positive attitudes in wave one								
Zero	2.09±1.55 n=31	2.19±1.56 n=31	t=-0.533 p=0.598	1.89±1.12 n=44	1.67±1.03 n=44	t=1.469 p=0.149	t=1.646 p=0.106	t=1.317 p=0.193
One	3.23±2.61 n=30	3.60±5.36 n=30	t=-0.530 p=0.600	2.34±1.97 n=79	2.47±1.98 n=79	t=-0.552 p=0.582	t=1.125 p=0.269	t=0.321 p=0.750
Two	2.79±2.11 n=48	3.08±2.77 n=48	t=-1.613 p=0.113	2.89±2.09 n=155	2.90±1.54 n=159	t=-0.027 p=0.979	t=0.428 p=0.670	t=1.261 p=0.210
Three	3.60±1.87 n=66	3.39±1.81 n=66	t=0.947 p=0.347	3.22±1.89 n=158	3.29±2.01 n=158	t=-0.588 p=0.557	t=1.298 p=0.196	t=0.090 p=0.929
Household deprivation marker score								
Zero– lowest	2.88±1.49 n=40	3.12±1.33 n=40	t=-1.452 p=0.154	3.29±2.02 n=119	3.22±1.57 n=119	t=0.473 p=0.637	t=-0.390 p=0.698	t=1.378 p=0.171
One	3.33±1.97 n=58	3.09±1.90 n=58	t=1.069 p=0.289	2.96±2.08 n=127	2.90±1.53 n=127	t=0.342 p=0.733	t=0.674 p=0.502	t=-0.672 p=0.503
Two	3.22±2.48 n=48	3.48±4.37 n=48	t=-0.546 p=0.588	2.59±1.84 n=133	2.82±2.27 n=133	t=-1.645 p=0.102	t=0.989 p=0.327	t=0.037 p=0.971
Three	2.39±2.43 n=24	2.67±3.69 n=24	t=-0.974 p=0.340	2.11±1.63 n=51	2.06±1.62 n=51	t=0.282 p=0.779	t=0.784 p=0.440	t=0.971 p=0.337
Four - highest	3.00±2.02 n=2	1.79±2.32 n=2	t=5.667 p=0.111	1.86±1.29 n=7	1.73±1.14 n=7	t=0.362 p=0.729	t=0.030 p=0.980	t=-2.729 p=0.034
Number of children in household under the age of 16 years								
Zero	3.37±2.13 n=108	3.44±3.23 n=108	t=-0.289 p=0.773	3.23±2.18 n=268	3.19±1.99 n=268	t=0.277 p=0.782	t=0.732 p=0.465	t=0.382 p=0.703
One to two	2.61±2.09 n=53	2.78±2.61 n=53	t=-0.918 p=0.363	2.25±1.40 n=141	2.34±1.36 n=141	t=-0.892 p=0.374	t=1.190 p=0.238	t=0.378 p=0.707
Three plus	2.22±1.08 n=14	2.05±0.98 n=14	t=0.856 p=0.408	1.80±0.93 n=31	2.07±1.40 n=31	t=-1.589 p=0.123	t=-0.050 p=0.960	t=-1.673 p=0.104

Paired sample t-test and Independent sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 14: Fruit and vegetable consumption by changes in specific factors affecting food choice

Factor affecting choice of food bought	Tesco Seacroft shoppers			Not Tesco Seacroft Shoppers			Independent sample t-test	
	Those citing factor in wave one but not wave two			Those citing factor in wave one but not wave two				
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test	Wave two consumption	Change in consumption
The costs of food/my food budget	2.64±2.19	2.69±1.85	t=-0.133 p=0.895 n=32	2.68±1.48	2.89±1.52	t=-1.266 p=0.211 n=55	t=-0.515 p=0.609	t=-0.432 p=0.668
Not eating certain foods	3.31±1.35	3.26±1.37	t=0.326 p=0.748 n=17	4.38±2.92	4.31±3.41	t=0.251 p=0.803 n=44	t=-1.706 p=0.093	t=0.065 p=0.949
What my spouse/partner will eat	2.36±1.34	2.32±1.42	t=0.165 p=0.870 n=30	3.31±2.52	3.30±2.29	t=0.026 p=0.979 n=47	***t=-2.321 p=0.023****	t=-0.098 p=0.922
What my child/children will eat	3.41±2.35	3.11±1.53	t=0.583 p=0.568 n=18	2.52±1.28	2.27±1.13	t=1.102 p=0.281 n=26	t=1.991 p=0.056	t=-0.086 p=0.932
Trying to eat a healthy balanced diet	3.05±1.81	3.77±5.94	t=-0.686 p=0.501 n=20	3.20±2.15	2.69±1.87	***t=2.736 p=0.008** n=65***	t=0.798 p=0.434	t=1.147 p=0.265
The kinds of food I like eating	2.54±1.46	2.55±1.67	t=-0.086 p=0.932 n=33	3.24±2.80	3.01±2.56	t=0.807 p=0.423 n=69	t=-1.090 p=0.279	t=0.751 p=0.454
Convenience	2.02±1.00	2.10±1.21	t=-0.455 p=0.653 n=26	3.40±2.94	3.57±3.33	t=-0.737 p=0.465 n=48	***t=-2.729 p=0.008****	t=-0.250 p=0.803
Whether my spouse/partner is with me	2.92±1.32	2.90±1.53	t=0.121 p=0.905 n=30	2.55±1.27	2.99±1.90	t=-1.850 p=0.072 n=41	t=-0.228 p=0.820	t=-1.509 p=0.136
Whether my child/children are with me	2.68±2.32	2.19±1.17	t=1.276 p=0.215 n=23	2.78±1.78	2.38±1.17	t=1.174 p=0.096 n=35	t=-0.627 p=0.534	t=-0.223 p=0.825
Whether I'm hungry or not	2.72±1.56	2.55±1.24	t=0.824 p=0.418 n=26	2.92±1.89	2.84±1.79	t=0.508 p=0.613 n=83	t=-0.900 p=0.371	t=-0.319 p=0.751

Paired sample t-test and Independent sample t-tests statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 15: Fruit and vegetable consumption by changes in specific factors limiting food choice

Factor limiting choice of food bought	Tesco Seacroft shoppers			Not Tesco Seacroft Shoppers			Independent sample t-test	
	Those citing factor in wave one but not wave two			Those citing factor in wave one but not wave two				
	Wave one	Wave two	Paired sample t-test	Wave one	Wave two	Paired sample t-test	Wave two consumption	Change in consumption
What is available in the store I can get to	2.83±1.94	2.80±1.65	t=0.142 p=0.888 n=51	3.13±2.29	3.17±2.15	t=-0.271 p=0.787 n=85	t=-1.118 p=0.266	t=-0.267 p=0.790
Ability to carry and transport foods home	3.13±2.28	3.45±5.00	t=-0.428 p=0.672 n=30	3.45±3.09	3.52±3.70	t=-0.219 p=0.828 n=30	t=-0.059 p=0.953	t=0.307 p=0.761
Food goes off before its eaten	2.96±1.72	3.09±1.79	t=-0.499 p=0.622 n=26	3.07±1.91	2.96±1.89	t=0.601 p=0.551 n=46	t=0.298 p=0.767	t=0.744 p=0.461
Difficult to get to shops because of age or disability	2.81±2.54	5.68±8.72	t=-1.306 p=0.228 n=9	4.08±3.49	4.38±4.32	t=-0.636 p=0.532 n=21	t=0.426 p=0.679	t=1.144 p=0.283

Paired sample t-test and Independent sample t-tests statistical tests: differences between consumption groups ***$p<0.001$, **$p<0.01$, *$p<0.05$ (Statistically different results are in italics)

