Takeaway food served by small independent UK takeaways, its consumption, composition, and reformulation

Toni M Blackham

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Abstract

Background - Compared to England, Merseyside has a higher prevalence of adults living with overweight or obesity, lower life expectancy and significantly higher mortality rates from cardiovascular disease and cancer. Frequent consumption of fast food or takeaway food is associated with increased energy intake, weight gain and cardiovascular disease. Previous analysis has focussed on meals from fast food chains and found high levels of fat, saturated fat, and salt. Evidence of the nutritional content of takeaway food served by small independent takeaway outlets is sparse and warrants further research.

Aim and Objectives - To explore takeaway food served by small independent takeaway outlets in Merseyside. This was approached using three studies: first, an investigation of takeaway food consumption in Merseyside; second an analysis of nutritional composition of takeaway food using public analyst laboratory data supplied by local councils; third, reformulation and sensory acceptance testing of a takeaway meal to improve its nutritional content.

Methods – Takeaway food consumption was investigated using a quantitative questionnaire which was distributed to staff and students at Liverpool John Moores University (n = 461). Nutritional composition of takeaway meals from Indian, Chinese, kebab, pizza and English-style establishments (n = 511; meal types = 28) were analysed for portion size, energy, total fat, SFA, TFA, salt and total sugars. Statistical analysis was conducted using SPSS. Recipe reformulation was performed as part of the *Eatright* Liverpool project using information collected by Liverpool City Council Trading Standards from independent takeaway outlets in Liverpool.

Results – Takeaway consumption was popular, with a fifth of respondents eating takeaway food once or twice a week and almost half eating it once or twice a month. Frequent takeaway consumption was significantly associated with sex, age, BMI, and marital status (p <0.05). The odds of being a frequent takeaway consumer were almost four times greater for respondents who were "usually too busy to cook". Greater knowledge about the healthiness of takeaways was associated with respondents who ate takeaways less frequently, were younger, females, single/divorced/separated or were university educated. Greater receptiveness to healthier takeaways was associated with respondents who ate takeaways more frequently, had higher BMI or were female.

Takeaway meals showed large portion sizes and high levels of energy, fat, saturated fat and salt. Comparing medians (interquartile range) for different meal categories, Chinese meals had the largest portion sizes (830 g (694-935 g)), per portion. Pizzas contained the highest energy content (1820 kcal (1469-2152 kcal)) and salt content (9.15 g (6.79–11.96 g)) whilst English meals had the highest total fat content (79.8 g (65.7-94.0 g)) and Kebabs the highest TFA content (2.68 g (1.85-4.45 g)). There was a high degree of variability between and within categories. There were also large differences between specific takeaway meals, for instance, pizzas and fish and chips were high in SFA, many Chinese meals were high in salt, kebabs were high in fat, SFA, and salt and some of the meals were very high in sugar, specifically sweet and sour meals.

Recipe reformulation was successfully used to improve the nutritional composition of a takeaway meal by reducing the amount of salt and fat, and sensory acceptance testing showed consumers preferred the reformulated recipe in comparison with the original recipe ($p = 0.011$)

Conclusions – Takeaway consumption in Merseyside was commonplace and analysis of takeaway food highlights the need for reductions in energy, fat, SFA, salt (or sugar) in takeaway food served due to the negative health outcomes of frequent consumption. Furthermore, a takeaway meal was successfully reformulated to be lower in salt and fat without being detrimental to acceptability with consumers, showing that healthier takeaways can be prepared when working in partnership with chefs in takeaway outlets.

Contribution to knowledge – Encouraging independent takeaways to make small gradual changes when preparing meals and continuing to do so, could have a positive impact on the health of the population of Merseyside and work towards reducing the gap in health inequalities. These findings will add to the existing evidence base and help to inform governments public health policies to improve the health of takeaway consumers in the UK.

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Glossary of Terms

AFHF	Away from home food
ATNI	Access to Nutrition Initiative
BDA	British Dietetic Association
CARDIA	Coronary Artery Risk Development in Young Adults
CIEH	Chartered Institute of Environmental Health
CI	Confidence Interval
DALYS	Disability Adjusted Life Years
DEFRA	Department for Environment, Food, & Rural Affairs
EFS	Expenditure and Food Survey
EPIC	European Prospective Investigation into Cancer and Nutrition
FAFH	Food away from home
FEAT	Food environment assessment tool
FFA	Free Fatty Acids
FFO	Fast food outlet
GDA	Guideline Daily Allowance
GLC	Gas-Liquid Chromatography
HDL	High-density lipoprotein
HDL-C	High-density lipoprotein-cholesterol
HFSS	High fat, salt and/or sugar
HOMA	Homeostasis Model Assessment
ICC	Intraclass Correlation Coefficient
IMD	Index of Multiple Deprivation
IOI	Island of Ireland
IQR	Inter Quartile Range
iTFAs	Industrially produced trans fatty acids
QALY	Quality Adjusted Life Years
LACORS	Local Authority Coordinators of Regulatory Services
LCBA	Liverpool Chinese Business Association
LCC	Liverpool City Council
LDL	Low-density lipoprotein
LDL-C	Low-density lipoprotein-cholesterol
LEP	Liverpool City Region Local Enterprise Partnership
LJMU	Liverpool John Moores University
MAFF	Ministry of Agriculture, Fisheries and Food
MEDS	Muslim Enterprise Development Service
MSG	Monosodium Glutamate
MUFA	Monounsaturated Fatty Acids
NCD	Non-Communicable Disease
NDNS	National Diet and Nutrition Survey
NHANES	National Health and Nutrition Examination Survey
NLSY79	National Longitudinal Survey of Youth 1979 cohort
OHID	Office of Health Improvement and Disparities
PAL	Public Analyst Laboratory
PCA	Principal Components Analysis

PHE	Public Health England
PHVO	partially hydrogenated vegetable oils
PUFA	Polyunsaturated Fatty Acids
RCT	Randomised Controlled Trial
RNI	Reference Nutrient Intake
SACN	Scientific Advisory Committee on Nutrition
SD	Standard Deviation
SDIL	Soft Drinks Industry Levy
SFA	Saturated Fatty Acids
SPSS	Statistical Package for Social Sciences
T2D	Type 2 Diabetes
TFA	Trans Fatty Acids
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

Chapter 1

Introduction

1 Introduction

The aim of this thesis was to investigate three key areas in relation to takeaway food served by small locally owned takeaway outlets in Merseyside: consumption of takeaway food, its nutritional composition, and its reformulation. For the purpose of this research, takeaway food is defined as hot meals, prepared in situ, which are either taken away, consumed on site, or delivered from non-chain, independent establishments (such as chip shops, pizza outlets, fried chicken outlets, Chinese, Indian or Kebab takeaways) and not food that is purchased from fast food chains or places selling sandwiches, pies, or pasties.

This thesis is organised into six chapters: **Chapter 1** provides a broad overview of the research problem and the aims and objectives. **Chapter 2** provides a review of the literature and covers the consumption of takeaway food and its nutritional composition. The thesis includes two parallel studies: one on takeaway consumption by consumers (chapter 3) and one on the nutritional composition of takeaway food (chapter 4). **Chapter 3** includes the research carried out to investigate takeaway food consumption in Merseyside (study 1). **Chapter 4** presents the analysis of the nutritional composition of takeaway food in Merseyside (Liverpool, Knowsley and the Wirral) using data provided by these three local councils Trading Standards teams (study 2). Along with secondary research covered in the literature review, the results from these chapters display a strong rationale for reformulation of takeaway food prepared by small independent takeaway outlets. Consequently **Chapter five** includes part of the pilot recipe reformulation work (study 3) undertaken with locally owned independent takeaway outlets taking part in *Eatright* Liverpool (a collaborative study between Liverpool City Council (LCC), Liverpool Primary Care Trust and Liverpool John Moores University). This research was undertaken in a real-world setting and involved the recipe reformulation of takeaway meals and provision of recommended changes to chefs to assist them in preparing healthier takeaways. Detailed descriptions of the research questions, methods used, the findings and accompanying discussions are in chapters 3, 4 and 5. **Chapter 6** provides a synthesis of the results from all three studies, concludes the thesis, outlines any strengths and limitations, and provides recommendations for future research.

This thesis will add to the existing evidence base for the out of home food sector and support strategies which involve the reformulation of takeaway food as well as help inform national and local government public health policies.

1.1 Food Away from Home

As a nation, households in the United Kingdom (UK) spend almost a third (31%) of their household expenditure on eating out (including alcohol), snacks and soft drinks and this has been the case for the last decade (Cabinet Office, 2008a; DEFRA, 2014; DEFRA, 2020). In 2019, this represented a household expenditure of £19.40 per week on restaurant and café meals, £5.60 on takeaways and snack food eaten outside the home, and £5.40 on takeaways eaten at home (NatCen Social Research, 2019). One way to distinguish between the food we eat out and the food we eat at home is to classify it depending on where it was prepared, not eaten; specifically food that is 'home food' and food that is 'away from home food' (Guthrie, Lin and Frazao, 2002). Away from home food (AFHF) is purchased mainly from food service establishments such as fast food or takeaway outlets whereas home foods are purchased from a retail store, for example a supermarket, grocery or convenience store (Guthrie, Lin and Frazao, 2002). Both these types of food can be eaten at home or away from home, however food away from home (FAFH) is usually ready to eat and consumed as is (Guthrie, Lin and Frazao, 2002). An Eating Out report prepared for McDonalds defines “Fast food and Takeaways in the informal eating out market” as “Outlets serving food that can be prepared and served very quickly, and without waited service” (Allegra Strategies, 2009).

During the 1980’s and 1990’s, popularity of food from takeaway catering establishments increased in the UK sector. There was also rapid growth in the branded fast food sector such as McDonalds, Burger King and KFC (Jones et al., 2002) which by 2001 accounted for almost £3 billion in sales (Mintel, 2001). In 1975, only 14% of all meals eaten were takeaways, however this had increased to 27% by 1984 (Heald, 1987). In 1985, takeaways were more popular in the lower social grades C1, C2 and DE (for example supervisory, administrative and skilled/semi-skilled/unskilled manual occupations and unemployed) than the higher social grades A and B (the professional and managerial classes) (Heald, 1987). In 1979, the average amount of money spent on takeaway chips for consumption in the home was 1p per person per week (MAFF, 1973), this had increased to 19p by 2002-2003 in the Family Food Expenditure and Food survey taking current prices into account (DEFRA, 2004).

Similar to the UK, rapid growth in the away from home food market occurred in the USA, with fast food growing at an annual rate of 6.8 per cent between 1982 and 1997 and expenditure on fast food increasing from 29.3 to 34.2 per cent (Jekanowski, 1999). Some of this rapid growth is attributed to rising incomes, longer workdays, two-income households and consumer demand for convenience foods (Jekanowski, 1999). In a nationally representative longitudinal study of adults in the US, adults from all incomes and wealth spectrums were found to eat fast food. Their analysis of 3 waves (2008, 2010 and 2012 of the National Longitudinal Survey of Youth 1979 cohort (NLSY79) found workers versus non-workers and working longer hours increased the likelihood of frequent fast-food consumption (Zagorsky and Smith, 2017).

Furthermore, since the 1950's there has been an increase in the popularity of (modified) ethnic foods or world cuisines such as Chinese, Indian, Thai and Italian served from takeaway outlets in the UK (Foster and Lunn, 2007). By 2003, ethnic-food sales from takeaway outlets and restaurants were worth approximately £3.2 billion, with over half of these sales attributed to Indian food and a third to Chinese food (Leatherhead Food International, 2004 in Church, 2005). The term 'ethnic' is used to signify dishes associated with a particular culture (Mitchell, 2006). These types of foods most likely originated from changes in the ethnicity of the UK population due to immigration and the ability to travel further afield (Mitchell, 2006) and these multicultural foods are now commonplace and unexceptional in the UK diet.

1.1.1 Brief History of Fish and Chips

Fish

In the 16th Century, fried fish came to the British Isles with the Portuguese Sephardic Jewish people who were fleeing the Spanish inquisition (Fein, 2019). The origins of eating fish on a Friday may partly be due to Judaic traditions and also Christianity which forbade the consumption of meat on Fridays (Barr and Ritschel, 2020). Jewish law forbids the consumption of milk and meat together, however fish is pareve, a neutral food in kosher terms, neither milk nor dairy (Barr and Ritschel, 2020). This meant that observant Jews were able to conceal their true religious identity by eating fish on Fridays (which was considered kosher) and thereby avoided eating non-kosher foods (Barr and Ritschel, 2020). The Jewish people would also cook enough fish on a Friday to eat cold for lunch the next day (Fein, 2019). In this way they would avoid cooking on Shabbat, the seventh day of the week and a day of rest (Barr and Ritschel, 2020). The Jewish people liked to prepare the fish by coating it in flour and frying it in oil and as their community flourished in England, the popularity of fried fish became widespread all over the country. By 1850, the poorer inhabitants of London were eating 875 million fresh or smoked herrings a year and there were more than 300 street sellers serving fried plaice, haddock, sole and whiting (Burnett, 2004).

Potatoes

Potatoes originate from the Andes (Peru, Chile, and Bolivia) in South America. Spanish Conquistadors came across them in the 1530s when searching for gold and were impressed with their versatility (Birtles, 2020). They found potatoes were easy to farm, could be stored for long periods of time and relieved scurvy among sailors due to their vitamin C content (Birtles, 2020). By the 1580s, the Spanish Conquistadors had shipped them to Spain and by 1600 they had arrived in Europe (Panayi, 2014). During the 17th and 18th century, potatoes gained popularity in Ireland and England and by 1840, potatoes had become a staple of the working-class diet and as their cultivation increased, they reduced in price (Panayi, 2014). By the 1850s, street sellers were selling baked potatoes or fried potatoes (but unlike the chips of present day) (Burnett, 2004). One of the first mentions of chips as we know them today is in a book titled “A Modern System of Domestic Cookery” (Radcliffe, 1823) which suggests cutting potatoes a quarter of an inch thick (‘scallops’) before frying them in lard or dripping.

Fish and Chips

In the latter half of the 19th century, fresh fish became much more available due to advancements in commercial fishing. The use of steamships meant trawlers could travel further afield and the use of artificial ice meant large quantities of fresh fish could be preserved (Panayi, 2014). The railway network which connected ports to cities permitted easy transportation of fresh fish around the country (Lloyd, 2017). By the early 19th Century there were reports that Devonians were eating fried fish with chipped potatoes and in Cornwall, people were eating corned fish and potatoes (Groom, 2004; Panayi, 2014). It is believed that the very first fish and chip shop was opened in London by Mr Joseph Malin in the early 1860s and the shop remained opened until 1970 (Fein, 2019). It was the first of its kind selling both fried fish and potato chips together. The shop was just a few minutes’ walk from the east end of London where the Jewish community lived (London shtetl) between the mid-19th century and World War Two (Butrnett, 2004; Hawkes, 2019). Fish and chip shops provided cheap, filling, convenient ready cooked food to the working class and by 1910, there were 25,000 fish and chip shops in the country (Panayi, 2014; Lloyd, 2017). In the early 20th century it is estimated that the fish and chip shop trade consumed approximately 10% of the potato crop and 20-25% of fish landed at the ports (Walton, 1989; Burnett, 2004), although these proportions would have been considerably higher in northern industrial towns where a ‘fish supper’ (battered fish and chips) was a popular choice with the working classes (Burnett, 2004). This was the case until the 1960s when the traditionally British meal started to face competition from Chinese, Indian and Italian takeaways (Panayi, 2014).

1.1.2 Brief History of Indian Cuisines

The history of Indian cuisine in the UK dates to the 1600s with the migration of Indian seamen to Britain. Indian seamen from a district in Bengal (later this became Bangladesh) were employed by the East India Company as deck hands, galley workers and later engine hands and firemen (in the steam age) (Highmore, 2009). These positions were often hazardous, not well paid, and often led to seamen jumping ship or being left behind in Britain (*Ibid*). By the nineteenth century, thousands of Indian seamen had migrated to Britain. To provide refuge, cheap boarding house cafes were established which served South Asian food. Aside from serving food, these establishments provided social meeting places, help and refuge to Indian seamen (*Ibid*).

Many of the chefs in the boarding house cafes learnt to cook on the ships, or on the job and prepared cheap meals from limited resources (*Ibid*). Alongside the boarding house cafes, which provided food for the migrant seamen, the "Shafi" Indian restaurant opened in 1920 (Hamid, 2022) which catered for middle-class Indian students who were studying at London universities (Highmore, 2009). During this interwar period, the first high-end Indian restaurant "Veeraswamy's" also opened on Regent Street in 1926 (Highmore, 2009; Veeraswamy, 2022). Designed for fine dining, the restaurant catered to Imperial Britain with tiger skins hanging from the wall and Indian door attendants to hold out umbrellas for its customers (Highmore, 2009). It specialised in madras chicken curry and biryani. Around the end of the 1920s, the Kohinoor restaurant opened which was more commercial in nature and this became the model for the high street Indian restaurant (Highmore, 2009). This led to a more diverse customer base at Indian restaurants. In the 1960s and 1970s, the number of Indian restaurants increased as they gained popularity with students and young people due to their low-priced meals, exotic food (although adapted to British palates) and long opening hours when compared with other types of establishments (Humble, 2005). In 1946 there were only 20 Indian restaurants in London, this had increased to 300 in Britain by 1960 and 3000 by 1980 (Adams, 1987 cited in: Highmore, 2009). Food served in Indian restaurants was different from traditional culinary practices, meals were made via batch cooking to keep costs down, with basic recipes easily transformed into different dishes with the use of different spices and flavourings. For example, creamy korma, hot madras and hotter vindaloo (Humble, 2005). As the Indian restaurant became established in Britain, the range of dishes on the menu became standardised to include meals expected by the customer such as biryani, madras, korma and balti (Highmore, 2009).

1.1.3 Brief History of Chinese Cuisines

The Chinese community in Britain dates to when Chinese seamen were recruited in the 1850s for the maritime trade in Asia and jumped ashore. They tended to stay around the ports of London and Liverpool and by 1931, there was only a small population of 1934 Chinese people in Britain (Chan, Cole and Bowpitt, 2016). Liverpool is recognised as having the oldest Chinese community in Europe (Wong, 1989 cited in: Beck, 2007). After the Second World War, many Chinese farmers migrated to the UK from Hong Kong. In part, this was due to people developing a taste for new cuisines, which created opportunities for them to open Chinese restaurants and takeaways (Chan, Cole and Bowpitt, 2016). Initially Chinese settlers lived in big cities, for example London, Manchester, and Liverpool, but as competition increased, they moved to smaller towns and villages (Chan, Cole and Bowpitt, 2016), with numbers increasing rapidly until the 1970s. In 1931 there were very few Chinese restaurants and Chinese takeaways in Liverpool, but by 1968, this had increased to 46 and 67 respectively (Wong, 1989 cited in: Beck, 2007). Harsher immigration laws and the introduction of VAT led to many restaurants being converted into fish and chip shops or takeaways (Humble, 2005). By 1970 there were 4000 Chinese catering outlets in the UK (Humble, 2005), and this had increased to approximately 17,500 by 2011, contributing approximately £4.6 billion each year to the economy (Kagan et al., 2011). This sector supports the Chinese community financially, employing more than 50 per cent of the working Chinese population (Kagan et al., 2011). Initially, food served in Chinese restaurants was based on Canton, Hong Kong and Shanghai styles of food, by the 1970s this was widened to include Pekinese cooking with the likes of dim sum, dumplings and steamed buns (Humble, 2005).

1.1.4 Brief History of Pizza

The birthplace of pizza was in Naples in the 19th century, Neapolitan pizza was sold as a kind of flatbread topped with oil, lard, tomatoes, fish, or cheese. Instead of being sold as a whole pizza, it was sold to the urban poor in sizes they could afford, for breakfast, lunch or dinner (Helstosky, 2008) and was popular because it could be consumed quickly. Since the basic ingredients could be combined in numerous ways to produce different tastes, it could be eaten frequently without people getting bored of eating it (Helstosky, 2008; McWilliams, 2012). Alexandre Dumas visited Naples in 1835 and described pizza as a “gastronomic thermometer of the market” due to the toppings indicating the cost and availability of certain foods in Naples and therefore the status of a harvest or the health of the local economy (Helstosky, 2008). Originally, pizza was consumed exclusively by the poor but as pizza increased in popularity it gained respect with Italians outside of Naples, and spread to the rest of Southern Italy (Helstosky, 2008). In the late 1800s/early 1900s, pizza migrated to America with the immigration of more than three million Italians, many of whom were from Southern Italy and motivated by labour poverty (Thoms, 2011; Dickson, 2016). In 1905, the first pizzas sold in New York were by Lombardi's in Little Italy for five cents (Rothman, 2012). Pizza remained popular in immigrant enclaves of many cities in America and gained popularity with the general population after World War II (Helstosky, 2008). Similarly, soldiers enjoyed pizza so much whilst occupying Italian territory during World War II (McWilliams, 2012) that it spread to Europe and America when the soldiers returned home (Dickson, 2016). In the post-1945 era pizza became a comfort food, and the middle and upper classes changed it from a food of necessity to a snack or food used for parties and social occasions.

Pizza is appealing to both adults and children due to its versatility; toppings can be varied, it can be eaten at home or in a restaurant, it can be used as an everyday food, or a food served on special occasions. The popularity of pizza has transformed it into a standardized, mass-produced food and also an individualized, upscale gourmet food (Helstosky, 2008). The early 1950s saw the sale of frozen pizzas in response to the emerging TV dinner trend (McWilliams, 2012). In 1958, two brothers opened Pizza Hut in Wichita, Kansas, USA and this was followed with their first franchise the following year (McWilliams, 2012). Food service franchises were welcomed as more women entered the work force, because they were fast, convenient and unpretentious (Helstosky, 2008). In England, it was 1965 before the first pizza chain opened in Soho, London. Peter Boizot imported a pizza oven from Naples and opened Pizza Express which centred on selling authentic Italian pizza rather than standardised American, kid-friendly, junk-food pizza (Sukhadwala, 2018), sold in large sizes and designed to be consumed by several people at once (Helstosky, 2008). A few years later in 1973, the American chain, Pizza Hut opened its first location in England and by 1999 had over 400 restaurants in the UK (Pizza Hut UK Ltd, 2017). Worldwide, Dominos and Pizza Hut can be found serving pizzas with toppings varied to reflect local tastes. In 2022, the UK market size of the dine-in pizza sector was £2.2 billion whilst pizza delivery and takeaways was almost £3 billion (Mintel, 2023b).

1.1.5 Brief History of Kebabs

Kebabs predate the Ottoman Empire and were made popular by immigrants from the Middle East and North Africa (Helstosky, 2008). Whilst Europeans were cooking large hunks of meat or whole animals on large rotating spits, people from the Middle East were mostly cooking small pieces or strips of meat on skewers (Perry, 1995; Montagner, 2022). The reasons behind this were that small pieces of meat cook faster than large pieces and that firewood was cheaper and more easily available in forest-covered Europe (Perry, 1995).

The Turkish translation of shish kebab is a “skewer” of “roast meat”, traditionally small pieces of meat cooked on a skewer (with or without vegetables) over embers or grilled, usually lamb, mutton, or chicken (Safvi, 2018). Shish kebabs are often marinated to add flavour and tenderise the meat. Koftas (from ‘kufta’ to beat or grind) are made from minced meat or small pieces of meat (Safvi, 2018). The meat is cut up really finely with herbs and spices added for flavour. When a thick paste has been formed, the meat is lumped onto skewers like little sausages, sometimes with vegetables added in between and often served with a little bit of yogurt or sumac sprinkled on (Kasper and Roden, 2015).

Donner or döner kebab translates from the Turkish word dönmek meaning “to turn or rotate” and literally means rotating roast. In the 17th century it was usual to cook stacks of seasoned and sliced meat on a horizontal rotisserie. In the early 1800s, it was noticed that when cooked horizontally, the fat dripped into the fire, which made the flames rise up, whereas when the meat was cooked vertically, the fat dripped down the meat instead, basting the meat, keeping it moist and retaining flavour (Helstosky, 2009; Carter, 2020). This is believed to have occurred in either the Pontus Mountains in Turkey around 1830 or in Bursa, Turkey in the 1860s (Heine and Lewis, 2018). It was in the 1940s when the vertical rotating kebab arrived in Istanbul, and Beyti Güler served donner kebabs from his restaurant to kings and other celebrities in 1945. This consisted of slices of the outer layers of donner kebab served on a plate with rice and vegetables (Carter, 2020). In Istanbul in the 1960s, the donner sandwich was created; sliced donner meat placed inside a halved pita which has been cut down the middle to form a pocket.

During the 1950s and 60s, West Germany experienced rapid economic growth, and recruited guest workers (*Gastarbeiter)* from Turkey to fill their shortage of workers (Manivannan, 2022). It was in the early 1970s when a Turkish worker, realising there were no substantial lunch options for busy on the go workers, started serving warm grilled meat and salad inside a flat bread from a stall in Berlin Zoo, West Berlin (Montagner, 2022). Since then, it has transformed into the popular donner kebab we know today, thinly-sliced meat, topped with salad, vegetables and sauces served in a pita (Carter, 2020). By 1978, there were around 125 kebab shops in Britain and this had increased to approximately 2000 by the end of the 1990s (Panayi, 2008). In the UK, the kebab industry has a £2.2 million turnover with over 70,000 employees (Ekingen and

Cizer, 2013). These independent fast food businesses serve culturally acceptable, inexpensive food which has become popular worldwide with endless local variations, such as the Greek gyro, Arabic shawarma or Spanish al pastor (Raffard, 2019).

1.1.6 Popular types of Food away from home

Typical FAFH (away from home, out of home, fast food or takeaway food) includes fish and chips, burgers, fried chicken and pizza as well as other types of meal options from cuisines such as Chinese, Thai and Indian food (Smith et al., 2009). In Mintel's 2015 Ethnic Restaurant and Takeaways report, Chinese and Indian cuisines were the most popular choices British people had used or visited (n = 1753, 76% Chinese, 72% Indian, 40% Thai) (Mintel, 2015b). When respondents in the Mintel survey were asked which types of takeaway/home delivery they had purchased in the past three months, three in four (76%) had ordered ethnic cuisine (Chinese, Indian or Thai), two in three (65%) fast food (fish and chips, fried chicken, burgers, kebabs) and over half (56%) had ordered pizza (Mintel, 2015a). Similarly in the 2015 Annual Food Study, the UK's top five favourite takeaways were Chinese food, Indian food, fish and chips, pizza and fried chicken (VoucherCodes, 2015). More recently, Mintel's 2020 Ethnic Restaurants and Takeaways report shows lesser known ethnic cuisines such as Middle Eastern/Greek, Japanese and Korean are gaining popularity at the expense of Chinese/Taiwanese and Indian/South Asian cuisines (Mintel, 2020b). However, Chinese and Indian cuisines remain the most popular, with 55% of survey participants (n = 2000) having eaten Chinese/Taiwanese cuisine and 41% Indian/South Asian cuisine in the previous three months (Mintel, 2020b). Furthermore, the top three takeaway cuisines in a UK YouGov survey (n = 1692) were also Chinese meals (25%), Indian meals (17%) and fish and chips (16%) (YouGov, 2021). There are also regional differences in takeaway consumption with some types of takeaway food being more popular in some areas than others. According to a report by Raisin UK (2022) fish and chips is the most popular takeaway in the midlands, whilst Chinese food is most popular in the northwest of England and Scotland. In terms of money spent on takeaways, the 2015 Annual Food Spend Study found adults in Liverpool spend more than double the adult expenditure on takeaways in the UK; £1,342 compared with £602 a year respectively (VoucherCodes, 2015).

The increase in the consumption of FAFH is not confined to the UK but is occurring globally, for example Asia, India, Australia, New Zealand, the USA and Europe (ACNielson, 2005; De Vogli, Kouvonen and Gimeno, 2014; Takeaway.com, 2020). The past few decades have seen a rapid increase in the fast food and takeaway market as the consumption of FAFH has gained popularity, with the market value of the eating out and takeaway sector at £31 billion in 2009 (Mintel, 2010a). By 2019, the value of the UK eating out market was estimated at approximately £76.8 billion (Mintel, 2019), with ethnic restaurants and takeaways accounting for roughly £12.6 billion of this (Mintel, 2020b).

1.2 Digital Marketplace

Furthermore, people's health behaviours are not purely defined my physical environments but also online food environments (Rinaldi, D'Aguilar and Egan, 2022). A digital marketplace for FAFH has developed in recent years, which makes the purchase of these types of food even more convenient by increasing availability of food and beverages and providing delivery over longer distances (World Health Organization, 2021). Third-party delivery platforms like Just Eat, UberEats and Deliveroo facilitate consumers to purchase takeaway food from local food businesses using apps on their mobile devices (Mintel, 2020a). The use of smart phones and websites has not only assisted consumers to order takeaway food but has also helped smaller independent takeaways compete alongside the bigger chain restaurants and outlets, although the fees charged by third party delivery platforms can be high, between 15% and 35% of the total cost of the order plus VAT (Shenker 2021; WHICH, 2021). This has resulted in a growth in the takeaway delivery market from £2.4 billion in 2008 to £4.2 billion in 2014, a growth of 73% (Lavenant, 2018). For instance, Just Eat allows consumers to choose from over a 100 different types of cuisine, delivered to their home at the click of a button (Just Eat plc, 2015). In 2014, they had 8.1 million active users globally (Just Eat consumers are considered active if they use their account to make an order more than once a month) and by 2015, this had grown to 13.4 million (Just Eat plc, 2015). The takeaway sector continues to expand and in 2019, 19.5 million active Just Eat consumers made €3 billion worth of orders in ten European countries and Israel. This corresponds to 159.2 million orders and represents a 70% increase when compared with 2018 (Takeaway.com, 2020). Deloitte (2019) estimated a 4% increase in 2019 on the restaurant sector as a result of third-party platforms, equivalent to 606,000 extra meals a week via restaurant chains and 305,000 through independents.

These figures show that FAFH or takeaway food is no longer seen as an occasional treat; it is consumed on a regular basis and has become a normal part of the diets of a substantial section of the population. If anything, these figures will most likely continue to increase. There is unlikely to be a reduction in takeaway food consumption due to various reasons including lack of political will, busy lifestyles, time constraints, cost, and convenience (ACNielson, 2005; Rydell et al., 2008; Mintel, 2015a; Mozaffarian et al., 2018). These reasons were corroborated in a Turning the Tables report (Lasko-Skinner, 2020), where survey results of 1000 UK adults found 51% of consumers were too stressed to eat healthy foods, 39% could not afford healthy food and 37% advised healthy food was not available in their local shops. The main drivers for choosing unhealthy food were ranked as taste (43%), cost (34%) and ease (34%) (Lasko-Skinner, 2020). Furthermore, 71% of those surveyed were in support of government subsidies that make healthy foods cheaper and 47% were in favour of additional taxes on unhealthy foods (Lasko-Skinner, 2020).

1.2.1 COVID-19 Pandemic and Third-Party Delivery Platforms

Additionally, public health measures bought in during the COVID-19 pandemic had a large effect on the food landscape due to people being told to stay at home, increased working from home and restrictions on where people could purchase and consume food (O'Connell, Smith and Stroud, 2022). The dine in option was removed from restaurants and cafes and many food businesses turned to selling food to takeaway or be delivered. There was an increase in reliance on mobile technology by the hospitality industry, which helped restaurants and takeaways survive the pandemic whilst conveniently delivering food to consumers. There was also an increase in food businesses (such as fast-food restaurants and takeaways) renting shared or private kitchen space in dark kitchens (delivery-only commercial kitchens) (*Ibid*). Some food entrepreneurs use dark kitchen space to open a 'virtual kitchen' to supply food which can only be accessed via online delivery apps whilst other food businesses may use dark kitchens to expand their delivery area without accruing additional costs of opening another high street restaurant (*Ibid*). In an online food delivery study of a metropolitan local authority in London, Rinaldi, D'Aguilar and Egan (2022) identified 116 food businesses renting kitchen space from three dark kitchens. The types of food businesses included restaurants operated by Deliveroo, national restaurant or takeaway chains (19%) and independent restaurants or takeaways (5.2%). Over half (52%) of the food businesses were virtual restaurants, 47% sold fast food and 21% dessert (*Ibid*). Post-covid, it looks like dark kitchens are here to stay with their market value expected to increase from $56.7 billion in 2021 to 112.5 billion by 2027 (Peach, 2022).

In terms of the UK cost-of-living crisis, small locally owned food businesses will be affected by increasing energy and food costs, squeezing already small profit margins (Shenker 2021; Smith, 2022). A decrease in takeaway consumption might also be expected as consumers try to reduce non-essential spending, however a recent survey of 4,000 consumers by KPMG (2023) suggests 31% of consumers still have at least one takeaway a week and 38% of 18–24-year-olds still consume a takeaway at least two or three times a week. Moreover, half of the consumers in the survey advised they would continue to order the same amount of takeaway over the next year and 8% expect to order more (KPMG, 2023).

1.3 Consumption of Fast Food and Takeaway Food in the UK

Surveys have shown that fast food and takeaway food consumption has increased in the UK over recent years. When respondents were asked whether they had eaten out over the past month in the Food and You survey (wave 5), 56% had eaten takeaway food from either a restaurant or takeaway outlet, 33% had eaten in a fast food restaurant and 26% had purchased food to take away from a fast food restaurant (NatCen Social Research, 2019). Previous Food and You surveys cannot be directly compared due to changes in the questions; however, the earlier wave 3 of the survey (2014) found 27% of respondents had purchased takeaway food to eat over the previous seven days (Food Standards Agency, 2014a). This is an increase on an earlier UK Consumer Attitudes to Food Standards survey in 2006 which found 22% of respondents ate takeaways at least once a week and more than half (58%) ate them a few times a month (Food Standards Agency, 2007). The Food and You survey also found men were more likely than women to report eating fast food (27% compared with 16%) and takeaways (32% compared with 22%) (Food Standards Agency, 2014a). The Food and You surveys further showed that younger respondents were more likely to report eating fast food or takeaways, with 46% of 16-24 year olds having eaten it in the past week compared with 24% of 25-54 year olds and 7% of 55 year olds and over (Food Standards Agency, 2014a).

1.4 Consumption of Fast Food and Takeaways in Merseyside

Available literature focussing on eating behaviours, particularly relating to fast food or takeaway consumption in Merseyside, is sparse. Some data was collected as part of the Taste4Health scoping project in Liverpool in 2007 (n = 926), which found 26% of respondents ate food from takeaway outlets and 13% from fast food restaurants at least once or twice a week (Liverpool NHS PCT, 2010). In the NHS Merseyside Lifestyle Survey 2012/13 (n = 2,391), 26% of adults interviewed in Knowsley ate fast food at least once a week (Jackson and Cornick, 2013). Furthermore, 22% of consumers were more likely to purchase from a local independent outlet (for example chip shop or takeaways serving Chinese, Indian or Pizza) at least once a week compared with only 14% from a fast-food chain like KFC, McDonalds (Jackson and Cornick, 2013)

1.5 Density of Fast-Food outlets in the UK

According to the Food environment assessment tool (Feat), there were 59,459 fast food outlets (FFOs) in England in June 2018, a 13% increase from 52,476 over the previous 4 years. The number of outlets serving fast food or takeaway food varies between areas in the UK and the average density for England is 0.96 per 1000 population. The lowest density of FFOs can be found in Rochford, Essex with 0.26 per 1000 population whilst the highest density of 2.32 per 1000 population is in Blackpool, Lancashire in the north west of England (PHE, 2018b). In Merseyside, Liverpool and the Wirral both have an above average density of FFOs with 1.29 and 1.05 per 1000 population respectively whilst Knowsley has a lower than average density with 0.62 per 1000 population (PHE, 2018b). To calculate the density of FFOs, PHE refers to fast food as food that is “energy dense and available quickly, therefore it covers a range of outlets that include, but are not limited to, burger bars, kebab and chicken shops, chip shops and pizza outlets” (PHE, 2018b).

1.6 Health, Fast Food and Takeaway Food

Cardiovascular disease (CVD) is a leading cause of non-communicable disease (NCD), globally responsible for an estimated 17.9 million deaths each year, of which 85% (15.2 million) were due to coronary heart disease or stroke (GBD 2015 Mortality and Causes of Death Collaborators, 2016). A systematic evaluation of global dietary consumption patterns found one in five deaths were attributable to dietary risks and could be prevented by improving diet. The study concluded that 11 million deaths were due to diet-related disease with CVD accountable for the majority of these deaths (10 million), followed by cancer and type 2 diabetes (GBD 2017 Diet Collaborators, 2019). Non optimal intake of three dietary risks accounted for more than 50% of deaths, and these were diets low in wholegrains, low in fruit and high in salt. Other leading dietary risk factors were diets low in nuts and seeds, vegetables and omega 3 fatty acids (GBD 2017 Diet Collaborators, 2019). Fast food and takeaway foods tend to be low in wholegrains and vegetables but high in energy, fat and salt (Stender, Dyerberg and Astrup, 2007; Dunford et al., 2010; Jaworowska et al., 2012; Jaworowska et al., 2014; Ziauddeen et al., 2015; An, 2016), contributing factors towards increased levels of obesity and early deaths from stroke and coronary heart disease (CHD) (Bibbins-Domingo et al., 2010; Wang et al., 2016).

One consequence of eating FAFH is that the consumer has less knowledge about its nutritional content (Guthrie, Lin and Frazao, 2002). A study undertaken in Ireland

(O'Dwyer et al., 2005), showed that foods eaten outside the home contribute a disproportionately high level of fat (and energy) intake when compared with foods prepared at home. Other studies have shown that eating fast food can result in increased energy intake (Paeratakul et al., 2003; Schröder, Fito and Covas, 2007; Lachat et al., 2012; An, 2016) and higher body mass index (BMI) (Pereira et al., 2005; Kant, Whitley and Graubard, 2015). Fast food consumption has also been associated with a higher prevalence of moderate obesity in individuals consuming such foods twice a week or more (Smith et al., 2009; Jaworowska et al., 2013). McCrory et al. (2019) have also shown fast food portion sizes are increasing in their analysis of thirty years of fast food served by ten popular fast-food restaurants in the USA. In 2016, a meal consisting of one main and one side contained 767 kcal compared with 668 kcal in 1986, an increase of 14.8%. For mains on their own, portion size increased by 13.6 g/decade and by 30 kcal/decade (McCrory et al., 2019).