Table 16: Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors affecting food choice				
Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Tesco user, improved availability, increased affordability, improved attitudes, less factors affecting (n=6)	3.33±1.19	2.79±1.28	t=1.710	p=0.148
Tesco user, improved availability, increased affordability, improved attitudes, same/more factors affecting (n=6)	1.93±0.80	1.67±0.42	t=0.759	p=0.482
Tesco user, improved availability, increased affordability, no improved attitudes, less factors affecting (n=7)	1.92±0.87	1.86±0.79	t=0.290	p=0.782
Tesco user, improved availability, increased affordability, no improved attitudes, same/more factors affecting (n=7)	1.20±0.62	1.14±0.70	t=0.265	p=0.800
Tesco user, improved availability, no increased affordability, improved attitudes, less factors affecting (n=10)	3.67±3.23	3.23±1.50	t=0.472	p=0.648
Tesco user, improved availability, no increased affordability, improved attitudes, same/more factors affecting (n=19)	3.17±1.47	3.13±1.34	t=0.157	p=0.877
Tesco user, improved availability, no increased affordability, no improved attitudes, less factors affecting (n=6)	1.83±0.92	2.43±1.60	t=-1.087	p=0.327
Tesco user, improved availability, no increased affordability, no improved attitudes, same/more factors affecting (n=12)	1.88±0.88	2.62±1.51	t=-1.999	p=0.071
Tesco user, no improved availability, increased affordability, improved attitudes, less factors affecting (n=9)	2.68±1.08	3.13±1.89	t=-1.090	p=0.308
Tesco user, no improved availability, increased affordability, improved attitudes, same/more factors affecting (n=12)	3.06±2.15	4.27±7.78	t=-0.701	p=0.498
Tesco user, no improved availability, increased affordability, no improved attitudes, less factors affecting (n=4)	1.57±1.47	2.21±1.93	t=-1.417	p=0.251
Tesco user, no improved availability, increased affordability, no improved attitudes, same/more factors affecting (n=10)	2.17±1.27	2.40±1.15	t=-0.610	p=0.557
Tesco user, no improved availability, no increased affordability, improved attitudes, less factors affecting (n=27)	2.86±1.69	2.67±1.74	t=0.824	p=0.418
Tesco user, no improved availability, no increased affordability, improved attitudes, same/more factors affecting (n=40)	2.73±1.56	2.51±1.49	t=1.379	p=0.176
Tesco user, no improved availability, no increased affordability, no improved attitudes, less factors affecting (n=22)	2.94±1.96	3.05±1.93	t=-0.463	p=0.648
Tesco user, no improved availability, no increased affordability, no improved attitudes, same/more factors affecting (n=21)	2.00±1.45	2.98±2.99	t=-2.067	p=0.052

Paired sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 17: Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors affecting food choice				
Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Not Tesco user, improved availability, increased affordability, improved attitudes, less factors affecting (n=10)	3.20±3.27	3.83±5.15	t=-1.010	p=0.339
Not Tesco user, improved availability, increased affordability, improved attitudes, same/more factors affecting (n=9)	3.44±2.65	2.22±1.66	t=2.205	p=0.059
Not Tesco user, improved availability, increased affordability, no improved attitudes, less factors affecting (n=4)	2.29±0.55	1.89±1.04	t=0.792	p=0.486
Not Tesco user, improved availability, increased affordability, no improved attitudes, same/more factors affecting (n=12)	2.81±1.59	2.85±1.68	t=-0.128	p=0.900
Not Tesco user, improved availability, no increased affordability, improved attitudes, less factors affecting (n=21)	4.10±3.94	3.61±1.67	t=0.639	p=0.530
Not Tesco user, improved availability, no increased affordability, improved attitudes, same/more factors affecting (n=33)	2.97±1.58	2.95±1.57	t=0.112	p=0.911
Not Tesco user, improved availability, no increased affordability, no improved attitudes, less factors affecting (n=14)	2.51±1.31	3.01±1.09	t=-1.451	p=0.171
Not Tesco user, improved availability, no increased affordability, no improved attitudes, same/more factors affecting (n=18)	3.13±1.77	2.83±1.48	t=0.694	p=0.497
Not Tesco user, no improved availability, increased affordability, improved attitudes, less factors affecting (n=19)	3.17±2.16	2.79±1.74	t=1.184	p=0.252
Not Tesco user, no improved availability, increased affordability, improved attitudes, same/more factors affecting (n=30)	2.80±1.64	2.99±2.08	t=-0.553	p=0.584
Not Tesco user, no improved availability, increased affordability, no improved attitudes, less factors affecting (n=13)	1.71±0.76	2.09±1.31	t=-1.496	p=0.161
Not Tesco user, no improved availability, increased affordability, no improved attitudes, same/more factors affecting (n=16)	2.93±3.11	2.89±2.51	t=0.086	p=0.932
Not Tesco user, no improved availability, no increased affordability, improved attitudes, less factors affecting (n=44)	3.23±2.31	3.17±2.18	t=0.405	p=0.687
Not Tesco user, no improved availability, no increased affordability, improved attitudes, same/more factors affecting (n=64)	3.43±2.26	3.53±1.90	t=-0.397	p=0.693
Not Tesco user, no improved availability, no increased affordability, no improved attitudes, less factors affecting (n=38)	2.98±1.73	2.72±2.12	t=0.982	p=0.332
Not Tesco user, no improved availability, no increased affordability, no improved attitudes, same/more factors affecting (n=52)	2.59±1.51	2.80±2.11	t=-1.025	p=0.310

Paired sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 18: Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors limiting food choice

Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Tesco user, improved availability, increased affordability, improved attitudes, less factors limiting (n=6)	3.07±1.08	2.52±0.93	t=1.553	p=0.181
Tesco user, improved availability, increased affordability, improved attitudes, same/more factors limiting (n=6)	2.19±1.27	1.93±1.22	t=0.840	p=0.439
Tesco user, improved availability, increased affordability, no improved attitudes, less factors limiting (n=4)	1.82±1.07	1.43±0.90	t=2.668	p=0.076
Tesco user, improved availability, increased affordability, no improved attitudes, same/more factors limiting (n=10)	1.46±0.73	1.53±0.81	t=-0.377	p=0.715
Tesco user, improved availability, no increased affordability, improved attitudes, less factors limiting (n=13)	3.48±2.77	3.49±1.37	t=-0.015	p=0.988
Tesco user, improved availability, no increased affordability, improved attitudes, same/more factors limiting (n=16)	3.22±1.67	2.89±1.35	t=1.370	p=0.191
Tesco user, improved availability, no increased affordability, no improved attitudes, less factors limiting (n=3)	2.81±1.05	2.00±1.78	t=1.913	p=0.196
Tesco user, improved availability, no increased affordability, no improved attitudes, same/more factors limiting (n=15)	1.68±0.73	2.67±1.48	***t=-3.393***	***p=0.004*****
Tesco user, no improved availability, increased affordability, improved attitudes, less factors limiting (n=8)	3.41±2.52	5.63±9.45	t=-0.860	p=0.418
Tesco user, no improved availability, increased affordability, improved attitudes, same/more factors limiting (n=13)	2.58±1.04	2.65±1.65	t=-0.198	p=0.847
Tesco user, no improved availability, increased affordability, no improved attitudes, less factors limiting (n=3)	1.76±1.22	2.00±1.79	t=-0.714	p=0.549
Tesco user, no improved availability, increased affordability, no improved attitudes, same/more factors limiting (n=11)	2.06±1.38	2.44±1.27	t=-1.024	p=0.330
Tesco user, no improved availability, no increased affordability, improved attitudes, less factors limiting (n=20)	3.10±1.90	2.65±2.12	t=1.723	p=0.101
Tesco user, no improved availability, no increased affordability, improved attitudes, same/more factors limiting (n=47)	2.64±1.46	2.55±1.32	t=0.664	p=0.510
Tesco user, no improved availability, no increased affordability, no improved attitudes, less factors limiting (n=12)	2.69±1.66	3.18±1.62	t=-1.646	p=0.128
Tesco user, no improved availability, no increased affordability, no improved attitudes, same/more factors limiting (n=31)	2.40±1.83	2.95±2.75	t=-1.565	p=0.128

Paired sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

Table 19: Fruit and vegetable consumption by changes in physical access, availability, affordability, attitudes and factors limiting food choice