1.7 Obesity

Obesity is a major health issue and its prevalence is increasing worldwide (WHO, 2021a). As discussed in “Health Matters: obesity and the food environment” prepared by Public Health England (PHE), some of the main drivers for obesity are behaviour, environment, genetics and culture (PHE, 2017a). The report states that the two main risk factors for obesity are the food and drink environment and physical inactivity and attributes the increase in out of home meal consumption as an important contributing factor to the rise in obesity (PHE, 2017a). Healthier choices when purchasing takeaway food could lead to health benefits such as reducing blood pressure, type 2 diabetes, lipid abnormalities and potentially longer-term benefits including a reduction in mortality rates from CHD and stroke at a population level (Schwab et al., 2014; He and MacGregor, 2018). The government’s Foresight report estimated that one third (36% of males and 28% of females) of the adult population in the UK would be obese by 2015 (Butland et al., 2007). The Statistics on Obesity, Physical Activity and Diet, England published in May 2020 found obesity rates in England were not quite as high as the figures projected by the Foresight report, however 28% of adults were living with obesity, an increase from 15% in 1993. Furthermore, the report found almost two-thirds (63%) of adults in England were living with overweight or obesity (NHS Digital, 2020). Similar obesity levels were also found in the Scottish Health Survey in 2019, with 29% of adults living with obesity and 66% living with overweight or obesity (Scottish Government, 2020). Liverpool has a larger proportion of adults who are overweight or obese, PHE shows 66.9% for 2018/19 when compared with the England average of 62.3% at that time (PHE, 2021b). Liverpool also has significantly higher rates of early deaths from CHD and stroke, for instance the early mortality rate (under 75 years) for CHD in Liverpool is 55.6 per 100,000 people compared with 37.5 per 100,000 in England (PHE, 2020c). Early mortality rates for stroke are also 21.1 per 100,000 people in Liverpool compared to 12.5 per 100,000 in England (PHE, 2021a). Liverpool's latest 'One Liverpool' strategy aims to tackle these health inequalities, with its main goal of halving the life expectancy gap between Liverpool and England by 2024 (NHS Liverpool Clinical Commissioning Group, 2019).

1.8 Nutritional Composition of Fast Food

On the whole, research has focused on the major fast-food chains, with limited data on takeaway food from independent establishments. Several studies have analysed the nutritional composition of fast food served by national fast food chains using information available on company websites. In general, these studies found meals were high in energy, fat, saturated fat (SFA) and salt (Dunford et al., 2010; Hearst et al., 2013; Ziauddeen et al., 2015; Prentice, Smith and McLean, 2016; Mackay et al., 2021); contributing factors towards increased levels of obesity and reduced life expectancy (Pereira et al., 2005; Bibbins-Domingo et al., 2010; Bhutani et al., 2018). Additionally, large variations in nutritional composition were found when the same meals were analysed, but served by different fast-food chains, or from the same fast- food chain in a different country (Stender, Dyerberg and Astrup, 2007; Dunford et al., 2010; Heredia-Blonval et al., 2014). A New Zealand study examined sodium content of fast food from chain restaurant menus using online nutrition information (n = 471) and used laboratory analysis to determine sodium content of twelve popular types of fast food (n = 52) served by independent outlets (Prentice, Smith and McLean, 2016). The study found the majority (12 of the 13 fast food categories from chain outlets and 10 of the 12 fast foods served by independent outlets) exceeded the 2012 sodium targets (range 200-550 mg/100g depending on fast food type) set by the UK Food standards Agency (FSA). This study also found wide variation in sodium content for the same food served between outlets, for example the sodium content for a portion of egg-foo-yung ranged between 159 and 418 mg/100g depending on the outlet it was served at (Prentice, Smith and McLean, 2016). The variability in nutritional content between foods served at different outlets suggests that recipe reformulation should be explored to improve the quality of food served, not only by fast food chains but also independent takeaways.

1.9 Government Dietary Guidelines

Current government dietary guidelines for adults in the UK are that men and women should consume approximately 2500 kcal and 2000 kcal per day respectively (PHE, 2016b). Table 1.1 shows the recommended dietary guidelines for energy, macronutrients, and salt. Additionally, front of pack nutrition labels on foods often include suggested daily reference intakes (RI), these are shown in the last column, and were previously referred to as Guideline Daily Amounts (GDAs) (Department of Health, 2016). RIs for fat, SFA, sugars and salt are the maximum amounts an adult should consume in one day, and are based on the requirements for an average female with an energy intake of 2000 kcal (Department of Health, 2016).

Table 1.1 Government recommendations for energy, macronutrients, salt and dietary fibre for males and females aged 19 to 64 years plus suggested Reference Intakes

	Males	**Females**	**RI for adults**
Energy (MJ/day)	10.5	8.4	
Energy (kcal/day)	2500	2000	2000
Carbohydrate (g/day) (at least)	333	267	260
Free Sugars (g/day) (less than)	33	27	
Total Sugars (g/day) (less than)			90
Protein (g/day)*	55.5	45	50
Fat (g/day) (less than)	97	78	70
Saturated fat (g) (less than)	31	24	20
Polyunsaturated fat (g/day)	18	14	
Monounsaturated fat (g/day)	36	29	
Trans unsaturated fat (g/day)	5	5	
Sodium (g/day) (less than)	2.4	2.4	
Salt (g/day) (less than)	6.0	6.0	6
Dietary fibre (g/day)	30	30	

*(0.75 g / kg / day - assuming average weight of a man is 74 kg and a woman 60 kg)

(Department of Health, 1991; PHE, 2016b)

1.10 Definition of Takeaway Food

For the purposes of the present thesis, takeaway food is characterised as hot meals, prepared in situ, either taken away or consumed on site from non-chain, independent establishments and not food purchased from fast food chains or places which sell sandwiches, pies, or pasties.

1.11 Nutritional Composition of Takeaway Food

In the UK, available literature focusing on the nutritional composition of takeaway meals served by small independent takeaways is scant apart from some data collected by local councils and Trading Standards. As part of the Local Authorities Food Standards Survey 14, the Local Government Group (2011) coordinated a detailed survey of 409 samples of Indian and Chinese takeaway food collected by 30 local authorities in seven regions of England and Northern Ireland. The survey focussed on two meals: chicken tikka masala with pilau rice and sweet and sour chicken with fried rice (Local Government Group, 2011). The results showed significant variation in the composition of the meals and high levels of salt in both meal types, with chicken tikka and pilau rice providing 92% (5.52 g) of the GDA for salt for an adult and sweet and sour chicken and fried rice providing 119% (7.12 g). An average portion of the chicken tikka and pilau rice meal (808 g) also contained high levels of fat (60 g) and SFA (23.2 g) whilst an average portion of the sweet and sour chicken and fried rice meal (830 g) contained 67.7 g of sugar (Local Government Group, 2011). As part of the Healthier Takeaways project in Antrim, Northern Ireland, fish and chips meals from nine different takeaways were analysed. In some cases, meals contained 100% or more of the GDA for fat and SFA, some meals were high in trans fatty acids (TFA), and all were high in salt, some containing almost 5 g per meal (Antrim Borough Council, 2009). *Safe*food has also collected food samples from takeaways and restaurants with a takeaway service on the island of Ireland (*safe*food, 2012a; *safe*food, 2012b; *safe*food, 2015). They purchased pizzas, Chinese meals and Indian meals for analysis and found large portion sizes for the majority of the meals and a large range in the nutritional content of energy, fat, SFA and salt (*safe*food, 2012b; *safe*food, 2012a; *safe*food, 2015).

The shortage of information regarding the nutritional composition of takeaway food served by small independent takeaways provides the rationale for the present thesis. The investigation of nutritional composition data in Merseyside could contribute to the existing evidence base and assist public health nutrition teams nationally in identifying where improvements could be made to takeaway meals as well as contribute to strategies to encourage consumers to make healthier takeaway purchases.

1.12 Improving Takeaway Food

At the time this research was started, there were limited studies in England which involved working with chefs in these types of outlets to improve the quality of the meals they sold. More recently, Goffe et al. (2016) conducted a cross-sectional study in fish and chip shops in northern England to determine whether sodium content of fish and chips was different depending on the use of 17- or 5-hole saltshakers. They used flame photometry to analyse 61 portions of fish and chips, purchased anonymously by the researchers from shops where servers added salt to meals as standard practice. Fish and chip meals served by shops using 5-hole saltshakers (n = 29) contained 22% less sodium than those served by shops using 17-hole saltshakers (n = 32) (Goffe et al., 2016). Another study carried out in northern England involved an intervention to promote smaller portion sizes in fish and chip shops (Goffe et al., 2019). The study involved working with an independent wholesaler to develop and supply smaller sized packaging to 12 fish and chip shops across nine local authorities in northern England. The intervention aimed to facilitate and promote portion control using box packaging in order to standardise portion size and promote smaller portions of fish and chip meals at a lower cost (Goffe et al., 2019). At six week follow up, the study observed a 27 g decrease in mean total meal weight of smaller portion meals (2 g decrease in mean weight of battered fish, 26 g decrease in mean weight of chips) and a 37 g decrease in mean total weight of regular meals when compared with baseline. The study also observed an increase in the proportion of meals sold of a smaller portion size and showed that it is feasible to promote smaller portions which are acceptable with fish and chip shop staff and their customers (Goffe et al., 2019). A few local authorities have also provided training using a Takeaway Masterclass to staff working in local independent takeaway food outlets to improve cooking practices and menu options (Hirst, 2013; Hillier-Brown et al., 2019).

1.13 Takeaway Toolkit

In an effort to improve the quality of takeaway food, a number of toolkits have also been developed. One such “Takeaways Toolkit” was developed by the London Food Board and the Chartered Institute of Environmental Health (CIEH). The takeaway toolkit is intended to assist local authorities by offering a range of tools to tackle the proliferation of takeaways and their impact on public health (London Food Board, CIEH and Mayor of

London, 2012). The toolkit recommends a multifaceted approach due to the complexity of this area; however, one of its main recommendations is that local authorities should work with takeaway businesses and the food industry to make takeaway food healthier. It particularly recommends the use of environmental health teams (as they visit food premises regularly to carry out food safety inspections) to provide information, training and advice (London Food Board, CIEH and Mayor of London, 2012). By encouraging takeaway businesses to make changes to cooking practices and reformulate recipes to improve the healthiness of the food they serve, it is possible this could contribute to improvements in the health of takeaway consumers and a reduction in chronic diseases (London Food Board, CIEH and Mayor of London, 2012).

Further research undertaken by the Cities Instiitute at London Metropolitan University produced a takeaway toolkit for use by fast food businesses (Bagwell et al., 2014). The toolkit acknowledges that small independent takeaways face a number of challenges and barriers when operating in low income communities. For this reason the toolkit provides insight to potential barries and provides strategies to help engage local fast food businesses and encourage them to adopt healthier catering practices without compromising profitability (Bagwell et al., 2014).

This is in alignment with recommendations from PHE, which has produced guidance for local councils working with small food businesses with its ‘Strategies for Encouraging Healthier ‘Out of Home’ Food Provision’ report to assist communities in accessing healthier out of home food (PHE, 2017d). More recently PHE published its ‘Whole systems approach to obesity’ report which has been designed to support local action to understand and address health inequalities whilst recognising the range and complexities of causes of obesity (PHE, 2019).

There is a dearth of literature in this area which provides the rationale for the final part of this project which will involve the researcher working with recipe information provided by an independent takeaway outlet taking part in *Eatright* Liverpool. A collaborative study between Liverpool City Council (LCC), Liverpool Primary Care Trust and Liverpool John Moores University. This work links directly into current government policy by assisting small independent takeaway businesses to prepare healthier takeaway meals via recipe reformulation.

1.14 Aims and Objectives

The central theme of this thesis is to study takeaway food served by small independent takeaway outlets in Liverpool and the surrounding area (Merseyside). Liverpool and some of its surrounding areas are high in deprivation compared with the rest of England with an above average density of FFOs (PHE, 2016a).

Aims:

The aims of this thesis were to investigate the nutritional composition of takeaway food served by small independent takeaway outlets and to explore takeaway food consumption in Merseyside. Answering these questions will add to the existing evidence base and help to inform national and local government public health policies as well as support strategies involving recipe reformulation of takeaway food.

Objectives:

- To investigate takeaway food consumption, knowledge, and attitudes from a sample of takeaway consumers using an online questionnaire.
- To determine the nutritional composition of a sample of takeaway meals prepared at independent takeaway outlets using data collected by Local Councils Trading Standards.
- To explore the use of recipe reformulation to improve the nutritional composition of selected takeaway meals served by local independent takeaway outlets taking part in the *Eatright* Liverpool project.

1.15 Thesis Study Map

Chapter 1: Introduction.

Chapter 2: Literature Review – based on secondary research of takeaway food.

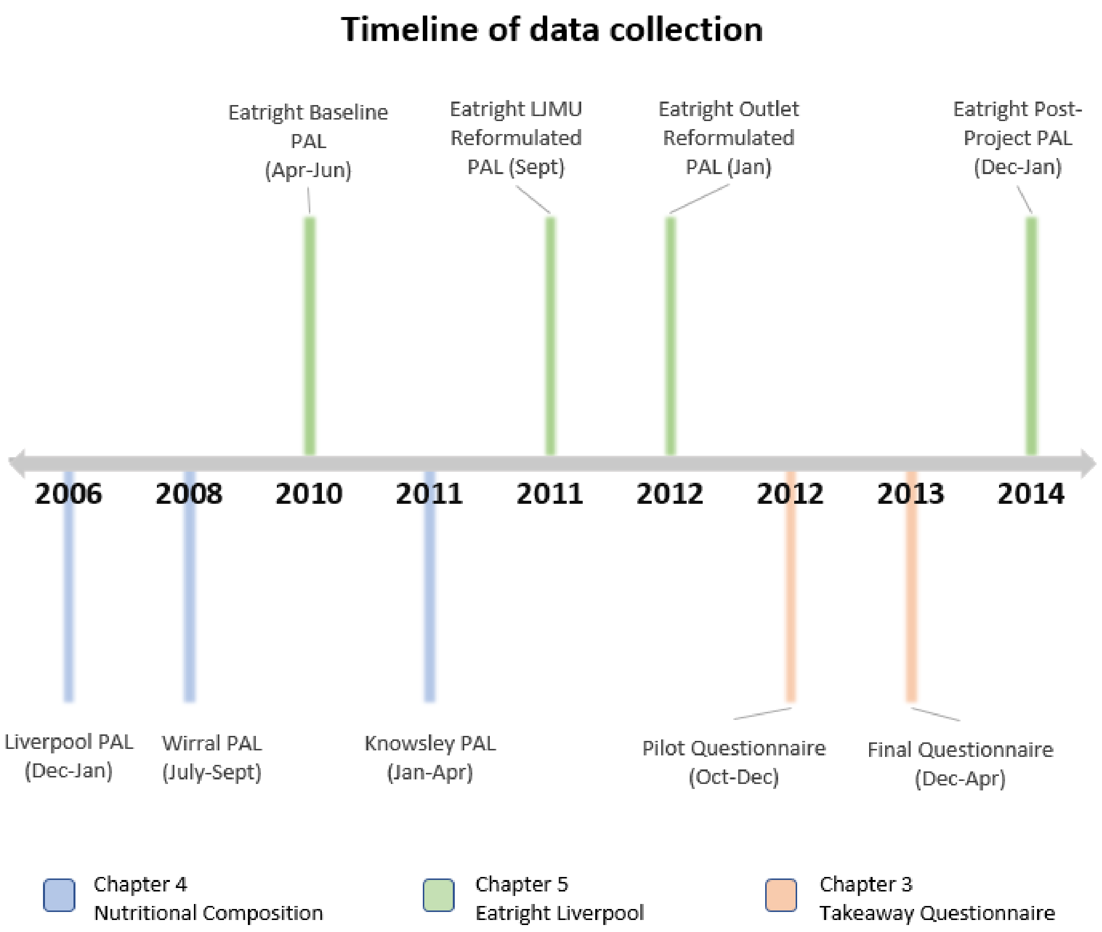
Chapter 3: Investigation of takeaway consumption in Merseyside.

Chapter 4: Investigation of the nutritional composition of takeaway food in Merseyside.

Chapter 5: Investigation of recipe reformulation of takeaway food from independent takeaway outlets in Liverpool, Merseyside.

Chapter 6: Synthesis.

1.16 Thesis Timeline



Chapter 2

Literature Review

2 Literature Review

2.1 Obesity

The World Health Organization (WHO) defines overweight and obesity as “abnormal or excessive fat accumulation that may impair health” (WHO, 2021a). Obesity is an important determinant of health and its prevalence is increasing worldwide (WHO, 2013). Since 1975, obesity has almost tripled worldwide (WHO, 2021a) and it is estimated that by 2025 2.7 billion adults will be living with overweight and over 1 billion adults will be living with obesity, if current trends continue (World Obesity Federation, 2021). In the UK, almost two thirds (63%) of adults are living with overweight or obesity (Baker, 2017) and this figure is expected to increase to 70% by 2034 (PHE, 2015b). Government bodies such as PHE have been involved in a variety of strategies to make the nation healthier and reduce obesity in adults and children. This includes schemes to increase physical activity and increase fruit and vegetable consumption in the population as well as the introduction of voluntary regulations in the food industry to reduce portion sizes, calories, salt and sugar and mandatory calorie labelling for large businesses in the out of home food sector (PHE, 2018c; Department of Health and Social Care, 2019; PHE, 2020d; Department of Health and Social Care, 2021).

A common method used to classify overweight and obesity in adults is body mass index (BMI), which is defined as a person’s weight in kilograms divided by the square of their height in meters (kg/m^2) (WHO, 2021a). Having a raised BMI (living with overweight or obesity) is a major risk factor for NCDs including CVDs (heart disease and stroke), T2D, hypertension, musculoskeletal disorders such as osteoarthritis and certain cancers (WHO, 2014a; WHO, 2021a). BMI is a useful tool to measure overweight and obesity at a population level, however it does have limitations and should only be considered as a rough guide (WHO, 2021a). BMI does not distinguish between excess body fat or excess muscle mass, fat distribution, age or gender (Conolly and Craig, 2019). This means that muscular adults or athletes with low body fat could be classed as overweight and older adults who lose muscle mass as they age could be considered a healthy weight whilst carrying excess fat (NHS, 2018). For this reason, many studies will measure waist circumference to identify central obesity as well as BMI when determining health risk from being overweight (Conolly and Craig, 2019)

The WHO defines overweight as a BMI greater than or equal to 25 and obesity as a BMI greater than or equal to 30. In the 2018 Health Survey for England, just over a quarter of adults were living with obesity, 26% of men and 29% of women (a BMI of $30kg/m^2$ or higher) (Conolly and Craig, 2019). In addition, more than half of the adults (56%) in the survey were at increased, high or very high risk of chronic disease due to their waist circumference and BMI, with women (46%) more likely than men (35%) to be in the high or very high risk categories (Conolly and Craig, 2019). The prevalence of overweight and obesity for children aged 2 to 15 in this survey was 13% and 15% respectively (Conolly and Craig, 2019). Obesity during childhood is concerning, not only due to its association with increased risk of obesity, premature death and disability in adulthood but children can also experience psychological effects, breathing difficulties, insulin resistance and early markers of CVD (WHO, 2021a).

2.2 Cost of Obesity in the UK

Obesity affects productivity in the workplace and is associated with increased levels of short and long-term sickness absence (Goettler, Grosse and Sonntag, 2017). Moreover, obesity places an economic burden on the government and on the NHS and there has been an increase in the economic cost of obesity over the last couple of decades. The Taste for Health scoping report found poor diet costs the NHS in Liverpool between £29.9 and £44.8 million per annum, the wider economic cost of obesity to Liverpool is between £21 and £23.2 million (Liverpool NHS PCT, 2010). At the time of Liverpool's Taste for Health 2007 scoping report, the UK costs attributable to overweight and obesity were estimated at £15.8 billion per year, with approximately £4.2 billion of this cost attributed to the NHS (National Obesity Observatory, 2010). By 2015, this cost to the NHS increased to around £6 billion (or 5%) with an additional £10 billion spent on diabetes, (Dobbs et al., 2014) (including 10% attributed to type 1 diabetes) (International Diabetes Federation, 2013). The current estimated NHS spend on obesity related diseases is £6.5 billion (Frontier Economics, 2022) and expenditure by the NHS on overweight and obesity is projected to increase to between £10 and £12 billion by 2030 (Dobbs et al., 2014). Furthermore, the estimated costs to the wider economy due to CVD in England is £15.8 billion per year (including premature death, disability, and informal costs) (British Heart Foundation, 2022). The government's Foresight programme predicted that by 2050, the cost to society could rise as high as £50 billion if overweight and obesity continued to rise based on current trends (Butland et al., 2007). Recent analysis by Frontier Economics (2022) advises that the current full cost of obesity in the UK already exceeds this prediction at an estimated £58 billion annually (Frontier Economics, 2022). Just a 10% reduction in obesity prevalence could lead to approximately £6 billion in savings for the NHS and wider economy (Frontier Economics, 2022).

2.3 Obesity in Liverpool

Increased prevalence of obesity has been associated with living in areas of greater deprivation (Katsoulis et al., 2021). In the 2021 Health Survey for England, obesity prevalence was highest amongst adults living in the most deprived areas compared with the least deprived areas (34% compared with 20% respectively) (Neave, 2022). Compared with the England average, Liverpool has a higher percentage of adults living with overweight or obesity (66.9% compared with 62.3%), life expectancy is lower and there are significantly higher rates of early deaths from CVD (PHE, 2021b). An adults life expectancy in Liverpool is approximately 3 years less than the average life expectancy in England; between 2013 and 2015 average life expectancy in Liverpool for males was 76.3 years and 80.4 years for female compared with 79.5 years for males and 83.1 years for females in England (PHE, 2017b). The “One Liverpool Strategy: A Healthier, Happier, Fairer Liverpool for All” advises that Liverpool has one of the worst health outcomes compared to the rest of the UK and aims to reduce the gap in health inequalities in Liverpool (NHS Liverpool Clinical Commissioning Group, 2019).

2.3.1 Deprivation in Liverpool, Knowsley, and the Wirral

Liverpool is situated in Merseyside, a metropolitan county in the northwest of England which is comprised of five boroughs: city of Liverpool, Knowsley, St. Helens, Sefton and the Wirral (Britannica, 2021). The Liverpool City Region includes six local authority districts: Halton, Knowsley, Liverpool, Sefton, St Helens and Wirral which are members of the Liverpool City Region Local Enterprise Partnership (LEP) (Christie, 2013).

The Local Authority Health profiles for the northwest region show all five boroughs and all six districts have higher rates of ‘under 75 mortality rates from all causes’ as well as ‘higher mortality rates from all CVDs’ when compared with the England average mortality rates (OHID, 2020). When looking at any type of cancer, the latest regional report by North West Cancer Research shows the prevalence of cancer rates in Merseyside to be similar to those for the overall North West average (North West Cancer Research, 2022). However, the cancer mortality rate is 15% higher in Merseyside when compared with the national average. These findings highlight the health inequalities for people living in Merseyside. Furthermore, people living in the most deprived areas in England are four times more likely to die prematurely from CVD and twice as likely to die prematurely from cancer than those in the least deprived area (OHID, 2022a) and Merseyside is considered to be a highly deprived area.

The English Index of Multiple Deprivation (IMD) measures deprivation of an area using seven domains of deprivation: income, employment, health and disability, education skills and training, barriers to housing and services, living environment, and crime (Department for Communities and Local Government, 2011b). The IMD 2019 can be used to compare small areas in England, by dividing it up into 32,844 Lower-layer Super Output Areas (LSOA) or neighbourhoods with an average population of 1500 (Ministry of Housing Communities and Local Government, 2019). The neighbourhoods are ranked relative to all the other areas. In this way, the IMD gives an indication of overall deprivation experienced by people living in an LSOA, high ranking neighbourhoods are considered “highly deprived”, the first is the most deprived area and the 32,844th is the least deprived area (Conolly and Craig, 2019; Ministry of Housing Communities and Local Government, 2019).

In 2010, at the start of this research, over a fifth of England’s most deprived 10% LSOAs were in the northwest region (Department for Communities and Local Government, 2011b). Liverpool, Sefton, Knowsley, and St Helens, along with the area of Birkenhead on the Wirral contained large concentrations of LSOAs with high levels of deprivation (Department for Communities and Local Government, 2011b). Liverpool was ranked as the most deprived area in England out of a total of 317 local authority areas and Knowsley was second (Department for Communities and Local Government, 2011a). The Wirral ranked at number 66 and was in the top 20% of most deprived areas (Wirral Intelligence Service, 2019). The latest IMD 2019 shows a slight improvement for Liverpool which has dropped to the third most deprived local authority area after Blackpool (first) and Knowsley (second) whilst the Wirral has risen to 42nd place (Liverpool City Council, 2020). Furthermore, Liverpool has seven of the top 100 most deprived LSOAs nationally, whilst the Wirral has six, Knowsley has five and St Helens has two (Liverpool City Council, 2020). Figure 2.1 shows the most and least deprived areas in Liverpool City Region whilst Figure 2.2 shows the most and least deprived areas in the Liverpool borough using the IMD 2019.

Figure 2.1 originally presented here (Distribution of the most deprived LSOAs in Liverpool City Region using IMD 2019) cannot be made freely available via LJMU E-Theses Collection because of copyright reasons. The figure was sourced from Liverpool City Council (2020).

Figure 2.2 originally presented here (Most and least deprived areas in Liverpool using IMD 2019) cannot be made freely available via LJMU E-Theses Collection because of copyright reasons. The figure was sourced from Liverpool City Council (2020).

2.4 Deprivation and Fast-Food Outlets

In relation to fast food, studies have shown a higher density of FFOs located in areas of higher deprivation. Macdonald, Cummins and Macintyre (2007) investigated associations between area deprivation and the four largest fast-food chains in Scotland and England (McDonald's, Burger King, KFC, and Pizza Hut). For England and England and Scotland combined, the study found density of outlets per 1000 people increased linearly from the more affluent to the more deprived areas for each individual fast food chain and when the chains were grouped together (Macdonald, Cummins and Macintyre, 2007).

A positive association was also found between area deprivation and density of takeaway outlets in Norfolk with the mean density of takeaway food outlets being highest at each time point in the most deprived wards between 1990 and 2008 (Maguire, Burgoine and Monsivais, 2015). In their study, takeaway outlets were defined as outlets whose primary business was the sale of hot food for consumption off the premises. For example, fried chicken, pizza, kebabs, fish and chips, Indian or Chinese takeaways and some fast-food franchises but not cafes, full-service restaurants, drinking establishments and shops (Maguire, Burgoine and Monsivais, 2015). Over the 18-year period, the largest absolute increase in takeaway outlet density was in the most deprived wards with density increasing by two outlets per 10,000 population in the most deprived tertile (Maguire, Burgoine and Monsivais, 2015). One reason for the higher concentration of takeaways in low-income communities could be due to lower rents as well as a plentiful supply of local labour (Bagwell, 2011; Blow et al., 2019a) . However, a Cambridgeshire study of commuting adults found workplaces rather than the home provided the highest exposure to takeaway food outlets in their study of different food environments (Burgoine and Monsivais, 2013). Exposure to takeaways (including fast food) was 80% higher in the workplace, whilst exposure to restaurants was 155% higher (Burgoine and Monsivais, 2013).

2.4.1 Density of Fast-Food Outlets

As mentioned previously, the number of FFOs in the UK is increasing. In 2012, the average density of FFOs by local authority in England was 77.9 per 100,000 population (National Obesity Observatory, 2012), increasing to 88 per 100,000 population in 2014 (PHE, 2016c) and to 96.1 per 100,000 population by the end of 2017 (PHE, 2018b). The density of FFOs also tends to be higher in local authority areas with a high deprivation score, as shown in Figures 2.3, 2.4 and 2.5 (PHE, 2018b). The definition of fast food by

PHE is food that is available quickly from fast food and takeaway outlets (chain and non-chain) such as burger bars, kebab and chicken shops, chip shops and pizza outlets (PHE, 2016c; PHE, 2018b).

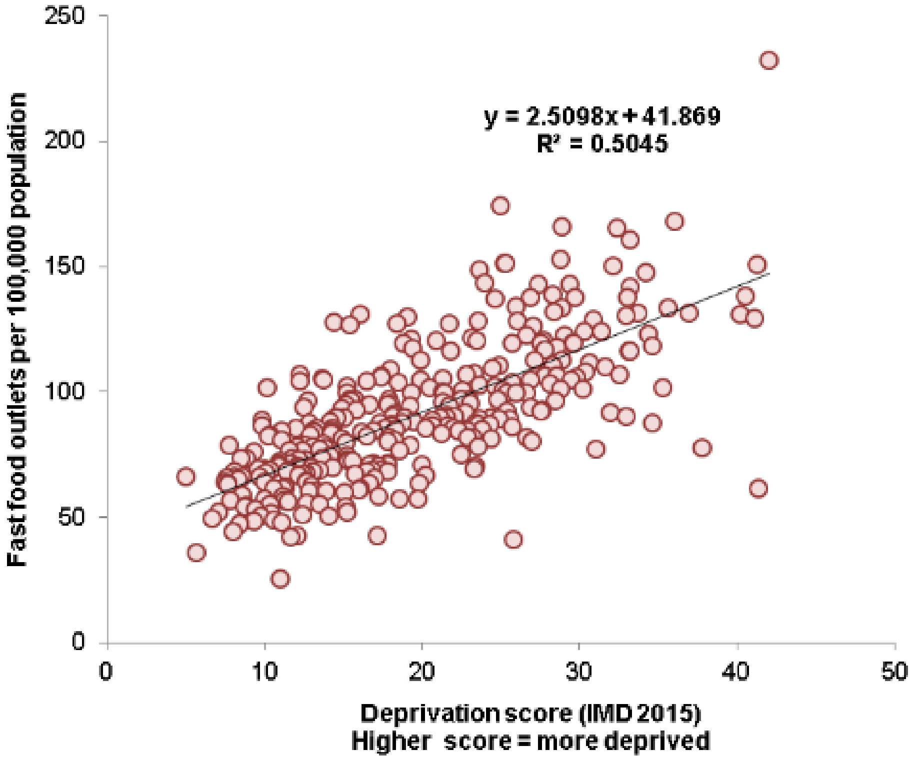


Figure 2.3 Relationship between density of fast-food outlets and deprivation by local authority (PHE, 2018b).

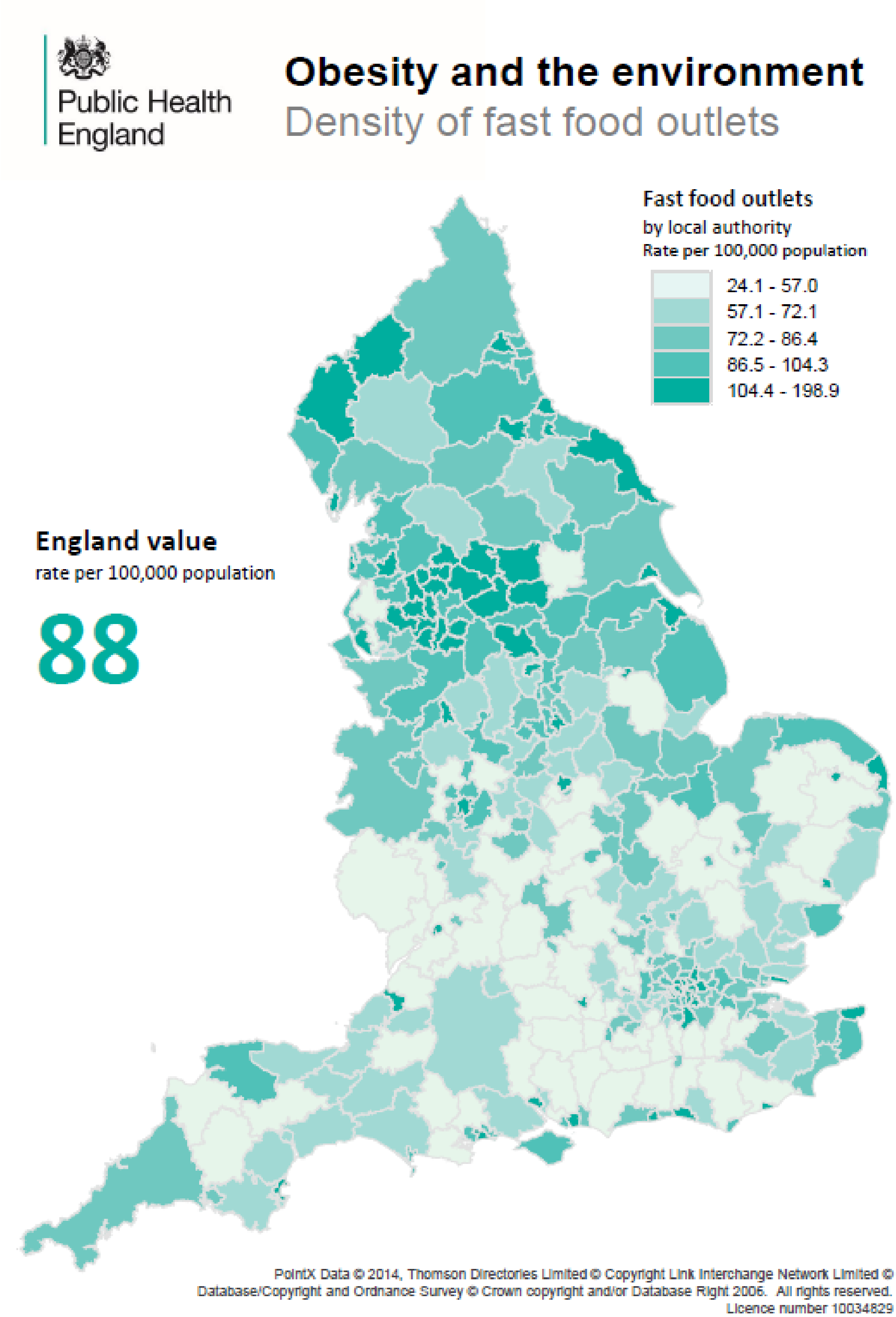


Figure 2.4 Density of FFOs per 100,000 people in England by local authority (PHE, 2016c).
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https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

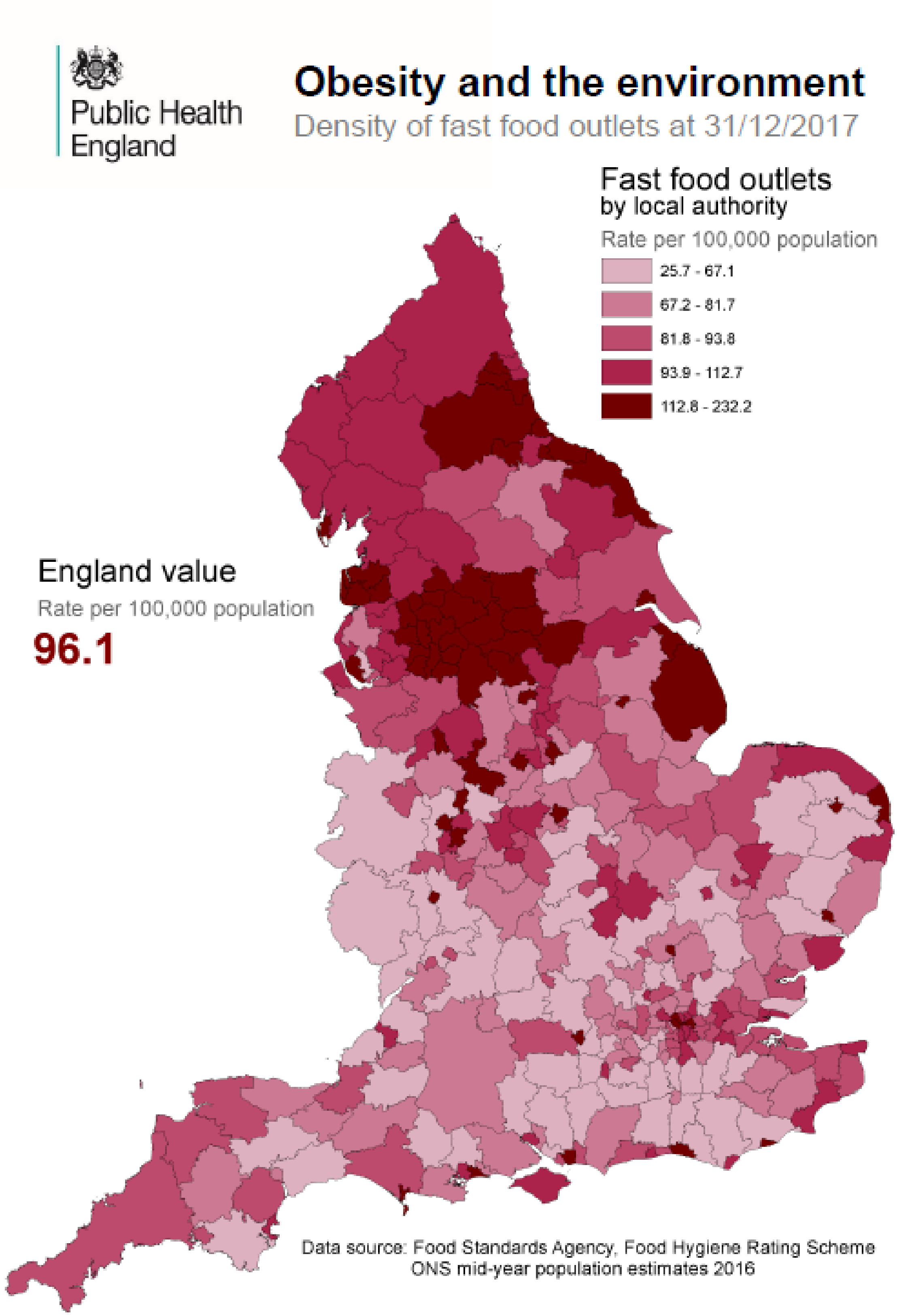

Figure 2.5 Density of FFOs per 100,000 people in England by local authority (PHE, 2018b)

2.4.2 Density of Fast-Food Outlets in Merseyside

Although Liverpool is no longer the most deprived local authority (now 3rd) (Department for Communities and Local Government, 2015), it still has a higher density of FFOs, 129 outlets per 100,000 population in Liverpool compared with the 96.1 England average (PHE, 2018b; Knowsley Council, 2022).