Scenario (n=)	Wave one	Wave two	Paired sample t-test	
Not Tesco user, improved availability, increased affordability, improved attitudes, less factors limiting (n=6)	3.50±4.27	4.43±6.74	t=-0.885	p=0.417
Not Tesco user, improved availability, increased affordability, improved attitudes, same/more factors limiting (n=13)	3.23±2.27	2.44±1.57	t=1.868	p=0.086
Not Tesco user, improved availability, increased affordability, no improved attitudes, less factors limiting (n=3)	3.24±1.61	3.67±2.84	t=-0.596	p=0.612
Not Tesco user, improved availability, increased affordability, no improved attitudes, same/more factors limiting (n=13)	2.55±1.40	2.36±1.19	t=0.748	p=0.469
Not Tesco user, improved availability, no increased affordability, improved attitudes, less factors limiting (n=16)	3.54±1.45	3.36±1.35	t=1.019	p=0.324
Not Tesco user, improved availability, no increased affordability, improved attitudes, same/more factors limiting (n=38)	3.36±3.18	3.15±1.74	t=0.476	p=0.637
Not Tesco user, improved availability, no increased affordability, no improved attitudes, less factors limiting (n=12)	2.75±2.09	2.69±1.37	t=0.095	p=0.926
Not Tesco user, improved availability, no increased affordability, no improved attitudes, same/more factors limiting (n=20)	2.93±1.26	3.04±1.28	t=-0.393	p=0.699
Not Tesco user, no improved availability, increased affordability, improved attitudes, less factors limiting (n=12)	2.43±1.19	2.08±1.07	t=0.990	p=0.344
Not Tesco user, no improved availability, increased affordability, improved attitudes, same/more factors limiting (n=37)	3.12±2.00	3.18±2.09	t=-0.210	p=0.835
Not Tesco user, no improved availability, increased affordability, no improved attitudes, less factors limiting (n=7)	2.43±1.34	2.14±0.87	t=0.816	p=0.445
Not Tesco user, no improved availability, increased affordability, no improved attitudes, same/more factors limiting (n=22)	2.37±2.69	2.66±2.33	t=-0.913	p=0.372
Not Tesco user, no improved availability, no increased affordability, improved attitudes, less factors limiting (n=25)	3.57±2.95	3.87±2.93	t=-1.489	p=0.150
Not Tesco user, no improved availability, no increased affordability, improved attitudes, same/more factors limiting (n=83)	3.29±2.05	3.24±1.64	t=0.244	p=0.808
Not Tesco user, no improved availability, no increased affordability, no improved attitudes, less factors limiting (n=25)	2.87±1.58	2.91±1.98	t=-0.148	p=0.883
Not Tesco user, no improved availability, no increased affordability, no improved attitudes, same/more factors limiting (n=65)	2.71±1.63	2.71±2.16	t=-0.011	p=0.991

Paired sample t-test statistical tests: differences between consumption groups ***p<0.001, **p<0.01, *p<0.05 (Statistically different results are in italics)

LIST OF REFERENCES

Acheson D, Barker D, Chambers J, Graham H, Marmot M, and Whitehead M. Independent inquiry into inequalities in health report. Sir Donald Acheson. 1998. London, The Stationery Office.

Agudo A, Pera G, the EPIC group of Spain. Vegetable and fruit consumption associated with anthropometric, dietary and lifestyle factors in Spain. *Public Health Nutrition* 1999;**2**:263-72.

Ammerman AS, Lindquist CH, Lohr KN, Hersey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: A review of the evidence. *Preventive Medicine* 2002;**35**:25-41.

Anderson AS, Cox DN, McKellar S, Reynolds J, Lean MEJ, Mela DJ. Take five, a nutrition education intervention to increase fruit and vegetable intakes: impact on attitudes towards dietary change. *British Journal of Nutrition* 1998;**80**:133-40.

Anderson AS, Lean MEJ, Foster A, Marshall D. Ripe for change: fruit and vegetables in Scotland - current patterns and potential for change. *Health Bulletin* 1994;**52**:51-64.

Anderson AS, Macintyre S, West P. Adolescent meal patterns: grazing habits in the west of Scotland. *Health Bulletin* 1993;**51**:158-65.

Anderson AS, Macintyre S, West P. Dietary patterns among adolescents in the West of Scotland. *British Journal of Nutrition* 1994;**71**:111-22.

Anderson AS, Morris SE. Changing fortunes: changing food choices. *Nutrition and Food Science* 2000;**30**:12-15.

Anderson AS, Hunt K. Who are the 'healthy eaters'? eating patterns and health promotion in the west of Scotland. *Health Education Journal* 1992;**51**:3-10.

Anderson ES, Winett RA, Wojick JR, Winett SG, Bowden T. A computerized social cognitive intervention for nutrition behavior: Direct and mediated effects on fat, fiber, fruits and vegetables, self-efficacy, and outcome expectations among food shoppers. *Annals of Behavioral Medicine* 2001;**23**:88-100.

Anderson SA. Core indicators of nutritional state for difficult-to-sample populations. *Journal of Nutrition* 1990;**120**:1559-600.

Anonymous. Self-reported concern about food security - eight states, 1996-1998. *Mortality and Morbidity Weekly Review* 2000;**49**:933-36.

Appleby PN, Key TJ, Thorogood M, Burr ML, Mann J. Mortality in British vegetarians. *Public Health Nutrition* 2002;**5**:29-36.

Barker ME, McClean SI, Thompson KA, Reid NG. Dietary behaviours and sociocultural demographics in Northern Ireland. *British Journal of Nutrition* 1990;**64**:319-29.

Barker ME, Thompson KA, McClean SI. Attitudinal dimensions of food choice and nutrient intake. *British Journal of Nutrition* 1995;**74**:649-59.

Barratt J. The cost and availability of healthy food choices in southern Derbyshire. *Journal of Human Nutrition & Dietetics* 1997;**10**:63-69.

Baxter IA, Schröder MJA. Vegetable consumption among Scottish children: a review of the determinants and proposed strategies to overcome low consumption. *British Food Journal* 1997;**99**:380-87.

Beardsworth A, Haslam C, Keil T, Goode J, Sherratt E. Contemporary nutritional attitudes and practices: a factor analysis approach. *Appetite* 1999;**32**:127-43.

Beaumont J, Leather S, Lang T, and Mucklow C. Nutrition Task Force: Low Income Project Team Working Group 2 - Policy. 1995. Watford, Institute of Grocery Distribution.

Beresford SAA, Thompson B, Feng Z, Christianson A, McLerran D, Patrick DL. Seattle 5 a day worksite program to increase fruit and vegetable consumption. *Preventive Medicine* 2001;**32**:230-38.

Billson H, Pryer JA, Nichols R. Variation in fruit and vegetable consumption among adults in Britain. An analysis from the dietary and nutritional survey of British adults. *European Journal of Clinical Nutrition* 1999;**53**:946-52.

Bingham S. Weighed records. In Cameron ME, van Staveren WA, eds. *Manual on methodology for food consumption studies*, pp 55-63. Oxford: Oxford University Press, 1988.

Bingham SA, Cassidy A, Cole TJ, Welch A, Runswick SA, Black AE *et al.* Validation of weighed records and other methods of dietary assessment using the 24 h urine nitrogen technique and other biological markers. *British Journal of Nutrition* 1995;**72**:531-50.

Bingham SA, Gill C, Welch A, Day K, Cassidy A, Khaw KT *et al.* Comparison of dietary assessment methods in nutritional epidemiology: weighed records v. 24 h recalls, food frequency questionnaires and estimated-diet records. *British Journal of Nutrition* 1994;**72** :619-43.

Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *The Lancet* 1986;**1**:307-10.

Blane D, Bartley M, Davey Smith G. Disease aetiology and materialist explanations of socioeconomic mortality differentials. *European Journal of Public Health* 1997;7:385-91.

Block G, Cox C, Madans J, Schreiber GB, Licitra L, Melia N. Vitamin supplement use by demographic characteristics. *American Journal of Epidemiology* 1988;**127**:297-309.

Block G, Hartman AM. Issues in reproducibility and validity of dietary studies. *American Journal of Clinical Nutrition* 1989;**50**:1133-38.

Block G, Patterson B, Subar A. Fruit, vegetables and cancer prevention: a review of the epidemiological literature. *Nutrition and Cancer* 1992;**18**:1-29.

Bolton-Smith C, Smith WC, Woodward M, Tunstall-Pedoe H. Nutrient intakes of different social-class groups: results from the Scottish Heart Health Study (SHHS). *British Journal of Nutrition* 1991;**65**:321-35.

Bostock L. Pathways of disadvantage? Walking as a mode of transport among low-income mothers. *Health and Social Care in the Community* 2001;**9**:11-18.

Brindle D. Tesco pioneers work skills in 'food deserts'. The Guardian Newspaper. 19th July 1999. London.

Bromley RDF, Thomas CJ. The retail revolution, the carless shopper and disadvantage. *Transactions of the Institute of British Geographers NS* 1993;**18**:222-36.

Brown Rodgers A, Kessler L, Portnoy B, Potosky AL, Patterson B, Tenney J *et al.* 'Eat for health': A supermarket intervention for nutrition and cancer risk reduction. *American Journal of Public Health* 1994;**84**:72-76.

Brug J, Debie S, van Assema P, Weijts W. Psychosocial determinants of fruit and vegetable consumption among adults: results of focus group interviews. *Food Quality and Preference* 1995;**6**:99-107.

Brug J, Lechner L, de Vries H. Psychosocial determinants of fruit and vegetable consumption. *Appetite* 1995;**25**:285-96.

Burema J, Van Staveren WA, Van den Brandt PA. Validity and reproducibility. In Cameron ME, Van Staveren WA, eds. *Manual on methodology for food consumption studies*, pp 171-81. Oxford: Oxford University Press, 1988.