Knowsley does not follow this trend and has a lower density of FFOs, with around 62 outlets per 100,000 population. However, Prescot North, a ward in Knowsley has 16 FFOs which is equivalent to a rate of 167 outlets per 100,000 population (Knowsley Council, 2022). The other three local authorities in Merseyside have similar FFO densities which are all higher than the England average (Table 2.1).

Table 2.1 Number of Fast-Food Outlets per 100,000 population

Local Authority	Number of outlets	Rate per 100,000 population
Liverpool	630	129
Wirral	334	105
Sefton	285	104
St Helens	189	106
Knowsley	91	62
England Average		96.1

(PHE, 2018b; Knowsley Council, 2022)

Another way of exploring the geography of takeaways across England is by using the 'Food environment assessment tool' (Feat). This tool can be used at a neighbourhood level (CEDAR and MRC Epidemiology Unit, 2021). Feat defines takeaways as food outlets where hot food is ordered and paid for at the till, with no waiter service, and limited or no sit-in option and includes bakeries such as Greggs, fast food chains and independent takeaways (Butler, 2017) so is slightly different to the one used by PHE. When using Feat to discover the numbers of takeaways in Merseyside, the highest densities still tended to be in the areas with the highest deprivation. Some areas of Liverpool, Wirral and Knowsley were shown to have much higher takeaway densities than other areas, for example Huyton East with 146, Prescot with 195, Liscard with 313 and Walton with 930 takeaways per 100,000 population (CEDAR and MRC Epidemiology Unit, 2021). The Walton figures include County road in Liverpool, which is considered a highly deprived area with an IMD of 18 (Ministry of Housing Communities & Local Government, 2019). The Feat tool also showed hotspot areas such as Liverpool city centre (885) and Birkenhead on the Wirral (609) (CEDAR and MRC Epidemiology Unit, 2021).

These findings are interesting; however, density of FFO is only one of many factors which influences peoples eating habits and food choices (Knowsley Council, 2022). Another factor to consider is the availability of affordable nutritious food and this was explored by Kellogg's who investigated food deserts across Britain with a focus on areas of deprivation and its impact on residents. Their report found some of the most deprived food deserts in England were also in Liverpool, in its Walton constituency and in Knowsley (Corfe, 2018). A deprived food desert was a food desert in the most deprived 25% of areas, according to the governments Index of Multiple Deprivation measures and 'food desert' was considered to be an area with two or less supermarkets/convenience stores whereas a 'normal area' contained between three and seven (Corfe, 2018).

2.4.3 Obesity in Adults and Fast-Food Consumption

Several studies have shown the consumption of FAFH can result in increased energy intake (Paeratakul et al., 2003) and higher BMI (Pereira et al., 2005; Smith et al., 2009; Kant, Whitley and Graubard, 2015; Albalawi, Hambly and Speakman, 2022). The effect of fast-food consumption of 25 high income countries was investigated by De Vogli, Kouvonen and Gimeno (2014) over the period of 1888 and 2008. They found fast food consumption to be positively and significantly associated with BMI, each additional fast-food purchase per capita was associated with an increase in age standardized BMI of 0.03 kg/m^2 (De Vogli, Kouvonen and Gimeno, 2014).

In Spain, Schröder, Fito and Covas (2007) used a Food Frequency Questionnaire (FFQ) to investigate the diets of 2,930 adults between 1999 and 2000. Moderate fast-food consumption was reported with 1.1% of adults eating fast food more than once a week, 2.7% once a week and 6.3% once a month. Increasing fast food consumption was associated with higher energy intakes, poor diet quality and higher BMI (Schröder, Fito and Covas, 2007). Compared with not consuming fast food, consuming a fast-food product more than once a week increased the risk of being obese by 129% (Schröder, Fito and Covas, 2007). Fast food consumption also decreased significantly with increasing age (p <0.001). One limitation of the study was that only four popular fast-food items were included on the FFQ (hamburger, cheeseburger, Big Mac (or similar) or French fries) suggesting underestimation of fast-food consumption may have occurred.

In the out of home food eating review by Nago et al. (2014), frequent consumption of out of home food was positively associated with the risk of becoming overweight or obese and weight change (Bes-Rastrollo et al., 2010). When compared with eating at a restaurant, fast food consumption was associated with greater increase in body weight and waist circumference over time (Duffey et al., 2009) and takeaway food consumption was positively associated with BMI change in women (Ball, Brown and Crawford, 2002). In a follow-up study of Australian women aged 18-23 years at baseline, women who ate takeaway foods once a week were 15% less likely to be weight maintainers (within 5% of their baseline BMI) four years later when compared with women who never or rarely ate takeaway foods (Ball, Brown and Crawford, 2002; Nago et al., 2014). In a Mediterranean follow-up study of Spanish participants, consumers who ate away from home meals two times or more per week were significantly heavier than non-eating-out consumers, gaining 129 g/year (p <0.001). In addition, these consumers had a higher adjusted risk of gaining 2 kg or more in weight per year (Bes-Rastrollo et al., 2010) with no significant differences in the prediction of weight gain between males and females. Furthermore, they observed 855 new cases of participants living with overweight or obesity who were healthy weight at baseline (BMI < 25 kg/m^2), becoming overweight or obese was significantly associated with eating away from home meals (hazard ratio 1.33, 95% CI 1.13, 1.57, p <0.05) (Bes-Rastrollo et al., 2010).

In the Cambridgeshire study which examined takeaway food consumption, bodyweight, and exposure to takeaway food consumption, Burgoine et al. (2014) found exposure to takeaway food outlets was positively associated with takeaway food consumption. When exposed to takeaway outlets whilst at work, individuals ate an additional 5.3 g (95% CI 1.6, 8.7, p <0.05) of takeaway food per day compared with those least exposed (Burgoine et al., 2014). However, a more recent study which spanned a geographically diverse area only found weak associations between access to fast food and obesity (Mason, Pearce and Cummins, 2018) although the definition for fast food was different to other studies. In their study, outlets were classed as fast food if they were categorised as a hot or cold FFO or takeaway in the UK Ordnance Survey AddressBase (Mason, Pearce and Cummins, 2018). Using cross-sectional observational data from the UK Biobank, residential addresses were used to calculate the distance to the nearest FFOs and physical activity facilities. This study found high densities of physical activity facilities were associated with lower adiposity in adults aged 40 to 70 years. Adults with access to at least six facilities within a 1000 metres had smaller waist circumference, lower BMI and body fat percentage (1.22 cm, 0.57 kg/m^2, 0.81% respectively) (Mason, Pearce and Cummins, 2018). Proximity to FFOs was weakly associated with waist circumference and BMI, adults living at least 2000 metres away from a FFO had 0.26 cm smaller waist circumference than those that lived within 500 metres (Mason, Pearce and Cummins, 2018).

As part of the 1994-1996, 1998 Continuing Survey of Food Intakes by Individuals (CSFII), dietary information was collected from more than 17,000 adults and children in the USA. Two non-consecutive 24 hour dietary recalls were collected on different days of the week, 3 to 10 days apart (Paeratakul et al., 2003). Significantly higher intakes of total energy and fat were found when comparing dietary intake of those who reported eating fast food with those who did not (Paeratakul et al., 2003). In the National Health and Nutrition Examination Survey (NHANES), data collected between 2005 and 2010 found individuals who ate fast food more frequently had higher mean BMI and lower high-density lipoprotein (HDL) cholesterol concentrations, with stronger associations found in women than men (Kant, Whitley and Graubard, 2015). Further analysis of the 2003-2010 waves of the NHANES study (n = 18,098) also found the consumption of fast food was associated with higher intakes of energy, fat, SFA, sugar and sodium (An, 2016). Specifically, fast-food consumption was associated with net daily increases in energy of 190 kcal, 10.6 g total fat, 3.5 g SFA and 297 mg of sodium (An, 2016).

The influence of eating location on nutrient intakes was studied by O'Dwyer et al. (2005) in Ireland. If a respondent ate at a restaurant, pub, coffee shop or takeaway, it was classed as eating out, with no distinction made between FFOs and independent takeaway outlets. The study found takeaway foods contributed a disproportionately high level of fat to total energy and food energy when compared with foods prepared at home (45% fat compared to 36% respectively) (O'Dwyer et al., 2005). When comparing consumers who met current dietary recommendations for percentage of food energy from fat (≤35%), 40% of men and women met the guideline for food prepared at home, however only 7% met this guideline when takeaway was the eating location (O'Dwyer et al., 2005). In addition, foods prepared out of the home were more likely to be lower in fibre and micronutrients when compared with foods prepared in the home. Takeaway food also showed lower mean quantities of fibre, calcium, iron, zinc and vitamins A and C when compared with food prepared at home (O'Dwyer et al., 2005).

2.4.4 Obesity in Adolescents and Fast-Food Consumption

In a UK birth cohort of 3,620 teenagers, Fraser et al. (2011) showed increased consumption of fast food was positively associated with higher consumption of unhealthy foods. Increased visits to FFOs were also negatively associated with eating less fruit and vegetables (Fraser et al., 2011). In a study of over 4,000 thirteen to fifteen years olds in the Southwest of England, eating fast food was associated with a 23% increased risk of living with obesity and a 2% increase in body fat (Fraser et al., 2012). Similarly, in an American population, Fulkerson et al. (2011) found the odds of adolescents living with overweight or obesity was almost two times more likely if their families purchased the family evening meal from a fast food restaurant, had food delivered or picked up takeaway on one or more occasions during the week compared with adolescents of families who did not. For the parents, the odds of living with overweight or obesity were increased to between two and two and a half times greater when compared with parents who did not purchase these types of meals over the preceding week (Fulkerson et al., 2011). This study also found significantly higher metabolic syndrome risk score and insulin levels for adolescents whose parents reported weekly fast-food dinner purchases, when compared with adolescents who did not (Fulkerson et al., 2011).

2.5 Health Issues associated with Obesity and FAFH

In addition to living with overweight or obesity, consumption of takeaway food has been associated with other risk factors for CVD. In the CARDIA (Coronary Artery Risk Development in Young Adults) study, CVD risk factors were investigated with frequency of fast food consumption (Pereira et al., 2005). Over 3000 participants had fast food frequency, bodyweight and insulin resistance measured at baseline and at 15-year follow-up (Pereira et al., 2005). A strong positive association was found between consumption of fast food, weight gain and insulin resistance. On average, participants who consumed fast food a minimum of three times a week (n = 87) gained an extra 4.5 kg in bodyweight and a 104% increase in insulin resistance when compared with those who ate fast food only once a week or less (n = 203). Overall, a three times per week increase in fast food frequency was associated with a mean bodyweight increase of 3.9 kg (n = 386) (Pereira et al., 2005). These findings suggest that more frequent fast food consumption increases the risk of obesity and type 2 diabetes (Pereira et al., 2005). Duffey et al. (2009) analysed three waves of fast-food consumption data from the CARDIA study (years 7, 10, and 20). The study found significantly higher weight, waist circumference, insulin resistance and triglyceride concentrations and significantly lower high-density lipoprotein (HDL) cholesterol concentrations when comparing individuals in the highest quartile of fast food consumption (≥2.5 times a week) with those in the lowest quartile (0 to < 0.5 times a week) (Duffey et al., 2009). Eating one extra meal away from home (fast food or restaurant) was also associated with greater anthropometric changes 13 years later (Duffey et al., 2009). Analysis of the NHANES study (1999-2014) found frequent consumption of away from home meals was significantly associated with an increased risk of all-cause mortality (Du et al., 2021). The hazard ratio of mortality for frequent consumers of meals away from home (2 meals or more per day away) compared with seldom consumers (less than once a week) was 1.49 (95% CI 1.05, 2.13, p <0.05). Although there were several confounders to this study including the definition of away from home food which between 1999 and 2004 only included meals prepared at a restaurant and between 2005 and 2014 included restaurants, fast food places, food stands, grocery stores and vending machines (Du et al., 2021).

In a study of young Australian adults (aged 26-36 years), Smith et al. (2009) showed takeaway food consumption was associated with poorer diet quality and moderate abdominal obesity. Consuming takeaway food at least twice a week (almost 40% men and 20% women) was associated with a higher prevalence of moderate abdominal obesity in men and women, 31% and 25% respectively, when compared with those who ate it less frequently (Smith et al., 2009). In a later study, Smith et al. (2012) found significantly higher mean fasting glucose concentrations and homeostasis model assessment (HOMA) scores (p = 0.045 and p = 0.034 respectively) and fasting insulin tended to be higher in women who ate takeaway food twice a week or more compared with women who ate it once a week or less (4.82 vs 4.88 mmol/l, respectively). Men who ate takeaways more frequently also had higher fasting insulin concentrations and HOMA scores, but this was not statistically significant (*Ibid*). When taking waist circumference into account, the effects of takeaway consumption were reduced, however CVD risk factors are generally more common in older age groups and this was a study of young adults, aged 26 to 36 years.

2.5.1 Type 2 Diabetes

Diabetes is characterised by high blood glucose levels and increases the risk of dying prematurely from complications such as heart attack, stroke, kidney failure, leg amputation, vision loss and nerve damage (WHO, 2016a). Worldwide the prevalence of type 1 and type 2 diabetes is increasing, from 108 million in 1980 (WHO, 2016a) to an estimated 425 million adults aged 20-79 years in 2017 (International Diabetes Federation, 2017). Unless considerable changes take place to reduce the global burden of obesity and diabetes, the prevalence of diabetes is projected to be as high as 629 million adults by 2045 (International Diabetes Federation, 2017). In addition to the 425 million adults with diabetes, an additional 352 million people have impaired glucose tolerance and are at high risk of developing T2D (International Diabetes Federation, 2017). In England, there are an estimated 5 million people aged 16 and over with impaired glucose tolerance (PHE, 2015c).

Although type 1 diabetes cannot be prevented, the risk of developing T2D can be reduced. Obesity and large waist circumferences are key risk factors for developing T2D (90% of adults with T2D are living with overweight or obesity). This is concerning when 1 in 4 adults are living with obesity and 1 in 3 adults are living with overweight in the UK. Healthy weight adults are five times less likely to be diagnosed with diabetes than adults living with obesity (Gatineau et al., 2014). T2D is most commonly seen in adults; however, in 2000 it was diagnosed for the first time in overweight girls aged 9 to16 of Pakistani, Indian or Arabic origin (Ehtisham, Barrett and Shaw, 2000) and in 2002 in white adolescents (Drake et al., 2002). Contributing factors to the increase in T2D in children, adolescents and young adults are increasing obesity levels, reduced physical activity and poor diet (International Diabetes Federation, 2017). The 'health of minority ethnic groups' survey also found prevalence of T2D to be higher in Black Caribbean, Indian, Pakistani and Bangladeshi men and women when compared with the general population (Sproston and Mindell, 2006). The survey also found prevalence of T2D increases with age among all groups. Winkley et al. (2013) have also shown people of Black and South Asian ethnicity developed T2D approximately 10 years earlier than people from the White population in the UK.

Pereira et al. (2005) and Smith et al. (2012) have shown associations between fast food consumption, obesity, T2D and other CVD risk factors in the US and in Australia. In the UK, analysis of participants attending three diabetes screening studies (n = 10,461) found density of fast-food outlets to be associated with T2D risk (Bodicoat et al., 2015). The number of fast-food outlets in a person's neighbourhood (within 500 metre radius of home postcode) was significantly higher (p <0.001) among non-White ethnic groups, in urban areas and in socially deprived areas (Bodicoat et al., 2015). Furthermore, after adjusting for confounders, increased exposure to FFOs in the neighbourhood was significantly associated with an increased risk of T2D (OR = 1·02; 95% CI 1·00, 1·04) and obesity (OR = 1·02; 95% CI 1·00, 1·03). Weak positive associations for BMI and fasting glucose were also found (Bodicoat et al., 2015). Regression analyses carried out by Mazidi and Speakman (2018) on density of fast food restaurants in the US was also positively associated with CVD, stroke and T2D suggesting an increased risk of death with increased density of fast food restaurants, although the maximal impact from each outlet was small (Mazidi and Speakman, 2018).

2.5.2 Hypertension

Various dietary and lifestyle factors are associated with raised blood pressure (hypertension) and an increased risk of CVD and hypertension is the single most important risk factor for stroke (Meschia et al., 2014). Hypertension is a leading cause of death and disability worldwide, and accounts for an estimated 10.7 million deaths each year and 211 million disability-adjusted life-years (DALYs) (Forouzanfar et al., 2017). A number of studies have shown that too much salt (sodium chloride) in the diet is a leading cause of raised blood pressure and that reducing salt intake lowers blood pressure and reduces CVD risk (He, Li and Macgregor, 2013; He and MacGregor, 2018) and all-cause mortality (He et al., 2020).

Salt is a cheap ingredient used widely in the food industry to add flavour and texture to food and for food preservation (Sodium Working Group, 2010). Only a small amount of salt occurs naturally in food (about 12%) or is added directly during cooking (5%) or at the table by the consumer (6%) (Sodium Working Group, 2010). The major contributors of salt in UK diets is from processed foods (Bibbins-Domingo et al., 2010; WHO, 2014a) and foods prepared outside the home, which are considered to have a higher salt content than meals cooked at home (Guthrie, Lin and Frazao, 2002; Prentice, Smith and McLean, 2016; Mackay et al., 2021). For this reason, it can be difficult for consumers to reduce their salt intake over a long period of time (SACN, 2003).

A meta-analysis of 3,230 participants in 34 randomised trials showed that a modest reduction in salt intake over a period of four weeks or more caused a significant decrease in blood pressure (He, Li and Macgregor, 2013). Results from the meta-analysis also suggest that reducing dietary salt intake from approximately 10 g/day to 5-6 g/day would have a major effect on lowering blood pressure at a population level and thus reduce CVD (He, Li and Macgregor, 2013; He et al., 2020). In Finland, a one-third decrease in average salt intake over 3 decades has been associated with a decrease in average blood pressure at a population level and an approximate 75 to 80% decrease in mortality from stroke and CHD in the middle-aged population (Karppanen and Mervaala, 2006).