Buttriss JL. Food and nutrition: attitudes, beliefs, and knowledge in the United Kingdom. *European Journal of Clinical Nutrition* 1997;**65**:1985S-95S.

Cade J, Upmeier H, Calvert C, Greenwood D. Costs of a healthy diet: analysis from the UK Women's Cohort Study. *Public Health Nutrition* 1999;**2**:505-12.

Cade J. Diet of adults living in houses in multiple occupation. *European Journal of Clinical Nutrition* 1992;**46**:795-801.

Cade JE, Barker DJP, Margetts BM, Morris JA. Diet and inequalities in health in three English towns. *British Medical Journal* 1988;**296**:1359-62.

Cade JE, Burley VJ, Warm DL, Thompson RL, Margetts BM. Food frequency questionnaires: a review of their design, validation and utilisation. *Nutrition Research Reviews* 2002;In press.

Cade JE, Thompson RL, Burley VJ, Warm DL, Margetts BM. Consensus document on the development, validation and utilisation of food frequency questionnaires. 2001. See http://www.leeds.ac.uk/nuffield/pubs/ffq.pdf

Cade JE. Cross-sectional studies. In Margetts BM, Nelson M, eds. *Design Concepts in Nutritional Epidemiology*, pp 369-82. Oxford: Oxford University Press, 1997.

Campbell CC. Food insecurity: A nutritional outcome or a predictor variable? *Journal of Nutrition* 1991;**121**:408-15.

Caraher M, Dixon P, Lang T, Carr-Hill R. Access to healthy foods: part I. Barriers to accessing healthy foods: differentials by gender, social class, income and mode of transport. *Health Education Journal* 1998;**57**:191-201.

Caraher M, Dixon P, Lang T, Carr-Hill R. The state of cooking in England: the relationship of cooking skills to food choice. *British Food Journal* 1999;**101**:590-609.

Caraher M, Lang T. Can't cook, won't cook: A review of cooking skills and their relevance to health promotion. *International Journal of Health Promotion and Education* 1999;**37**:89-100.

Carlson SJ, Andrews MS, Bickel GW. Measuring food insecurity and hunger in the United States: Development of a national benchmark measure and prevalence estimates. *Journal of Nutrition* 1999;**129**:510S-16S.

Chettamrongchai P, Davies G. Segmenting the market for food shoppers using attitudes to shopping and to time. *British Food Journal* 2000;**102**:81-101.

Clarke GP, Eyre H, Guy CM. Deriving indicators of access to food retail provision in British cities: studies of Leeds, Bradford and Cardiff. *Urban Studies* 2002;**39**:2041-60.

Cole TJ. Sampling, study size, and power. In Margetts BM, Nelson M, eds. *Design Concepts in Nutritional Epidemiology*, pp 64-86. Oxford: Oxford University Press, 1997.

Competitions Commission 2000 see www.competition-commission.org.uk/reports

Connors M, Bisogni CA, Sobal J, Devine CM. Managing values in personal food systems. *Appetite* 2001;**36**:189-200.

Cox BD, Whichelow MJ, Prevost AT. Seasonal consumption of salad vegetables and fresh fruit in relation to the development of cardiovascular disease and cancer. *Public Health Nutrition* 2000;**3**:19-29.

Cox DN, Anderson AS, Lean MEJ, Mela DJ. UK consumer attitudes, beliefs and barriers to increasing fruit and vegetable consumption. *Public Health Nutrition* 1998;**1**:61-68.

Cox DN, Anderson AS, Reynolds J, McKellar S, Lean MEJ, Mela DJ. Take five, a nutrition education intervention to increase fruit and vegetable intakes: impact on consumer choice and nutrient intakes. *British Journal of Nutrition* 1998;**80**:123-31.

Cristofar SP, Basiotis PP. Dietary intakes and selected characteristics of women ages 19-50 years and their children ages 1-5 years by reported perception of food sufficiency. *Journal of Nutrition Education* 1992;**24**:53-58.

Crotty PA, Rutishauser IHE, Cahill M. Food in low-income families. *Australian Journal of Public Health* 1992;**16**:168-74.

Cullen KW, Baranowski T, Rittenberry L, Cosart C, Hebert D, de Moor C. Child-reported family and peer influences on fruit, juice and vegetable consumption: reliability and validity of measures. *Health Education Research* 2001;**16**:187-200.

Cullen KW, Baranowski T, Rittenberry L, Cosart C, Owens E, Hebert D *et al.* Socioenvironmental influences on children's fruit, juice and vegetable consumption as reported by parents: reliability and validity of measures. *Public Health Nutrition* 2000;**3**:345-56.

Cummins S, Macintyre S. The location of food stores in urban areas: a case study in Glasgow. *British Food Journal* 1999;**101**:545-53.

Cummins S, Macintyre S. 'Food deserts' – evidence and assumption in health policy making. *British Medical Journal* 2002;**325**:436-38.

Dallongeville J, Marecaux N, Cottel D, Bingham A, Amouyel P. Association between nutrition knowledge and nutritional intake in middle-aged men from Northern France. *Public Health Nutrition* 2000;**4**:27-33.

Darnton-Hill I, Coyne ET. Feast and famine: socioeconomic disparities in global nutrition and health. *Public Health Nutrition* 1998;**1**:23-31.

Davey L and the Food Commission. *Food Magazine* 2001.

Davey Smith G, Brunner E. Socio-economic differentials in health: the role of nutrition. *Proceedings of the Nutrition Society* 1997;**56**:75-90.

Davey Smith G, Shipley MJ, Rose G. Magnitude and causes of socioeconomic differentials in mortality: further evidence from the Whitehall Study. *Journal of Epidemiology & Community Health* 1990;265-70.

Davies B, Worrall S. Basket analysis: profiling British customers. *British Food Journal* 1998;**100**:102-09.

Davies D, Madran C. Time, food shopping and food preparation: some attitudinal linkages. *British Food Journal* 1997;**99**:80-88.

de Graaf C, van der Gaag M, Kafatos A, Lennernas M, Kearney JM. Stages of dietary change among nationally-representative samples of adults in the European Union. *European Journal of Clinical Nutrition* 1997; **51**:S47-S56.

Deep in Debt. NCH Action for Children. 1992. London.

Department of Health. Dietary Reference Values for Food Energy and Nutrients for the United Kingdom. 41. 1991. London, H.M. Stationery Office. Report of the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy.

Department of Health. Health Survey for England 1995. Prescott-Clarke P and Primatesta P. 1997. London, The Stationery Office.

Department of Health. Low income, food, nutrition and health: strategies for improvement. 1996. London, H.M. Stationery Office.

Department of Health. Nutritional Aspects of the Development of Cancer. 48. 1998. London, The Stationery Office. Report of the Working Group on Diet and Cancer of the Committee on Medical Aspects of Food and Nutrition Policy.

Department of Health. Saving Lives: Our Healthier Nation. 1999. London, H.M. Stationery Office.

Department of Health. The Health of the Nation. A Strategy for Health in England. 1992. London, H.M. Stationery Office.

Department of Social Security. Opportunity for all - Tackling poverty and social exclusion. 1999. London, H.M. Stationery Office.

Department of the Environment, Transport and the Regions. Indices of Deprivation 2000. 2000. London, H.M. Stationery Office.

Derrickson JP, Fisher AG, Anderson JEL, Brown AC. An assessment of various household food security measures in Hawaii has implications for national food security research and monitoring. *Journal of Nutrition* 2001;**131**:749-57.

Dittus KL, Hillers VN, Beerman KA. Benefits and barriers to fruit and vegetable intake: relationship between attitudes and consumption. *Journal of Nutrition Education* 1995;**27**:120-26.

Dixey R. Gender perspectives on food and cooking skills. *British Food Journal* 1996;**98**:35-41.

Dixon LB, Winkleby MA, Radimer KL. Dietary intakes and serum nutrients differ between adults from food-insufficient and food-sufficient families: Third national health and nutrition examination survey, 1988-1994. *Journal of Nutrition* 2001;**131**:1232-46.

Donkin AJ, Dowler EA, Stevenson SJ, Turner SA. Food availability at a local level: do the poor have worse choice? *Proceedings of the Nutrition Society* 2000;**58:**153a.

Donkin AJ, Dowler EA, Stevenson SJ, Turner SA. Mapping access to food in a deprived area: the development of price and availability indices. *Public Health Nutrition* 2000;**3**:31-38.

Donkin AJM, Dowler EA, Stevenson SJ, Turner SA. Mapping access to food at a local level. *British Food Journal* 1999;**101** :554-64.

Dowler E and Calvert C. Nutrition and diet in lone-parent families in London. 1995. London, Family Policy Studies Centre.

Dowler E, Blair A, Donkin A, Rex D, and Grundy C. Measuring access to healthy food in Sandwell. 2001. University of Warwick and Sandwell Health Action Zone.

Dowler E, Calvert C. Looking for 'fresh' food: diet and lone parents. *Proceedings of the Nutrition Society* 1995;**54**:759-69.

Dowler E. Budgeting for food on a low income in the UK: the case of lone-parent families. *Food Policy* 1997;**22**:405-17.

Dowler E. Inequalities in diet and physical activity. *Public Health Nutrition* 2001;**4**:701-09.

Drewnowski A, Henderson SA, Levine A, Hann C. Taste and food preferences as predictors of dietary practices in young women. *Public Health Nutrition* 1999;**2**:513-19.

Ellaway A, Macintyre S. Shopping for food in socially contrasting localities. *British Food Journal* 2000;**102**:52-59.

Erkkila AT, Sarkkinen ES, Lehto S, Pyorala K, Uusitupa MI. Diet in relation to socioeconomic status in patients with coronary heart disease. *European Journal of Clinical Nutrition* 1999;**53**:662-68.

Eurodiet. Eurodiet core report. Kafatos AG and Codrington CA. 2000. Crete.

Fagerli R Aa, Wandel M. Gender differences in opinions and practices with regard to a 'healthy diet'. *Appetite* 1999;**32** :171-90.

Family Budget Unit. *Low cost but acceptable: a minimum income standard for the UK: families with children.* Parker H. ed. Bristol: Policy Press, 1998.

Family Expenditure Survey. Family Spending. A report on the 1999-2000 Family Expenditure Survey. 2000. London, The Stationery Office.

FAO/WHO. Preparation and use of food-based dietary guidelines - Report of a joint FAO/WHO consultation Nicosia, Cyprus. 1996. Geneva, WHO. Nutrition Programme.

Finch S, Doyle W, Lowe C, Bates CJ, Prentice A, Smithers G, and Clarke PC. National Diet and Nutrition Survey: people aged 65 years and over, Volume 1: Report of the diet and nutrition survey. 1998. London, H.M. Stationery Office.

Food and Agricultural Organization of the United Nations. Rome declaration on world food security and world food summit plan of action. 1996.

Food Magazine. Food prices favour worse diets. *Food Magazine* 2000; **48**: pp20.

Forsyth A, Macintyre S, Anderson A. Diets for disease? Intraurban variation in reported food consumption in Glasgow. *Appetite* 1994;**22**:259-74.

Fraser GE, Welch A, Luben R, Bingham SE, Day NE. The effect of age, sex, and education on food consumption of a middle-aged English cohort - EPIC in East Anglia. *Preventive Medicine* 2000;**30**:26-34.

Frongillo Jr. EA, Rauschenbach BS, Olson CM, Kendall A, Colmenares AG. Questionnaire-based measures are valid for the identification of rural households with hunger and food insecurity. *Journal of Nutrition* 1997;**127**:699-705.

Furey S, McIlveen H, Strugnell C, Armstrong G. Cooking skills: a diminishing art? *Nutrition and Food Science* 2000;**30**:16-20.

Furst T, Connors M, Bisogni CA, Sobal J, Winter Falk L. Food choice: A conceptual model of the process. *Appetite* 1996;**26**:247-66.

Gerhardy H, Hutchins RK, Marshall DW. Socio-economic criteria and food choice across meals. *British Food Journal* 1995;**97**:24-28.

Gibson EL, Wardle J, Watts CJ. Fruit and vegetable consumption, nutritional knowledge and beliefs in mothers and children. *Appetite* 1998;**31**:205-28.

Glanz K, Basil M, Maibach E, Goldberg J, Snyder D. Why Americans eat what they do: Taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *Journal of the American Dietetic Association* 1998;**98**:1118-26.

Greenwood D, Cade JE, Draper A, Barrett JH, Calvert C, Greenhalgh A. Seven unique food consumption patterns identified among women in the UK Women's Cohort Study. *European Journal of Clinical Nutrition* 2000;**54**:314-20.

Gregory J, Foster K, Tyler H, and Wiseman M, for the Office of Population Censuses and Surveys. The Dietary and Nutritional Survey of British Adults. 1990. London, H.M. Stationery Office.

Gregory J, Lowe S, Bates CJ, Prentice A, Jackson LV, Smithers G, Wenlock R, and Farron M. National Diet and Nutrition Survey: young people aged 4 to 18 years, Volume 1: Report of the diet and nutrition survey. 2000. London, The Stationery Office.

Gregory JR, Collins DL, Davies PSW, Hughes JM, and Clarke PC. National Diet and Nutrition Survey: children aged 1 1/2 to 4 1/2years, Volume 1: Report of the diet and nutrition survey. 1995. London, The Stationery Office.

Griffiths S, Chipperfield B, Todd S, Rushton C, McCarthy M. Dietary beliefs, practices and attitudes of adults in an inner city population. *Journal of Human Nutrition and Dietetics* 1994;**7**:319-34.

Guy CM. Corporate strategies in food retailing and their local impacts; a case study of Cardiff. *Environment and Planning A* 1996;**28**:1575-602.

Halladorsson M, Kunst AE, Kohler L, Mackenbach JP. Socioeconomic inequalities in the health of children and adolescents. *European Journal of Public Health* 2000;**10**:281-88.

Hanes FA, MacDonald A. 'Can I afford the diet? 1988'. *Journal of Human Nutrition & Dietetics* 1988;**1**:389-96.

Haste FM, Brooke OG, Anderson HR, Bland JM, Peacock JL. Social determinants of nutrient intake in smokers and non-smokers during pregnancy. *Journal of Epidemiology & Community Health* 1990;**44**:205-09.

Hebert JR, Peterson KE, Hurley TG, Stoddard AM, Cohen N, Field AE, Sorensen G. The effect of social desirability trait on self-reported dietary measures among multi-ethnic female health center employees. *Annals of Epidemiology* 2001;11:417-27.

Hiller JE and McMichael AJ. Ecological Studies. In Margetts BM, Nelson M, eds. *Design Concepts In Nutritional Epidemiology*, pp 341-68. Oxford: Oxford University Press, 1997.

Hu FB, Rimm E, Smith-Warner SA, Feskanich D, Stampfer MJ, Ascherio A *et al.* Reproducibility and validity of dietary patterns assessed with a food-frequency questionnaire. *American Journal of Clinical Nutrition* 1999;**69**:243-49.

Hulshof KF, Lowik MR, Kok FJ, Wedel M, Brants HA, Hermus RJ *et al.* Diet and other life-style factors in high and low socio-economic groups (Dutch Nutrition Surveillance System). *European Journal of Clinical Nutrition* 1991;**45**:441-50.

Hunt P, Rayner M, Gatenby S. A national food guide for the UK? Background and development. *Journal of Human Nutrition & Dietetics* 1995;**8**:315-22.

Hupkens CL, Knibbe RA, Drop MJ. Social class differences in food consumption. *European Journal of Public Health* 2000;**10**:108-13.

Hupkens CL, Knibbe RA, Drop MJ. Social class differences in women's fat and fibre consumption: a cross-national study. *Appetite* 1997;**28**:131-49.

Irala-Estévez J, Groth M, Johansson L, Oltersdorf U, Prättälä R, Martínez-González MA. A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables. *European Journal of Clinical Nutrition* 2000;**54**:706-14.

James WP, Nelson M, Ralph A, Leather S. Socioeconomic determinants of health. The contribution of nutrition to inequalities in health. *British Medical Journal* 1997;**314**:1545-49.

Joffe M, Robertson A. The potential contribution of increased vegetable and fruit consumption to health gain in the European Union. *Public Health Nutrition* 2001;**4**:893-901.

Johansson L, Thelle DS, Solvoll K, Bjorneboe GE, Drevon CA. Healthy dietary habits in relation to social determinants and lifestyle factors. *British Journal of Nutrition* 1999;**81**:211-20.

Kafatos A and Codrington CA. EURODIET Core Report. 2000. Crete, University of Crete.

Kafatos A, Manios Y, Markatji I, Giachetti I, vaz de Almeida MD, Engstrom LM. Regional, demographic and national influences on attitudes and beliefs with regard to physical activity, body weight and health in a nationally representative sample in the European Union. *Public Health Nutrition* 1999;**2**:87-96.

Kearney JM, Gibney MJ, Livingstone BE, Robson PJ, Kiely M, Harrington K. Attitudes towards and beliefs about nutrition and health among a random sample of adults in the Republic of Ireland and Northern Ireland. *Public Health Nutrition* 2001;**4**:1117-26.