In the 2015 Health Survey for England, the definition for hypertension is a blood pressure 140/90mm Hg or above. This survey found hypertension was strongly associated with BMI, especially for men (Moody and Neave, 2016). Hypertension was twice as common among adults living with obesity as among those of normal weight; 43% of men and 37% of women living with obesity compared with 21% of men and 18% of women with a normal BMI (Moody and Neave, 2016). Similarly, more men and women were hypertensive who had a high waist circumference compared with those that did not (41% of men and 31% of women compared with 22% of men and 16% of women respectively) (Moody and Neave, 2016). An earlier survey also found a higher prevalence of hypertension in adults living in more deprived areas (34% men and 30% women in most deprived areas compared with 26% and 23% respectively in the least deprived) (Knott and Mindell, 2012).

In a study of university students in Singapore (n = 501, aged 18 to 40), prevalence of prehypertension and lifestyle factors were collected by Seow, Haaland and Jafar (2015). In their study, they found 27.4% of participants had prehypertension and 2.2% had hypertension. Their results (adjusted multivariable model) showed prehypertension and hypertension was associated with increased odds of participants eating more meals away from home (OR 1.05, 95% CI 1.01, 1.09), higher BMI (OR = 1.15, 95% CI 1.02, 1.30) and low physical activity (OR = 2.14, 95% CI 1.20, 3.82) compared with moderate/high. They also found prehypertension and hypertension were associated with being male (OR = 7.01, 95% CI 3.97, 12.4) and being older (OR = 1.06, 95% CI 1.01, 1.11), and waist circumference was associated with prehypertension and hypertension among females (OR = 1.08, 95% CI 1.01, 1.14) (Seow, Haaland and Jafar, 2015). Furthermore, eating meals away from home 15 times a week was a predictor of prehypertension and hypertension, with an odds ratio of almost 3 times higher (OR 2.79 (95% CI 1.18, 6.61) when compared with 4 meals a week (Seow, Haaland and Jafar, 2015). Conversely Smith et al. (2012) found no association between takeaway food consumption in the Australian study of cardio-metabolic risk factors. This study also involved a sample of young adults (age 26 to 36); however, a high proportion of participants ate takeaway food once a week or less (61% men and 80% women) compared with 39% men and 20% women who ate it twice a week or more, furthermore they did not measure prehypertension. Using data from the 2014–2015 KNHANES study (Korea National Health and Nutrition Examination Survey), Yeon and Han (2021) showed that reducing consumption of FAFH to less than four times a week could reduce salt intake by 1.9 g to 3.3 g.

Penney et al. (2017) analysed the 2008-2012 NDNS (n = 2,083, age 19 or older) which is considered a demographically representative sample of the UK population. Obesity status and accordance to the Dietary Approaches to Stop Hypertension (DASH) diet which can reduce blood pressure were evaluated in combination with the consumption of AFHF. After adjusting for cofounders (age, sex, total energy, survey year and socioeconomic status), regression analyses showed AFHF type (sit down restaurant, fast food or café) was associated with lower odds of conforming to DASH and higher odds of obesity (Penney et al., 2017). The odds of conforming to DASH in the middle tertile for AFHF consumption was 0.70 (95% CI 0.52, 0.95; p <0.05) and 0.45 (95% CI 0.31, 0.67; p <0.01) in the highest tertile; for obesity, the OR was 1.41 (95% CI 1.06, 1.89) for the middle tertile and 1.48 (95% CI 1.10, 1.99) for the highest tertile (Penney et al., 2017). When further adjusted for AFHF type, restaurant and café were no longer significant, however fast food use was associated with lower odds of conforming to DASH of 0.48 (95% CI 0.33, 0.69; p <0.01) and higher odds of obesity 1.30 (95% CI 1.01,1.69; p <0.01) (Penney et al., 2017). These findings support previous studies where the consumption of AFHF and fast food has been negatively associated with diet quality and positively associated with obesity (Duffey et al., 2009; Brindal et al., 2014; Bahadoran, Mirmiran and Azizi, 2015; Smith et al., 2017). Frequent fast-food consumers in this study had much lower odds of accordance to a DASH diet and were 48% more likely to be living with obesity (Penney et al., 2017). Furthermore, these findings show how fast food may be contributing towards hypertension and that reducing fast food intake may help to reduce dietary salt intake, although further research would be needed to study these consumers overall dietary patterns.

2.6 UK Salt Targets

In the UK, most people eat more than the recommended amount of salt on a daily basis. The Scientific Advisory Committee on Nutrition (SACN) recommends that adults reduce their daily intake to less than 6 g of salt per day (SACN, 2003; PHE, 2016b). The Reference Nutrient Intake (RNI) for salt is actually much lower at 4 g of salt a day (1600 mg sodium) (Department of Health, 1991). As regards salt consumption in Merseyside, the NHS Merseyside Lifestyle Survey 2012/13 showed 43% of adults in Knowsley generally add salt to their food during cooking compared to 50% of adults in Liverpool and the average of 47% for Merseyside (Jackson and Cornick, 2013; Langton, 2015).

Some progress to reduce average daily salt intake in the UK has been made in recent years. In the 2018/19 National Diet and Nutrition Survey (PHE, 2020a), the estimated salt intake for adults aged 19 to 64 years was 8.4 g/day (9.2 g/day for men and 7.6 g/day for women), this is a slight increase on figures from the 2014 NDNS survey at 8.0 g per day (9.1 g per day for men compared with 6.8 g per day for women) (Bates et al., 2016) but these changes were not significantly different. However, these results are an improvement from 8.6 g per day in 2008 (National Centre for Social Research, 2008) and from 9.5 g per day for men and women in 2001 (Hoare, 2004). Alonso et al. (2021) studied the impact of the population salt intake reduction programme in England between 2003 and 2018 where population-level salt intake reduced from 9.4 g/day to 8.4 g/day. They estimate that if the reduction in salt of 1 g/day per adult were to be maintained between 2018 and 2050, 83,140 cases of premature ischemic heart disease and 110,730 premature strokes would be avoided, as well as 542,850 extra quality adjusted life years

(QALY) generated and £1.64 billion in health care costs and £5.67 billion in social care costs would be saved (Alonso et al., 2021).

Although evidence shows that salt consumption is reducing, the population is still far from consuming the recommended 6 g per day or less (PHE, 2016b) and incidence of stroke is increasing in young adults (Hankey, 2013). The current UK target is to reduce population salt intakes to 7.0 g per day (Department of Health & Social Care, 2019). One area where improvements could be made is in the independent takeaway sector: if chefs were supported in preparing takeaway food containing less salt, one consequence of this could be a reduction in the average daily salt intake of the population which could in turn contribute to a reduction in health problems related to excessive salt consumption.

2.7 Worldwide Salt Targets

Estimates suggest that 2.5 million deaths could be prevented each year if the consumption of salt were reduced globally to less than 5 g per day (He and MacGregor, 2009; WHO, 2019). The WHO recommends a reduction in salt intake to less than 5 g a day in adults and has set a global target of a 30% reduction in the mean population salt consumption by 2025 to reduce blood pressure and the risk of coronary heart disease and stroke (WHO, 2014a). To reduce population-wide salt consumption, the WHO supports policies that are multidisciplinary and intersectoral to address broader determinants of health and improve the effectiveness of health programmes. Policies need to include the participation of all relevant stakeholders and make use of all available tools such as consumer education, labelling, legislation and product reformulation (WHO, 2014a). The present UK government expects the eating out, takeaway and delivery sector to reduce salt in served meals, however this legislation is not mandatory, only voluntary (PHE, 2020d). The importance of reducing salt levels in out of home foods is that a dose-response relationship has been shown between salt intake and blood pressure (He et al., 2020). Reductions in salt intake, particularly from takeaway food, could contribute towards reductions in blood pressure for these consumers, which could hypothetically reduce the risk of stroke or death from CVD.

2.8 UK Nutritional Guidelines

In general we are consuming too many calories on a daily basis, a conservative estimate at a population level is that adults consume 200-300 excess calories a day (PHE, 2018a). As previously mentioned, current nutritional guidelines for adults in the UK are that men and women should consume approximately 2500 kcal and 2000 kcal per day respectively

(PHE, 2016b). The guidelines state that for an adult, this should consist of 50% carbohydrate, 35% total fat and 15% protein (when not including alcohol) (Department of Health, 1991). Carbohydrate includes free sugars, intrinsic sugars, milk sugars and starch. Free sugars are sugars added to food or drinks or sugars found naturally in honey, syrups and unsweetened fruit juices (PHE, 2016b). Recent recommendations are that free sugars should not exceed 5% of total dietary energy for age groups from 2 years upwards (halved from previous recommendations of 10% non-milk extrinsic sugars). Hence 45% of carbohydrates in the diet should come from intrinsic sugars, milk sugars and starch (SACN, 2015). Total dietary fat recommendations are broken down into 11% SFA, 13% cis-monounsaturated fatty acids (MUFA), 6.5% cis-polyunsaturated fatty acids (PUFA) and 2% TFA (Department of Health, 1991). If UK diets matched nutritional guidelines, potential health benefits include reducing blood pressure, T2D, lipid abnormalities and potentially longer-term benefits such as a reduction in mortality rates from CVD at a population level (He and MacGregor, 2018). An estimated 70,000 premature deaths could be prevented in the UK each year which is more than 10% of current annual mortality (Cabinet Office, 2008b). Dietary changes to reduce these premature deaths include increasing fruit and vegetable consumption to 5 a day and reducing daily SFA, salt and free sugar intake (Cabinet Office, 2008b; SACN, 2015). These recommendations suggest that strategies which involve reducing the levels of salt, energy, total fat and SFA (or strategies sign-posting menu options lower in these types of components) may have a positive benefit on health.

2.9 Nutritional Composition of Fast Food

Studies have shown large variations in the nutritional composition of similar fast-food items. Analysis of the nutritional quality of restaurant foods in Canada using online menus found mean levels of SFA, sodium, and sugar were high in both sit down and fast-food restaurants, both per suggested serving size and per 100 g (Murphy et al., 2020). A study carried out in Australia analysed the nutritional quality of food items from leading fast-food chains. They found a significant variation in fat content between similar food products sold at different fast food chains for nutrient content per 100 g, with larger differences per serving (Dunford et al., 2010). Another study purchased French fries and fried chicken from McDonalds and Kentucky Fried Chicken (KFC) (Stender, Dyerberg and Astrup, 2007). Purchasing meals from different outlets in 35 countries, they found total fat content ranged from 41 to 65 g in McDonalds and 42 to 74 g at KFC. In a later study Dunford et al. (2012) investigated salt content of fast food in six fast food chains around the world. The study found substantial variability in salt content between products in the same categories but also between similar products served by the same company but in different countries (Dunford et al., 2012). These findings show that there can be a great deal of variation and therefore lack of consistency when purchasing the same meal from the same provider (Stender, Dyerberg and Astrup, 2007). However, the variations in the same meals served in different countries shows that it should be possible to improve fast food via recipe reformulation to reduce energy, fat, SFA and salt around the world (Ziauddeen et al., 2015).

As part of a study in New Zealand, fast food served by independent outlets was sent for laboratory analysis of sodium content for comparison with the 2012 sodium targets set by the UK Food Standards Agency (Prentice, Smith and McLean, 2016). The majority of meals exceeded the 2012 sodium targets: food items with the highest sodium content per 100 g included sausage rolls (689 mg/100 g), battered hotdogs (679 mg/100 g), beef hamburgers (499 mg/100 g), mince and cheese pies (522 mg/100 g), and chop suey (397 mg/100 g). Per serving, chop suey had the largest portion size (760 g) and the highest sodium content with 3086 mg/portion, egg foo yung had the second largest sodium content with 1994 mg/portion and a portion size of 595 g. This study also showed a wide variation in sodium content for the same meal served from different outlets (Prentice, Smith and McLean, 2016). Robinson et al. (2018) showed excessive amounts of energy in a large number of main meals and large amounts of variability in energy content of main meals between individual restaurants, in their analysis of nutritional information supplied on menus from major fast-food chains and full-service restaurants in the UK. Their findings also showed higher energy levels in restaurant meals compared with meals from fast food chains with an additional average 268 kcal (103 to 433) (Robinson et al., 2018). However, this study limited its analysis to full-service restaurants and fast-food chains with 50 or more outlets (Burger King, KFC, Leon, McDonalds, Subway and Wimpy) so did not include independent outlets. Furthermore, only two types of meals were analysed: burger and fries/chips meals and salad meals (Robinson et al., 2018).

2.10 Nutritional Composition of Takeaway Food

Most studies which have investigated the nutritional composition of FAFH have concentrated on the analysis of meals from fast food chains (for example Subway, McDonalds, Burger King, KFC), not taking into account other out of home meal options. One reason for this is that nutritional information for food served by fast food chains is readily available, however this is not the case for meals served by small independent takeaways due to the high cost of nutritional analysis and the lack of standardisation when preparing meals.

Nonetheless, several councils in the UK have collected samples of takeaway food and sent them away for nutritional analysis to determine calorie, fat, SFA, TFA or salt content. Trading Standards South East investigated the nutritional composition of fish and chips, Indian and Chinese takeaway foods in West-Sussex (Brown, 2007). The results showed large portion sizes as well as high levels of salt, fat and SFA in a large number of English, Chinese and Indian meals (Brown, 2007). North Yorkshire County Council purchased 25 meals from takeaways for analysis including British, Indian, and Chinese meals. Almost all of the meals contained 50% or more of the guideline daily allowance (GDA) for energy (calories) (n = 17) and fat (n = 19) (Hudson, 2007). High levels of TFA were also found in six of the meals and ten meals contained more than 6 g of salt (Hudson, 2007). The Healthier takeaways project in Antrim, Northern Ireland analysed fish and chips meals from nine different takeaways. In some cases, meals contained 100% or more of the GDA for fat and SFA, some meals were high in TFA, and all were high in salt, some containing almost 5 g (Antrim Borough Council, 2009). More recently, a study analysed the sodium content of fish and chips, meals, and component parts, purchased from fish and chip shops (n = 61) in Northern England (Goffe et al., 2016). The mean salt content in a portion of fish and chips was 1147 mg of sodium (SD = 424 mg; $p > 0.05$), equivalent to 2.9 g of salt (Goffe et al., 2016). The (LACORS, 2009) (Local Authority Coordinators of Regulatory Services) kebab report also found salt content of kebabs ranged from 0.47 g to 16.6 g, whilst the average salt content was 5.9 g. In their nutritional analysis of 494 samples of donner kebabs collected by 76 individual councils, almost half of the kebabs (43%) exceeded 6 g of salt, the recommended daily level for an adult (LACORS, 2009). Furthermore, donner kebabs varied considerably in portion size, ranging from 120 g to 677 g and calories per portion ranged from 365 to 1990 kcals (LACORS, 2009).

On the island of Ireland, *Safe*food collected food samples from takeaways and restaurants with a takeaway service (*safe*food, 2012a; *safe*food, 2012b; *safe*food, 2015). They purchased pizzas (n = 240), Chinese meal samples (n = 220) and Indian meal samples (n = 280) in duplicate, with one sample analysed for energy and the other for fat, SFA, protein, and salt content. The results from their analysis found large portion sizes for the majority of the meals and also a large range in the nutritional content of energy, fat, SFA and salt (*safe*food, 2012b; *safe*food, 2012a; *safe*food, 2015). The Local Government Group (2011) coordinated a survey of takeaway food from 30 local authorities. In total, 409 samples of chicken tikka masala, pilau rice, sweet and sour chicken and fried rice were selected for a detailed survey . There was significant variation in the composition of the meals, as well as high levels of fat and SFA (*Ibid*). An average sweet and sour chicken with fried rice meal contained 44.8 g of fat and 7.5 g of SFA whilst an average chicken tikka masala and pilau rice meal contained 60 g of fat and 23.2 g of SFA (85% GDA for fat and 116% for SFA) (*Ibid*). Both meals were also high in salt with chicken tikka masala and pilau rice providing 5.52 g (92% GDA) and sweet and sour chicken and fried rice providing 7.12 g (119% GDA). Another concern was the amount of sugar in the sweet and sour chicken and fried rice, with an average portion containing 67.7 g of sugar (approximately 16 teaspoons) (*Ibid*).

During 2013-2014, Sandwell PCT commissioned the purchase of 252 takeaway food items which were analysed for total fat, saturated and unsaturated fats, TFA and salt content (Saunders and Saunders, 2014). Similar to other studies, the results found high levels of total fat, SFA, and salt in the analysed samples. An average portion of fish and chips contained 59.9 g of fat, 34 g of SFA and 1.1 g of TFA whilst sweet and sour chicken and fried rice contained 80.9 g of fat, 30.9 g SFA and 6.9 g of salt (115% GDA for salt) (Saunders, Saunders and Middleton, 2015).

2.10.1 Portion Size

Since the 1970s, portion sizes of foods prepared for immediate consumption have been increasing (Young and Nestle, 2007). In the fast food industry, portion size is often used as a selling point (this is known as value marketing, where price per ounce decreases as portion size increases) and can encourage value conscious consumers to purchase larger meal items thereby increasing their energy intake (National Alliance for Nutrition and Activity, 2002). Furthermore, portion sizes served in the takeaway and fast-food sector have been shown to be substantially different to the same products sold by food retailers (ATNI, 2022). In the UK, large portion sizes were shown in the previously mentioned studies of takeaway food served by Chinese, Indian, fish and chips, kebabs and pizza outlets (Brown, 2007; LACORS, 2009; Local Government Group, 2011; *safe*food, 2012b; *safe*food, 2012a; *safe*food, 2015). These results show the importance of encouraging chefs to prepare smaller portions or reduce portion sizes of takeaway food to reduce intakes of energy, salt, fat and SFA and suggest that reducing portion sizes could help to improve the health of the population.

2.11 Nutritional Composition of FAFH (Fast Food and Takeaway Food)

Consumers eating FAFH have less knowledge and control over the nutritional content of these foods when compared with foods prepared at home (Guthrie, Lin and Frazao, 2002). As discussed previously, a number of studies have shown these types of food to be high in energy, fat, SFA, salt and added sugar (Hudson, 2007; Antrim Borough Council, 2009; LACORS, 2009; Local Government Group, 2011) and low in vitamins and minerals (Dunford et al., 2010; Lachat et al., 2012; Hearst et al., 2013; Ziauddeen et al., 2015; Prentice, Smith and McLean, 2016). A study of eating occasions (n = 523 adults and adolescents) at quick service restaurant chains in Australia found each increase in fast food consumption per month was associated with an increase in energy of 49 kJ (SE = 18), equivalent to 11.7 kcal (Brindal et al., 2014). Analysis of NHANES data collected between 2003 and 2010, found consumption of fast food was associated with a net increase in daily total energy of 190 kcal, 10.6 g total fat, 3.5 g SFA, 4.0 g sugar and 298 mg of sodium / 0.74 g of salt. Eating fast food was also associated with a decrease in fibre and vitamins A, C, D and K (An, 2016). Analysis of waves 1-4 of the UK NDNS also found adults who ate takeaway meals at home one or more times per week, consumed higher mean daily energy intakes of between 63 and 87 kcal per day when compared with those who rarely ate these types of meals (Goffe et al., 2017).