Kearney JM, McElhone S. Perceived barriers in trying to eat healthier - results of a pan-EU consumer attitudinal survey. *British Journal of Nutrition* 1999;**81**:S133-S37.

Kearney M, Gibney MJ, Martinez JA, de Almeida MDV, Friebe D, Zunft HJF *et al.* Perceived need to alter eating habits among representative samples of adults from all member states of the European Union. *European Journal of Clinical Nutrition* 1997;**51**:S30-S35.

Klaver W, Burema J, Van Staveren WA, Knuiman JT. Definition of terms. In Cameron ME, Van Staveren WA, eds. *Manual on methodology for food consumption studies*, pp 11-23. Oxford: Oxford University Press, 1988.

Krebs-Smith SM, Kantor LS. Choose a variety of fruits and vegetables daily: Understanding the complexities. *Journal of Nutrition* 2001;**131**:S487-S501.

Kristal AR, Goldenhar L, Muldoon J, Morton RF. Evaluation of a supermarket intervention to increase consumption of fruits and vegetables. *American Journal of Health Promotion* 1997;**11**:422-25.

Kushi LH, Folsom AR, Jacobs-DR J, Luepker RV, Elmer PJ, Blackburn H. Educational attainment and nutrient consumption patterns: the Minnesota Heart Survey. *Journal of the American Dietetic Association* 1988;**88**:1230-36.

Labonte R. Healthy public policy and the World Trade Organization: a proposal for an international health presence in future world trade/investment talks. *Health Promotion International* 1998;**13**:245-56.

Lagiou P, Trichopoulou A, Henderickx HK, Kelleher C, Leonhauser IU, Moreiras O *et al.* Household budget survey nutritional data in relation to mortality from coronary heart disease, colorectal cancer and female breast cancer in European countries. *European Journal of Clinical Nutrition* 1999;**53**:328-32.

Lampe JW. Health effects of vegetables and fruit: assessing mechanisms of action in human experimental studies. *American Journal of Clinical Nutrition* 1999;**70**:475S-90S.

Lang T, Andrews H, Beadle C, and Hannon E. Jam Tomorrow. A report of the first findings of a pilot study of the food circumstances, attitudes and consumption of 1,000 people on low incomes in the North of England. 1984. Manchester Polytechnic, Manchester.

Lang T, Caraher M. Access to healthy foods: part II. Food poverty and shopping deserts: what are the implications for health promotion policy and practice? *Health Education Journal* 1998;**57**:202-11.

Lang T. Diet, health and globalization: five key questions. *Proceedings of the Nutrition Society* 1999;**58**:335-43.

Lang T. Food & nutrition in the EU: Its implications for public health. Dr Olivier Weil. 1998. European Union. European Union Main Public Health Issues Project.

Lang T. Food and poverty: beyond blaming the poor. *Primary Health Care* 1995;**5**:10-16.

Lang T. The new GATT Round; Whose development? Whose health? *Journal of Epidemiology & Community Health* 1999;**53**:681-82.

Lang T. The new globalisation, food and health: is public health receiving its due emphasis? *Journal of Epidemiology & Community Health* 1998;**52**:538-39.

Lappalainen R, Saba A, Holm L, Naismith DJ, Gibney MJ. Difficulties in trying to eat healthier: descriptive analysis of perceived barriers for healthy eating. *European Journal of Clinical Nutrition* 1997;**51**:S36-S40.

Leather S, Dowler E. Intake of micronutrients in Britain's poorest fifth has declined. *British Medical Journal* 1997;**314**:1412-13.

Leather S. Fruit and vegetables: consumption patterns and health consequences. *British Food Journal* 1995;**97**:10-17.

Leather S. Less money, less choice: poverty and diet in the UK today. In National Consumer Council, ed. *Your food: whose choice?*, pp 72-94. London: H.M. Stationery Office, 1992.

Leeds Health Authority. Leeds Health Improvement Programme 1999-2002. 1999.

Lennernas M, Fjellstrom C, Becker W, Giachetti I, Schmitt A, Remaut de Winter AM *et al.* Influences on food choice perceived to be important by nationally-representative samples of adults in the European Union. *European Journal of Clinical Nutrition* 2001;**51**:S8-S15.

Light L, Tenney J, Portnoy B, Kessler L, Brown Rodgers A, Patterson B *et al.* Eat for health: A nutrition and cancer control supermarket intervention. *Public Health Reports* 1989;**104**:443-50.

Lipton M. Challenges to meet: food and nutrition security in the new millennium. *Proceedings of the Nutrition Society* 2001;**60**:203-14.

Little P, Barnett J, Kinmouth A-L, Margetts B, Gabbay J, Thompson R *et al.* Can dietary assessment in general practice target patients with unhealthy diets? *British Journal of General Practice* 2000;**50**:43-45.

Little P, Barnett J, Margetts B, Kinmouth A-L, Gabbay J, Thompson R *et al.* The validity of dietary assessment in general practice. *Journal of Epidemiology & Community Health* 1999;**50**:165-72.

Lloyd HM, Paisley CM, Mela DJ. Changing to a low fat diet: attitudes and beliefs of UK consumers. *European Journal of Clinical Nutrition* 1993;**47**:361-73.

Lorenzana PA, Sanjur D. Abbreviated measures of food sufficiency validly estimate the food security level of poor households: Measuring household food security. *Journal of Nutrition* 1999;**129**:687-92.

Lowe MS. Britain's regional shopping centres: New urban forums? *Urban Studies* 2000;**37**:261-74.

Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stags of the socioeconomic lifecourse. *Social Science and Medicine* 1997;**44**:809-19.

Macintyre S, Ellaway A, Der G, Ford G, Hunt K. Do housing tenure and car access predict health because they are simply markers of income or self esteem? A Scottish study. *Journal of Epidemiology & Community Health* 1998;**52**:657-64.

Margetts BM, Martinez JA, Saba A, Holm L, Kearney M. Definitions of 'health' eating: a pan-EU survey of consumer attitudes to food, nutrition and health. *European Journal of Clinical Nutrition* 1997;**51**:S23-S29.

Margetts BM and Nelson M. Overview of the principles on nutritional epidemiology. In Margetts BM, Nelson M, eds. *Design concepts in nutritional epidemiology*, pp 3-38. Oxford: Oxford University Press, 1997.

Margetts BM, Rogers E, Widhalm K, Remaut de Winter AM, Zunft HJF. Relationship between attitudes to health, body weight and physical activity and level of physical activity in a nationally representative sample in the European Union. *Public Health Nutrition* 1999;**2**:97-104.

Margetts BM, Thompson RL, Speller VM, McVey D. Factors which influence 'healthy' eating patterns: results from the 1993 Health Education Authority health and lifestyle survey in England. *Public Health Nutrition* 1998;**1**:193-98.

Margetts BM, Warm DL, Wrigley N, Jackson AA. Hunger and food insecurity in the UK: is there a problem? 2002 Submitted to British Medical Journal.

Marmot MG, Davey Smith G, Stansfield S, Patel C, North F, Head J *et al*. Health inequalities among British civil servants: the Whitehall II study. *The Lancet* 1991;**337**:1387-93.

Maxwell DG. Measuring food insecurity: the frequencies and severity of 'coping strategies'. *Food Policy* 1996;**21**:291-303.

McGlone P, Dobson, B. M., Dowler, E., and Nelson, M. Food projects and how they work. 1999. England, Joseph Rowntree Foundation.

McGoldrick PJ, Andre E. Consumer misbehaviour. Promiscuity or loyalty in grocery shopping. *Journal of Retailing and Consumer Services* 1997;**4**:73-81.

McHardy A. Collaboration brings the unemployed back into the workforce. The Guardian Newspaper. 11th July 2001. London.

McKenzie J. The impact of economic and social status on food choice. *Proceedings of the Nutrition Society* 1974;**33**:67-73.

McMichael AJ. Impact of climatic and other environmental changes on food production and population health in the coming decades. *Proceedings of the Nutrition Society* 2001;**60**:195-201.

Mela DJ. Food choice and intake; the human factor. *Proceedings of the Nutrition Society* 1999;**58**:513-21.

Ministry of Agriculture Fisheries and Food and Office for National Statistics. National Food Survey 1999 - Annual report on food expenditure, consumption and nutrient intakes. 2000. London, The Stationery Office.

Ministry of Agriculture Fisheries and Food. The dietary and nutritional survey of British adults - further analysis. 1994. London, H.M. Stationery Office.

Monbiot G. Superstores brand us to ensure we belong to them. The Guardian Newspaper. 31st July 2001. London.

Mooney C. Cost and availability of healthy food choices in a London health district. *Journal of Human Nutrition & Dietetics* 1990;**3**:111-20.

Morris JN, Donkin AJM, Wonderling D, Wilkinson P, Dowler EA. A minimum income for healthy living. *Journal of Epidemiology & Community Health* 2001;**54**:885-89.

Murcott A. Food choice, the social sciences and 'The Nation's Diet' research programme. In Murcott A, ed. *The Nations's Diet. The Social Science of Food Choice*, London: Longman, 1998.

Murcott A. Understanding life-style and food use: contributions from the social sciences. *British Medical Bulletin* 2002;56:121-132.

Narhinen M, Nissinen A, Puska P. Healthier choices in a supermarket. *British Food Journal* 1999;**101**:99-107.

National Children's Home. NCH poverty and nutrition survey. 1991. London, National Children's Home.

National Food Alliance. Food poverty: What are the policy options? National Food Alliance. 1998. London

National Food Alliance. Myths about Food and Low Income. National Food Alliance. 1997. London.

National Heart Forum. At least five a day. Strategies to increase vegetable and fruit consumption. Imogen Sharp. 1997. London, The Stationery Office.

National Heart Forum. Preventing coronary heart disease. The role of antioxidants, vegetables and fruit. Lesley Rogers and Imogen Sharp. 1997. London, The Stationery Office.

Nayga Jr RM, Weinberg Z. Supermarket access in inner cities. *Journal of Retailing and Consumer Services* 1999;**6**:141-45.

Nelson M and Bingham SA. Assessment of food consumption and nutrient intake. In Margetts BM, Nelson M, eds. *Design Concepts in Nutritional Epidemiology*, pp 123-69. Oxford: Oxford University Press, 1997.

Nelson M, Dyson PA, Paul AA. Family food purchases and home food consumption: comparison of nutrient contents. *British Journal of Nutrition* 1985;**54**:373-87.

Nelson M, Peploe K. Construction of a modest-but-adequate food budget for households with two adults and one pre-school child: a preliminary investigation. *Journal of Human Nutrition & Dietetics* 1990;**3**:121-40.

Nelson M. Childhood Nutrition and Poverty. *Proceedings of the Nutrition Society* 2000;**59**:307-15.

Nelson M. Developments in the UK: work of the Low Income Project Team. *Proceedings of the Nutrition Society* 1997;**56**:91-100.

Nelson M. The distribution of nutrient intake within families. *British Journal of Nutrition* 1986;**55**:267-77.

Nelson M. The validation of dietary assessment. In Margetts BM, Nelson M, eds. *Design concepts in nutritional epidemiology*, pp 241-72. Oxford: Oxford University Press, 1997.

Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: a review. *International Journal of Epidemiology* 1997;**26**:1-13.

Ni Mhurchu C. Effectiveness of motivational interviewing in dietary education for people with hyperlipidaemia. 1997. PhD Thesis, University of Southampton.

O'Brien LG, Guy CM. Locational variability in retail grocery price. *Environment and Planning A* 1985;**17**:953-62.

Ocke MC, Bueno-de-Mesquita HB, Goddijn HE, Jansen AM, Pols MA, Van Staveren WA *et al.* The Dutch EPIC food frequency questionnaire. I. Description of the questionnaire, and relative validity and reproducibility for food groups. *International Journal of Epidemiology* 1997;**26**:S37-S48.

Office for Health Economics. Morbidity and mortality rates in the UK. 1997. London, H.M. Stationery Office.

Office for National Statistics. 2001. London, The Stationery Office.

Office for National Statistics. Family Expenditure Survey - Family Spending. A report on the 1999-2000 Family Expenditure Survey. 2000. London, The Stationery Office.

Office of Population Censuses and Surveys and Office for National Statistics, Social Survey Division. Health survey for England 1994. 1996. London, H.M. Stationery Office.

Office of Population Censuses and Surveys. The 1991 Census. 1993. London. H.M. Stationery Office.

Olson CM. Nutrition and Health Outcomes Associated with Food Insecurity and Hunger. *Journal of Nutrition* 1999;**129**:521S-24S.

Osler M. The food intake of smokers and nonsmokers: The role of partner's smoking behavior. *Preventive Medicine* 1998;**27**:438-43.

Palaniappan U, Jacobs Starkey L, O'Loughlin J, Gray-Donald K. Fruit and vegetable consumption is lower and saturated fat intake is higher among Canadians reporting smoking. *Journal of Nutrition* 2001;**131**:1952-58.

Paramenter K, Waller J, Wardle J. Demographic variation in nutrition knowledge in England. *Health Education Research* 2000;**15**:163-74.

Piachaud D and Webb J. The price of food: missing out on mass consumption. 1996. Suntory and Toyota International Centre for Economics and Related Disciplines. London School of Economics. London.

Povey R, Conner M, Sparks P, James R, Shepherd R. Interpretations of healthy and unhealthy eating, and implications for dietary change. *Health Education Research* 1998;**13**:171-83.

Prevost AT, Whichelow MJ, Cox BD. Longitudinal dietary changes between 1984-5 and 1991-2 in British adults: association with socio-demographic, lifestyle and health factors. *British Journal of Nutrition* 1997;**78**:873-88.

Project Action Team 13 2000 see http://www.doh.gov.uk/shoppingaccess.htm

Pryer JA, Nichols R, Elliott P, Thakrar B, Brunner E, Marmot M. Dietary patterns among a national random sample of British adults. *Journal of Epidemiology & Community Health* 2001;**55**:29-37.

Randall E, Marshall JR, Graham S, Brasure J. Patterns in food use and their associations with nutrient intakes. *American Journal of Clinical Nutrition* 1990;**52**:739-45.

Raven H and Lang T. Off our trolleys? 1995. London, Institute for Public Policy Research.

Reisig VMT, Hobbiss A. Food deserts and how to tackle them: a study of one city's approach. *Health Education Journal* 2000;**59**:137-49.

Riboli E, Toniolo P, Kaaks R, Shore RE, Casagrande C, Pasternack BS. Reproducibility of a food frequency questionnaire used in the New York university's women's health study: effect of self-selection by study subjects. *European Journal of Clinical Nutrition* 1997;**51**:437-42.

Riboli E, Norat T. Cancer prevention and diet: opportunities in Europe. *Public Health Nutrition* 2001;**4**:475-84.

Riches G. Hunger, food security and welfare policies: issues and debates in First World societies. *Proceedings of the Nutrition Society* 1997;**56**:63-74.

Robertson A. WHO tackles food inequalities: Europe's first comprehensive Food and Nutrition Action Plan debate, 8-10 November 1999, Malta. *Public Health Nutrition* 2000;**3**:99-101.

Robinson N, Caraher M, Lang T. Access to shops: the views of low-income shoppers. *Health Education Journal* 2001;**59**:121-36.

Roos E, Prattala R, Lahelma E, Kleemola P, Pietinen P. Modern and healthy?: socioeconomic differences in the quality of diet. *European Journal of Clinical Nutrition* 1996;**50**:753-60.

Roos G, Johansson L, Kasmel A, Klumbiene J, Prattala R. Disparities in vegetable and fruit consumption: European cases from the north to the south. *Public Health Nutrition* 2000;**4**:35-43.

Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *Journal of Nutrition* 1999;**129**:517S-20S.

Rose G, Marmot MG. Social class and coronary heart disease. *British Heart Journal* 1981;**45**:13-19.

Roux C, Le Couedic P, Durand-Gasselin S, Luquet FM. Consumption patterns and food attitudes of a sample of 657 low-income people in France. *Food Policy* 2000;**25**:91-103.

Satia JA, Kristal AR, Curry S, Trudeau E. Motivations for healthful dietary change. *Public Health Nutrition* 2001;**4**:953-59.

Saul C, Payne N. How does the prevalence of specific morbidities compare with measures of socio-economic status at small area level? *Journal of Public Health Medicine* 1999;**21**:340-47.

Schulze M, Hoffman K, Kroke A, Boeing H. Dietary patterns and their association with food and nutrient intake in the European Prospective Investigation into Cancer and Nutrition (EPIC) - Potsdam Study. *British Journal of Nutrition*;85:363-373.

Shepherd R, Towler G. Nutrition knowledge, attitudes and fat intake: application of the theory of reasoned action. *Journal of Human Nutrition & Dietetics* 1992;**5**:387-97.

Shepherd R, Stockley L. Fat consumption and attitudes towards food with a high fat content. *Human Nutrition: Applied Nutrition* 1985;**39**:431-42.

Shepherd R. Social determinants of food choice. *Proceedings of the Nutrition Society* 1999;**58**:807-12.