2.12 Frequency of Fast Food and Takeaway Consumption

The availability of FAFH makes it an easy choice for society. There are many reasons for eating these types of foods; nowadays, people are living much busier lives but also like to combine eating FAFH whilst socializing with friends and family. A European study of takeaway consumption habits found the main reasons for consumption were price, location, type of cuisine, good hygiene standards and time constraints (ACNielson, 2005). Similar reasons were found in the fast-food meals study in the USA (n = 594), frequent fast-food consumers found outlets to be quick (92%), easy to get to (80%), served food which tastes good (69%) and food was inexpensive (63%) (Rydell et al., 2008). In a study of university employees (n = 478) in the USA by Garza et al. (2016), the most commonly reported reasons for purchasing fast food instead of preparing food at home were convenience (93%) and to socialise (50%). Over the last couple of decades, this convenience has led to an increase in consumption of out of home food (Rosenheck, 2008).

This increase in fast food and takeaway food consumption over recent years corresponds with surveys carried out by the FSA in the UK. In 2002, Wave 3 of the

Consumer Attitudes to Food survey with over 3000 respondents, found 20% of respondents regularly used a takeaway (fish and chip shop, Chinese, Indian, Pizza) and 58% used one occasionally (16% never) (Food Standards Agency, 2003). Respondents visited FFOs (for example McDonalds, KFC) less frequently, with 12% using them regularly and 38% occasionally (34% never) (Food Standards Agency, 2003). By 2006, Wave 7 of the Consumer Attitudes to Foods survey was amended to examine frequency of consumption of takeaway meals (although the distinction between independent takeaways and fast-food chains was not made). Results from this survey indicated that 22% of respondents ate takeaway meals at least once a week and 58% a few times a month, 18% advised they never ate takeaways (Food Standards Agency, 2007).

The Food and You survey is a biennial cross-sectional survey of adults aged 16 years and over living in private households, and its results are representative of the population due to random probability sampling. By 2014, wave 3 of the Food and You survey reported 75% of respondents eating out or buying food to takeaway in the last seven days. A quarter of respondents (27%) advised they had eaten takeaway food (for example Indian / Chinese / Pizza / fish and chips) and 21% advised they had eaten fast food (Food Standards Agency, 2014a). In the next Food and You survey (wave 4), respondents were asked whether they had eaten out over the past month instead of the last 7 days, nevertheless 67% of respondents had eaten at a restaurant in the last month and 55% had eaten takeaway food from a restaurant or takeaway outlet (NatCen Social Research, 2017). Wave 5, carried out two years later showed similar figures with 68% and 56% respectively (NatCen Social Research, 2019).

Similar figures for frequency of takeaway consumption were found in Liverpool in 2007 when compared with figures from the UK Consumer Attitudes to Foods survey. For the Survey of Food Habits and Attitudes in Liverpool, 926 residents were interviewed (Jon Dawson Associates, 2007). Participants were asked how often they consumed food purchased at takeaway outlets, fast-food restaurants, and other restaurants. A quarter of respondents (26%) advised they ate food from takeaway outlets and 13% from fast food restaurants at least once or twice a week (Liverpool NHS PCT, 2010). These figures are slightly higher than the 22% found in the 2006 Consumer Attitudes to Foods survey (Food Standards Agency, 2007). In a larger study carried out in Knowsley, 2,391 adults were interviewed for the NHS Merseyside Lifestyle Survey 2012/13. The survey found one in five adults never eat fast food (19%), whilst 55% consume it once or twice a month or less and 26% consume fast food at least once a week (Jackson and Cornick, 2013). Twenty-two per cent of consumers were more likely to purchase fast food from a local non-chain outlet (chip shop, pizza, Chinese or Indian) compared with 14% purchasing from a fast food chain such as McDonalds, KFC, Burger King or Dominos (Jackson and Cornick, 2013).

Takeaway for a Change was a pilot takeaway study carried out on the Wirral to encourage families to make healthier choices at local FFOs (Pulford, 2015). Takeaway businesses involved in the study were given grants and supported to provide healthier takeaways. Families were asked to complete a takeaway questionnaire (n = 214) and received a £15 voucher to spend at the takeaway businesses that were involved in the study. The most popular types of takeaways were Chinese meals, chips, pizza, kebabs and Indian meals and the study found 45% of participants consumed takeaways more than once a week with 92% of preferring to buy them in the evening (Pulford, 2015)..

2.12.1 FAFH and Sex

Different purchase patterns of takeaway food have been found for men and women, in the Food and You survey (wave 3) found men were more likely to eat fast food than women (27% compared with 16%) and takeaways (32% compared with 22%) (Food Standards Agency, 2014a). Women were more likely to have eaten in a café or coffee shop than men (45% compared with 36%) (Food Standards Agency, 2014a). Waves 4 and 5 had similar results with men eating takeaway food more frequently than women from a restaurant or takeaway outlet (59% compared to 50% respectively) (NatCen Social Research, 2017) and men were more likely than women (38%, compared with 28% respectively) to have eaten in a fast food restaurant in the last month (NatCen Social Research, 2019).

2.12.2 FAFH and Age

Studies have found takeaway and fast-food consumption more popular with younger age groups. An Australian fast food study found adults in the younger group (age 38 and under) consumed fast food significantly more frequently than adults in the older group (over 38 years old) (Dunn et al., 2008). Consumption rates of between 2 and 6 times per week were reported more frequently in the younger group compared to occasionally in the older group (Dunn et al., 2008). Wave 3 of the Food and You survey found almost half (46%) of respondents in the 16-24 age group had eaten fast food in the past week compared with 24% in the 25-54 age group (Food Standards Agency, 2014a). Similarly in wave 4, 60% in the 16 to 24 year group and 55% in the 25 to 34 age group reported eating out at least once or twice a week compared with 42% in the 35 to 44 group (NatCen Social Research, 2017). Wave 5 of the survey also found takeaway food was more popular with younger respondents with 77% (aged 16 to 24 years) having eaten takeaway food from a restaurant or takeaway outlet in the last month. Again, this declined with age with only 16% in the 75 years and over group (NatCen Social Research, 2019). In the Family Spending in the UK survey, the group that spent the most on takeaways eaten at home was the one where the head of the household was younger than 30 years old. Compared to older age groups, the youngest group (<30 years) spent £8.10 compared with £7.10 in the 30 to 49 and £5.80 in the 50 to 64 age brackets (Office For National Statistics, 2020). Frequency of eating meals out and takeaway meals at home were analysed in waves 1-4 of the UK National Diet and Nutrition Survey (NDNS) between 2008 and 2012 by Adams et al. (2015b). The results found 27.1% of adults (all age groups combined) ate meals out once per week or more. Eating out was more common in the youngest age group, where 41% of 19–29-year-olds ate meals out once or more per week. When it came to eating takeaway meals at home, 21.1% of adults (all age groups combined) ate takeaway meals at home once per week or more and this tended to decrease with age, with 32.4% in the youngest group (19-29 years) and 7.9% in the oldest group (over 69 years) (Adams et al., 2015b).

In the NHS Merseyside Lifestyle Survey 2012/13, takeaway food was more popular with younger adults, with fast food frequency decreasing with age and this pattern was observed for both chain and non-chain outlets (Jackson and Cornick, 2013). For non-chain outlets, 34% of 18 to 34 year olds consumed takeaways at least once a week compared to 11% of adults aged 55 and over (Jackson and Cornick, 2013). In the Survey of Food Habits and Attitudes to Food in Liverpool, young people aged 20-24 years old were more likely to eat takeaway and fast food, with 45% eating takeaway food and 33% eating fast food at least once or twice per week. Older people aged 65 years and over were least likely to eat takeaway food or food from fast-food restaurants and men tended to buy takeaways more frequently than women (Jon Dawson Associates, 2007).

2.13 Consumer Knowledge

In a study by Burton et al. (2006) participants were asked how many calories, grams of fat, SFA, and sodium they thought were in some restaurant menu items. On average, they found participants significantly underestimated the number of calories (by more than 600 kcal), fat, SFA and sodium in the less healthful menu items. The actual amount of fat and SFA was double that of participant expectations and the calorie content was almost two times higher (Burton et al., 2006). In the second part of the study, participants were provided with nutritional information for the menu items and researchers found this reduced the preference for the less-healthful menu items. This study showed many consumers were unaware of the poor nutritional content of some food items and that the provision of nutritional information could have a positive impact in terms of some consumers choosing healthier menu items (Burton et al., 2006). Consumers were also found to significantly underestimate sodium content in fast food meals in a survey of 993 adults and 794 adolescents dining at 6 fast food chains in 2013-2014 (Moran, Ramirez and Block, 2017).

In a survey carried out in Lincolnshire for the Eat In, Eat Out, Eat Healthy pilot project many consumers advised that they did not generally consider health issues when choosing a meal. Almost all consumers surveyed had never asked about healthier options when ordering although more than two thirds advised they would choose a healthier option if it were available. Over 50% of consumers advised, they would find nutritional information on the menu appealing and 33% said that they would like to have more information about what is in their food and see healthier options on the menu. More than 50% of consumers would also be interested if restaurants and takeaways reduced the calories, SFA and salt in their dishes as standard (Trading Standards East Midlands, 2011). These findings show the importance of strategies that encourage consumers to make healthier fast-food purchases.

2.14 Impacts of the proliferation of fast-food outlets

In 2012, the London Food Board and the Chartered Institute of Environmental Health (CIEH) produced a Takeaway Toolkit to help local authorities tackle the public health impacts of fast food. Figure 2.6 shows the extensive range of problems caused by the abundance of fast food takeaways and possible entry points for local authorities to tackle the health impacts including rising levels of obesity (London Food Board, CIEH and Mayor of London, 2012).

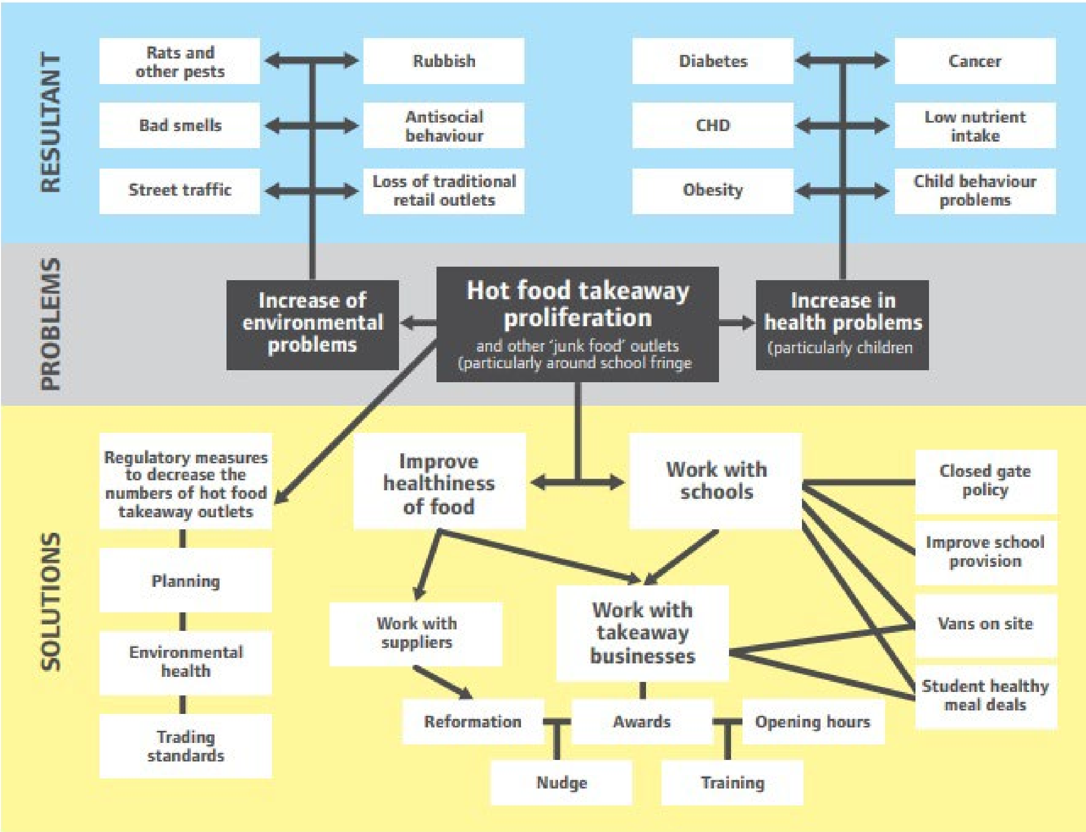

Figure 2.6 Impacts of FFO proliferation and opportunities for action
(London Food Board, CIEH and Mayor of London, 2012)

2.15 Reformulation of Takeaway Food

One solution to tackle the health impacts of takeaway food consumption involves working with takeaway businesses to improve the healthiness of the food they serve without compromising profits (Figure 2.6). Recipe reformulation could be an effective strategy: reducing salt, energy, total fat and SFA levels to improve the nutritional profile of takeaway foods (Bagwell et al., 2014). As shown in section 2.10, takeaway food has been shown to be high in fat, saturated fat, and salt (Local Government Group, 2011; *safe*food, 2012a; Saunders, Saunders and Middleton, 2015). Reducing energy density (by reducing fat or portion size) may help to reduce calories whilst reducing salt may be beneficial for consumers with hypertension. Furthermore, replacing saturated fat with unsaturated fatty acids could significantly benefit public health and may have a key role in reducing CVD risk (SACN, 2003; Bagwell et al., 2014; SACN, 2019).

2.16 Summary

The previously mentioned literature provides evidence that people in the UK are eating fast food and takeaway food regularly. Information on the consumption of takeaway food in Merseyside is limited as is the nutritional composition of takeaway food served from small independent takeaway outlets in this area. This thesis aims to analyse nutritional composition data of takeaway meals provided by local councils in the Merseyside area, to determine if the nutritional quality is similar to findings made by other studies.

A number of health conditions are associated with frequent consumption of takeaway food. Furthermore, Liverpool has a higher-than-average prevalence of overweight and obesity and is the third most deprived local authority in the UK. This thesis aims to investigate whether people in the Merseyside area are consuming takeaway food regularly as well as explore takeaway consumers knowledge about the healthiness of takeaway food. As the government and other organisations have a vested interest in improving public health, another research area will explore takeaway consumers attitudes towards eating healthier takeaway food, produced via recipe reformulation. Finally, this research will include some recipe reformulation work that was carried out in a real world setting with independent takeaway outlets in Liverpool that were participating in the *Eatright* Liverpool project.

Chapter 3

Takeaway Food Questionnaire

3 Takeaway Questionnaire

3.1 Introduction

Frequent takeaway consumption has been associated with weight gain, obesity (Smith et al., 2017; Zagorsky and Smith, 2017; Bhutani et al., 2018) and increased cardiovascular metabolic risk (Duffey et al., 2009; Smith et al., 2012). In addition, Rosenheck (2008) found strong evidence that fast food consumption was contributing to increased caloric intake and hence weight gain and obesity in a systematic review of sixteen studies (six cross sectional, seven prospective cohort, three experimental). This is concerning, as evidence suggests that consumption of both takeaway and fast food is increasing (as previously discussed in Chapter 1, section 1.3). Furthermore, Merseyside has a higher prevalence of adults who are living with overweight or obesity, early deaths from CVD and reduced life expectancy when compared with the rest of England (PHE, 2017b), which may be associated with a takeaway food dietary pattern amongst other dietary and lifestyle factors.

Differences in the definition of takeaway or fast food makes it difficult to compare findings across studies. Some studies have researched fast food and takeaway consumption in the UK and worldwide (Pereira et al., 2005; Duffey et al., 2009; Block et al., 2013; Adams et al., 2015b; NatCen Social Research, 2019); however, many of these studies are based on fast food chains and not food purchased from independent takeaway outlets (see Chapter 2, section 2.12 for more detail). Analysis of an online cross-sectional UK study by Birch et al. (2019) of 3,293 adults aged 18 and above found respondents from England were less likely to consume fast food and takeaways at least once a week than respondents in Northern Ireland. Respondents were asked how often they had food from fast food chains or local takeaway food places (Birch et al., 2019). A UK survey which studied takeaway food specifically was the FSAs UK Consumer attitudes to food standards survey which asked respondents how frequently they ate takeaway food (such as fish and chips, kebabs). Results from the 2006 survey (n = 3,523 adults) found 22% of adults ate takeaway food once a week or more and 58% a few times a month and (Food Standards Agency, 2007). There was another survey carried out in Liverpool in 2007 by Jon Dawson Associates (2007) which was interested in food habits and attitudes but was not specifically focussed on fast food or takeaway food. The survey involved interviewing 926 Liverpool households (n=926) for ‘Taste for Health’, Liverpool’s Food and Health Strategy 2010-2014. The survey found 26% of respondents ate food from takeaway outlets and 13% from fast food restaurants at least once or twice a week

(Liverpool NHS PCT, 2010). These studies suggest a scarcity of studies which have explored UK or regional takeaway food consumption, furthermore, research on how people use takeaways as a way to eat, information about consumption patterns, why people eat it and who with is also limited. Hence the motive for the present study which concentrates on the consumption of takeaway food served by small independent takeaway outlets in the Merseyside area.

As discussed in chapter 2, the nutritional composition of takeaway food has been shown to be lacking in terms of nutritional quality (energy dense, high in fat, SFA, salt and/or added sugar) (LACORS, 2009; Local Government Group, 2011; *safe*food, 2012a; *safe*food, 2012b; *safe*food, 2015). Hence the first objective of this study was to determine how often consumers purchase takeaway food in Merseyside. Furthermore, studies have shown demographics such as sex, age, and BMI (Dave et al., 2009; Albalawi, Hambly and Speakman, 2022) may influence the consumption of fast food which provides the rationale for this objective.

The availability of away from home food makes it an easy option and studies show people purchase it for various reasons including convenience, time constraints, lack of cooking skills, price, location, and taste (Mintel, 2015a; Garza et al., 2016; Mintel, 2020a). Hence the motive for the second objective, which is to explore consumers reasons for purchasing takeaway food.

Consumers are often unaware of the nutritional content of food from restaurants, fast food, or takeaway outlets and studies which examine consumers knowledge regarding the nutritional content of takeaway food from small independent outlets are limited. Chandon and Wansink (2007) showed calorie content was underestimated in meals purchased in fast food restaurants, with respondents (n = 147) making larger underestimates for larger meals. In the fast-food study by Block et al. (2013), two-thirds of participants underestimated the calories in meals and 25% underestimated calorie content by a minimum of 500 kcal. In a restaurant meals study by Moran, Ramirez and Block (2017), adults underestimated sodium content in restaurant meals by an average of 1013 mg (about 2.5 g salt).

Having greater nutrition knowledge may assist adults to improve their dietary choices and consume healthier diets, for example students with higher nutrition scores consumed less than 35% of daily calories from fat when compared with students with lower nutrition scores (Yahia et al., 2016). In their cross-sectional survey of university students (n = 231) in Central Michigan University, USA, Yahia et al. (2016) found nutrition score to be negatively associated with total fat, saturated fat, and cholesterol intake (-0.42, -0.15 and -1.38 respectively; p <0.0001).