Shepherd R. Evolving attitudes to food and nutrition. *Proceedings of the Nutrition Society* 2002;**61**:267-272.

Smith AM, Baghurst KI. Public health implications of dietary differences between social status and occupational category groups. *Journal of Epidemiology & Community Health* 1992;**46**:409-16.

Social Exclusion Unit. A New Commitment to Neighbourhood Renewal - National Strategy Action Plan. 2000. London, The Cabinet Office.

Social Exclusion Unit. National Strategy for Neighbourhood Renewal: Policy Action Team Audit. 2001. London, The Cabinet Office.

Sooman A, Macintyre S, Anderson A. Scotland's health--a more difficult challenge for some? The price and availability of healthy foods in socially contrasting localities in the west of Scotland. *Health Bulletin* 1993;**51**:276-84.

Steele PA, Dobson A, Alexander H, Russell A. Who eats what? A comparison of dietary patterns among men and women in different occupational groups. *Australian Journal of Public Health* 1991;**15**:286-95.

Stitt S. An international perspective on food and cooking skills in education. *British Food Journal* 1996;**98**:27-34.

Stratton P, Bromley K. Families' accounts of the causal processes in food choice. *Appetite* 1999;**33**:89-108.

Subar AF, Harlan LC, Mattison ME. Food and nutrient intake differences between smokers and non-smokers in the US. *American Journal of Public Health* 1990;**80**:1323-29.

Sun Lee J, Frongillo Jr EA. Nutritional and health consequences are associated with food insecurity among U.S. elderly persons. *Journal of Nutrition* 2001;**131**:1503-09.

Sustain. A battle in store: A discussion of the social impact of the major UK supermarkets. 2001. London, Sustain.

Takano T, Nakamura K. An analysis of health levels and various indicators of urban environments for Healthy Cities projects. *Journal of Epidemiology & Community Health* 2001;**55**:263-70.

Tarasuk VS, Beaton GH. Women's dietary intakes in the context of household food insecurity. *Journal of Nutrition* 1999;**129**:672-79.

Taylor Nelson Sofres. Family Food Panel. See www.tnsofres.com/uk

Thompson RL, Margetts BM, Speller VM, McVey D. The Health Education Authority's health and lifestyle survey 1993: who are the low fruit and vegetable consumers? *Journal of Epidemiology & Community Health* 1999;**53**:294-99.

Thompson RL, Margetts BM, Wood DA, Jackson AA. Cigarette smoking and food and nutrient intakes in relation to coronary heart disease. *Nutrition Research Reviews* 1992;**5**:131-52.

Townsend MS, Peerson J, Love B, Achterberg C, Murphy SP. Food insecurity is positively related to overweight in women. *Journal of Nutrition* 2001;**131**:1738-45.

Townsend P. Deprivation. *Journal of Social Policy* 1987;**16**:125-46.

Travers KD. The social organization of nutritional inequities. *Social Science and Medicine* 1996;**43**:543-53.

Treiman K, Freimuth V, Damron D, Lasswell A, Ankliker J, Havas S *et al.* Attitudes and behaviors related to fruits and vegetables among low-income women in the WIC program. *Journal of Nutrition Education* 1996;**28**:149-56.

Turrell G. Socioeconomic differences in food preference and their influence on healthy food purchasing choices. *Journal of Human Nutrition & Dietetics* 1998;**11**:135-49.

Uttley S. Hunger in New Zealand: a question of rights. In Riches G, ed. *First World Hunger: Food Security and Welfare Politics*, London: Macmillan, 1997.

van Rossum CTM, van de Mheen H, Mackenbach JP, Grobbee DE. Socioeconomic status and mortality in Dutch elderly people. *European Journal of Public Health* 2000;**10**:255-61.

van't Veer P, Jansen MCJF, Klerk M, Kok FJ. Fruits and vegetables in the prevention of cancer and cardiovascular disease. *Public Health Nutrition* 2000;**3**:103-07.

Villaneuva V, Garcia AM. Mortality and socioeconomic indicators in Spain 1962-1991. *European Journal of Public Health* 2000;**10**:268-73.

Wandel M. Dietary intake of fruits and vegetables in Norway: influence of life phase and socio-economic factors. *International Journal of Food Science & Nutrition* 1995;**46**:291-301.

Wardle J, Paramenter K, Waller J. Nutrition knowledge and food intake. *Appetite* 2000;**34**:269-75.

Wearne SJ, Day MJL. Clues for the development of food-based dietary guidelines: how are dietary targets being achieved by UK consumers? *British Journal of Nutrition* 1999;**81**:S119-S26.

Wheeler EF. Intra-household food and nutrient allocation. *Nutrition Research Reviews* 1991;**4**:69-81.

Whelan AR, Wrigley N, Cannings E, Warm DL. Life in a food desert. *Urban Studies* 2002:**39**:2083-2100.

Whichelow MJ, Erzinclioglu SW, Cox BD. Some regional variations in dietary patterns in a random sample of British adults. *European Journal of Clinical Nutrition* 1991;**45**:253-62.

Whichelow MJ. Choice of spread by a random sample of the British population. Association with socio-economic status and risk factors for cardiovascular disease. *European Journal of Clinical Nutrition* 1989;**43**:1-10.

Whitehead M. Food deserts: what's in a name? *Health Education Journal* 1998;**57**:189-90.

Wilkinson RG. Health Inequalities: relative or absolute material standards. *British Medical Journal* 1997;**314:**591-95.

Willett W. In Willett W, ed. *Nutritional Epidemiology*, pp 187-188. New York: Oxford University Press, 1998.

Willett W. Convergence of philosophy and science: the third international congress on vegetarian nutrition. *American Journal of Clinical Nutrition* 1999;**70S**:434S-38S.

Williams D, Prevost A, Whichelow M, Cox B, Day N, Wareham N. A cross-sectional study of dietary patterns with glucose intolerance and other features of the metabolic syndrome. *British Journal of Nutrition* 2000;**83**:257-66.

Wirfaelt E, Mattisson I, Gullberg B, Berglund G. Food patterns defined by cluster analysis and their utility as dietary exposure variables: a report from the Malmo diet and cancer study. *Public Health Nutrition* 2000;**3**:159-73.

Woodward M, Bolton-Smith C, Tunstall-Pedoe H. Deficient health knowledge, diet, and other lifestyles in smokers: Is a multifactorial approach required? *Preventive Medicine* 1994;**23**:354-61.

Working Paper of the French Presidency of the European Union. Working Paper: Health and Human Nutrition: Elements for European Action. 2000.

World Cancer Research Fund/American Institute for Cancer Research. Food, nutrition and the prevention of cancer: a global perspective. 1997. Menasha, BANTA Book Group.

Wright LT, Nancarrow C, Kwok PMH. Food taste preferences and cultural influences on consumption. *British Food Journal* 2001;**103**:348-57.

Wrigley N, Guy C, Lowe M. Urban regeneration, social exclusion and large store development: The Seacroft development in context. *Urban Studies* 2002:**39**:2101-14.

Wrigley N, Warm DL, Margetts BM, Whelan AR. Assessing the impact of improved retail access on diet in a 'food desert': a preliminary report. *Urban Studies* 2002:**39**:2061-82.

Wrigley N. After the store wars. Towards a new era of competition in UK food retailing? *Journal of Retailing and Consumer Services* 1994;**1**:5-20.

Wrigley N. How British retailers have shaped food choice. In Murcott A., ed. *The Nation's Diet: The Social Sciences of Food Choice*, pp 112-28. London: Longman, 1998.

Wrigley N. Food deserts in British Cities: policy context and research priorities. *Urban Studies* 2002;**39**:2029-40.

Wrigley N. PPG6 and the contemporary UK food store development dynamic. *British Food Journal* 1998;**100**:154-61.

Wrigley N. Sunk costs and corporate restructuring: British food retailing and the property crisis. In Wrigley N., Lowe M.S., eds. *Retailing, Consumption and Capitol*, pp 116-36. London: Longman, 1996.

Wrigley N. Understanding store development programmes in post-property-crisis UK food retailing. *Environment and Planning A* 1998;**30**:15-35.

Wylie C, Copeman J, Kirk SFL. Health and social factors affecting the food choice and nutritional intake of elderly people with restricted mobility. *Journal of Human Nutrition & Dietetics* 1999;**12**:375-80.

Wynn A. Inequalities in nutrition. *Nutrition & Health* 1987;**5**:79-94.

Zunft HJF, Friebe D, Seppelt B, de Graaf C, Margetts B, Schmitt A *et al.* Perceived benefits of healthy eating among a nationally-representative sample of adults in the European Union. *European Journal of Clinical Nutrition* 1997;**51**:S41-S46.