In addition to knowledge about the nutritional content of takeaway food, few studies have explored whether consumers are interested in purchasing healthier takeaways. In the Lincolnshire “Eat In Eat Out Eat Healthy” survey of regular Indian takeaway consumers (n = 494), two-thirds of consumers gave no consideration to overall healthiness when choosing a meal (Social Change, 2011). Nearly all the consumers had never asked about healthier options; however, a third were interested in seeing healthier options on the menu. More than half felt that a reduction in salt, fat and calories at takeaway outlets was appealing and more than half advised nutritional information on the menu would be of interest (Social Change, 2011).

Due to the limited studies concerning consumers knowledge about the nutritional content of takeaway food and attitudes to its reformulation, the third and fourth objectives of the present study are to investigate consumers knowledge about the healthfulness of takeaway food and their receptiveness to its reformulation. The fourth objective also fits in with government policy which recommends takeaway businesses improve the healthiness of the food they serve as this could help contribute to a reduction in chronic diseases and improve the health of takeaway consumers (London Food Board, CIEH and Mayor of London, 2012; PHE, 2017d).

3.2 Aim and Objectives of the Present Study

3.2.1 Aim

To investigate takeaway food consumption in Merseyside.

3.2.2 Objectives

1) Determine frequency of takeaway food consumption in Merseyside and its predictors.
2) Explore consumers reasons for takeaway food consumption.
3) Examine participants knowledge about the healthfulness of takeaway food.
4) Investigate participants receptiveness to takeaway food prepared in a healthier way.

3.3 Methods

This chapter has two method components, one addresses the development and validation of the takeaway questionnaire, the other addresses the objectives as stated in Section 3.2.

Ethics

Ethical approval of the study was obtained from Liverpool John Moores University (LJMU) ethical committee (11/ECL/015, Appendix 1.0).

Definition of Takeaway Food for the purpose of the study

Since the aim of this study was to investigate takeaway food served by small, independent takeaway outlets and not fast-food chains, it was important that a distinction be made between fast food and takeaway food. Hence the following definition for takeaway food was displayed at the start of the questionnaire: "*Meals purchased from small, independent outlets such as chip shops / pizza outlets / fried chicken outlets / Chinese / Indian / Kebab takeaways, small independent restaurants when using their takeaway service or these types of establishments which deliver takeaway food to your home*".

3.3.1 Development of the Takeaway Questionnaire

There are a number of research methods that can be used to collect data on dietary habits, such as 24-hour recalls, food diaries and food frequency questionnaires (FFQ). Food diaries and 24 hour recalls were not considered to be suitable methods for the present study due to cost, time, and response burden (Turconi et al., 2003). FFQs are designed to assess habitual diet by asking how often specific food items are consumed over a reference period (Willett, 1987) and can be limited in terms of other aspects such as food habits, eating behaviour and food knowledge (Turconi et al., 2003). The principle aim of the present study was to study the consumption of takeaway food, however reasons for its consumption as well as knowledge and attitudes to takeaway food were also of interest. For this reason, it was considered appropriate to design a questionnaire which would concentrate on takeaway food purchased from small independent takeaway outlets in Merseyside. It would include questions about frequency of consumption but also be tailored to ask about takeaway food knowledge and attitudes to its reformulation. A self-administered survey questionnaire can be an important tool for collecting data in public health research as it can be less resource intensive than other data collection methods and can target populations in wide geographic areas (Marcano Belisario et al., 2015). In addition, choosing to collect data via an online survey means the questionnaire can be delivered electronically which can help to reduce costs, increase sample size, be less burdensome for the researcher and the participants and facilitates survey completion (Marcano Belisario et al., 2015). Electronic survey responses have also been found to be equivalent to responses obtained via paper questionnaires (Marcano Belisario et al., 2015), timelier and preferred by respondents (Lane et al., 2006). Hence, the questionnaire was developed so that it could be completed online and was divided into the following sections:

1. **Social Demographics**: questions about sex, age, height, weight, marital status, postcode, education level and employment status.
2. **Takeaway Purchasing and Eating Behaviour:** multiple choice, Yes / No and Likert Scale questions to investigate frequency of takeaway food purchase, what type, use of takeaway delivery services, and an exploration of purchasing reasons.
3. **Takeaway Opinions:** Likert Scale questions to investigate consumers knowledge of the healthiness of takeaway food, portion sizes, and nutritional content (salt, fat, and energy).
4. **Takeaway Attitudes**: Likert Scale questions to investigate how receptive consumers were to reformulated takeaway food to make it healthier.

3.3.2 Pilot Takeaway Questionnaire

The pilot questionnaire consisted of 33 questions in total (see Appendix 2.0). To control for potential response bias, a validation item was included, and reverse scored using these two questions: “I think takeaway food is unhealthy” and later in the questionnaire “I think takeaway food is healthy”. Responses were collected using a five-point Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

3.3.2.1 Content Validity

The questionnaire was assessed by peer review to check the wording and layout of questions. A link to a pilot questionnaire was sent in an email to students and staff members studying or teaching at LJMU University. Respondents were able to leave feedback at the end of the questionnaire. After analysis of the pilot questionnaire (n = 105) and discussion with nutrition lecturers and other researchers, some extra questions were added to the questionnaire and the style of some questions were altered.

3.3.2.1.1 Questionnaire Amendments

i) It was suggested that a question be added to ask if people were eating more takeaway food now compared with a year ago. This was in relation to the recession which had started in 2008 and to investigate whether takeaways were an affordable luxury. By 2011, families were cutting back on luxuries like eating meals in restaurants, but there were signs that families were using FFOs instead (Wallop, 2012).

ii) "Who do you most often eat takeaway food with?" was amended so that respondents could write who they ate with if the option were not available in the list (question 11).

iii) For "What is the main reason you usually eat takeaway food?" respondents could choose one answer from a list (question 13). Feedback for this question was that it should be multiple choice as more than one reason might apply. This question was amended so that respondents could answer Yes or No for each reason.

iv) It was decided to merge the possible responses from question 18 "Thinking about the last takeaway meal you had, did you?" into question 19 "When buying a takeaway, do you usually?" as some of the responses overlapped.

v) Question 19 was also changed to a Likert scale question so that people could agree or disagree with each response (eat your portion on your own, in one session, eat some and save some for later, eat some and throw the rest away, share your portion with one other person, share your portion with more than one person).

vi) For respondents who never eat takeaways, "I tend not to buy takeaways because..." answers were converted to use Likert scales to provide more detailed information (question 20).

vii) In the "Takeaway Opinions" section the order of the answers for the Likert scale changed between questions. A few comments were made that this was confusing to respondents as it was not consistent, with respondents going back to check what answers they had entered. Thus, it was decided to design the answers in the same order, ranging from strongly disagree as the first choice down to strongly agree.

viii) It was suggested that a question on consumer guidance be added, hence the inclusion of "If consumer guidance were available on the menu (for example, Guideline Daily Amounts, traffic light system), would you find this useful".

3.3.2.1.2 Amendment to the Definition of Takeaway Food

It was also felt that the definition for takeaway food needed additional clarification. For the purposes of this research, the study was only interested in hot takeaway food sold at small independent takeaways and not food purchased from fast food chains or places that sold sandwiches, pies, pasties. Hence, the introduction to the questionnaire was amended to provide more detail.

3.3.2.1.3 Amendment to placement of Demographic Questions

Feedback from the pilot study also led to the movement of the demographic questions to the end of the questionnaire. Parmenter and Wardle (2000) advised that demographic questions are better placed at the end of the questionnaire to avoid any negative affect they may have on their answers as respondents dislike answering these kinds of questions. The final questionnaire can be viewed in Appendix 2.1.

3.3.3 Final Takeaway Questionnaire

A repeated measures design was used to establish the test-retest reliability of the takeaway questionnaire. One definition of reliability is the extent to which measurements can be replicated. The value for reliability ranges between 0 and 1, with values closer to one signifying stronger reliability (Koo and Li, 2016).

3.3.3.1 Statistics

3.3.3.1.1 Cronbach's Alpha

Internal consistency reliability was assessed using Cronbach's alpha coefficient (α). Ranging from 0 to 1, higher scores of Cronbach's α represent greater internal reliability, and an α value of 0.7 or above is considered sufficiently reliable (Crosby et al., 2015). Bland and Altman (1997) also advise scales with Cronbach's alpha values between 0.7 and 0.8 as satisfactory when comparing groups.

3.3.3.1.2 Cohens Kappa

Cohen's kappa (κ) can be used as a measure of the agreement between frequencies of two sets of data collected on two different occasions (Yu, 2005). The frequency of takeaway food consumption (categorical variable) was compared between the two time-points to assess stability in the time between the test and retest of the study. Perfect agreement is evident when Cohen's kappa equals 1, values greater than 0.75 are considered excellent agreement, values between 0.4 and 0.75 represent fair to good and below 0.4 are considered poor (Banerjee et al., 1999; Portney and Watkins, 2008).

3.3.3.1.3 Intraclass Correlation Coefficient (ICC)

Intraclass correlation coefficient (ICC) is an index used to measure reliability as it reflects the degree of correlation as well as agreement between measurements. ICC is a measure of reliability between two or more measurements of the same individual. ICC is calculated via mean squares obtained through analysis of variance and is widely used to evaluate inter-rater, test-retest and intra-rater reliability (Koo and Li, 2016). The present study was interested in test-retest reliability which shows “the variation in measurements taken by an instrument on the same subject under the same conditions”, for example a self-report survey instrument (Koo and Li, 2016).

Qin et al. (2019) make the following recommendations when carrying out ICC for test-retest reliability assessment. Use of the two-way model instead of the one-way model as time is a design factor in a typical test-retest assessment and the two time points are not interchangeable. A mixed-model effect is recommended over a random model as test-retest time points are prespecified and identical across all study subjects.

Absolute agreement is recommended over consistency because subjects are assumed to be stable for the construct of interest across the two time points (Qin et al., 2019). Portney and Watkins (2008) and Koo and Li (2016) also recommend the use of two-way mixed effects model when assessing test-retest reliability as repeated measures cannot be regarded as randomised samples, furthermore, they recommend the use of absolute agreement because measurements would be meaningless if there was no agreement between repeated measurements. The displayed results for ICC relate to average measures as these apply to the average score for a *k*-item test whereas the use of single measure applies to single measurements such as individual item scores (McGraw and Wong, 1996). Portney and Watkins (2008) suggest ICC values of 0.75 and above indicates good reliability while values of 0.75 and below indicates poor to moderate reliability.

3.3.4 Delivery of Final Takeaway Questionnaire

A structured self-completed questionnaire was used to collect study data on takeaway food from a convenience sample of participants. As mentioned previously, ethical approval was received from LJMU ethics committee before data collection commenced (Appendix 1.0). Informed consent was obtained when participants agreed to complete the questionnaire (see Final Questionnaire in Appendix 2.1). In the first instance, the questionnaire was sent to staff and students at LJMU in an email. Recipients were asked to access a web address or URL (Uniform Resource Locator) to complete the questionnaire online. A link to the questionnaire was also published in the university’s newsletter, published on the home page of the university website, Knowsley Councils website and distributed via snowball method to participants friends and family. In this way, takeaway food consumption data could be collected from students who lived and studied in Merseyside and staff members who commuted to work in Liverpool, thereby reaching adults over a wide area of Merseyside. Responses were collected between December 2012 and April 2013.

3.3.5 Data Analysis

Statistical analysis was carried out using the Statistical Package for Social Sciences software, IBM SPSS (version 27, IBM Corp, Armonk, NY, USA). Incomplete and spoilt questionnaires were eliminated from the results. All data were initially analysed using descriptive statistics. Frequencies and percentages were calculated for categorical variables. Continuous variables were tested for normality. Kruskal Wallis and Mann Whitney U tests were carried out where data was not normally distributed. Takeaway frequency was categorised as frequent/fairly frequent/infrequent due to the low response rate in the most days category. For the purposes of regression, takeaway frequency was collapsed into a dichotomous variable (frequent/infrequent) using SPSS. Pearson correlations, Chi-Square ($\chi 2$) tests for Independence and independent samples t-tests were used to determine any significant associations. A *p*-value of <0.05 was considered statistically significant and corresponding *p*-values are stated in the text where applicable. Correlation strength was determined using the r-value criteria devised by Evans (1996) (Table 3.1).

Table 3.1 Correlation *r*-values and corresponding levels of association

***r*-value range**	**Level of association**
0.00 to 0.19	Very weak
0.20 to 0.39	Weak
0.40 to 0.59	Moderate
0.60 to 0.79	Strong
0.80 to 1.00	Very strong

(Adapted from (Evans, 1996))

Using principal component analysis, a Health Score and a Receptiveness Score was generated based on consumers' takeaway knowledge and their opinions on reformulation of takeaway food respectively. Logistic regression was used to estimate odds ratios (OR) with 95% confidence intervals (CI) for variables that influence takeaway food consumption. Linear regression was used to explore the relationships of takeaway food consumption, Health Score and Receptiveness Score across demographic variables, including age, sex, education, and BMI. Preliminary analyses were carried out to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity.

3.3.6 Body Mass Index

A measure used to indicate the nutritional status of an individual is to calculate their body mass index (BMI). BMI is calculated using the formula: BMI = body mass (kg) / [height (m)]^2. For most adults, a BMI in the range 18.5 to 24.9 kg/m^2 is considered a healthy weight, and conventional BMI ranges are shown in Table 3.2 (WHO, 2021a; BDA, 2022). For this study, BMI was determined using self-reported weight and height from the questionnaire (when available).

Table 3.2 BMI Classifications

Nutritional status	BMI range (kg/m^2)
underweight	< 18.5
healthy weight	18.5 to 24.9
overweight	25 to 29.9
obese	30 to 39.9
severely obese	40 or above

(WHO, 2021a)

3.3.7 Calculating Sample Size for Final Questionnaire

The sample size was based on the results from the pilot study. In the pilot study, 93% of respondents ate takeaway food. Of these, 32.7% bought takeaways less than once a month, 37.8% once or twice a month, 24.5% once or twice a week and 3.1% most days. A previous study by the FSA found 58% of respondents ate takeaway meals a few times a month and 22% ate them at least once a week (Food Standards Agency, 2007). Taking these results into consideration, the sample size was calculated using the prevalence of 38% (once or twice a month).

Hence, for the final online survey, the minimum sample size was calculated using the power calculation for prevalence (Naing, Winn and Rusli, 2006) where Z value is 1.96 at a 95% interval of confidence (5% type 1 error), P is the expected proportion in the population based on previous studies and d is the absolute error.

$$n = \frac{Z^2 P(1-P)}{d^2} = \frac{1.96^2 \times 0.38(1-0.38)}{0.05^2} = 363$$

where n = sample size, Z = Z statistic for a level of confidence,
P = expected prevalence or proportion and d = precision

Using the power calculation above, the sample size was calculated to be 363 participants for the final questionnaire.

3.3.8 Scale Development using Principal Components Analysis

Principal Components Analysis (PCA) was performed on fifteen questions from the takeaway questionnaire (relating to perceptions of takeaway food healthiness and reformulation of takeaway food) to reduce the variables to a smaller number of principal components. PCA can be used to simplify a large number of interrelated variables in a dataset whilst retaining as much variation as possible (Jolliffe, 2002). When performing this analysis it is preferable to have a minimum sample size of 300 cases, for missing data the missing values can be estimated or in this case a missing data (pairwise) correlation matrix was analysed (Tabachnick and Fidell, 2013). Please see the Appendices for more detail regarding the PCA analysis (Appendix 3.0).

3.3.9 Scores based on Principal Components Analysis

PCA was used to characterise the factor structure of the "Takeaway Opinions" and "Changes to Takeaway Food" sections of the questionnaire (Appendix 2.1). Two underlying factors were identified as '*Takeaway Health Literacy'* (or Health Score) and '*Receptiveness to Healthier Takeaways'* (or Receptiveness Score). These two factors accounted for 56.6% of the variance, with component 1 contributing 32.1% and component 2 contributing 24.5% (Appendix 3.1).

3.3.9.1 Health Score / Takeaway Health Literacy

The first factor, '*Takeaway Health Literacy'*, represented takeaway consumers opinions on the healthiness of takeaway food (and is based on questions from the '*Takeaway Opinions*' section of the questionnaire in Appendix 2.1). This factor contained seven items which are shown in Table 3.3.

Table 3.3 Takeaway Health Literacy Score (or Health Score)

	Likert scale questions for the "Takeaway Opinions" section
Q13	I think takeaway food is unhealthy
Q14	I think that takeaway food is low in salt
Q15	I think that takeaway food is low in fat
Q16	I consider takeaway food to be low in calories
Q17	I think that takeaway food is linked with gaining weight
Q19	I think that a standard portion of takeaway food is too big for one adult
Q20	I think takeaway food is healthy

Questions 14, 15, 16 and 20 were recoded so that strongly disagree resulted in the highest score. The seven Likert scale questions (strongly disagree – strongly agree) were then combined into a total health score. The total summed score ranged from a minimum of 7 to a maximum of 35. A respondent's good knowledge of the subject resulted in a higher score. The health score was divided into tertiles based on approximately 33% of respondents in each group. The lowest tertile was defined as the "low knowledge" group and the highest tertile as the "high knowledge" group (Table 3.5).

3.3.9.2 Receptiveness Score / Receptiveness to Healthier Takeaways

The second factor, '*Receptiveness to Healthier Takeaways'*, was a combination of variables representing consumers receptiveness to reformulation of takeaway food (and is based on questions from the 'Changes to Takeaway Food' section of the questionnaire in Appendix 2.1). This factor contained seven items and is shown in Table 3.4.

Table 3.4 Receptiveness to Healthier Takeaways Score (or Receptiveness Score)

	Likert scale questions for "Changes to Takeaway Food" section
Q23	Would you be likely to purchase reduced salt meals from takeaway outlets?
Q24	Would you be likely to purchase reduced fat meals from takeaway outlets?
Q25	Would you be likely to purchase reduced sugar meals from takeaway outlets?
Q26	If smaller portions of your chosen meal were introduced at a reduced price, would you be more likely to purchase them?
Q27	If nutritional information were available on the menu (for example, amounts of salt, fat, sugar, calories), would you find this useful?
Q28	If consumer guidance were available on the menu (for example, Guideline Daily Amounts, traffic light system), would you find this useful?
Q29	If a rating scheme indicating which outlets serve healthier food was introduced, would you be interested in this information?

Strongly agree resulted in a high score whereas strongly disagree resulted in a low score. The seven Likert scale questions (strongly disagree – strongly agree) were combined for a total receptiveness score. The total summed score ranged from a minimum of 7 to a maximum of 35. The receptiveness score was divided into tertiles based on approximately 33% of respondents in each group. The lowest tertile was defined as the "low receptiveness" group and the highest tertile as the "high receptiveness" group (Table 3.5).

Table 3.5 Summary table for Scores

Knowledge	Health Score	Receptiveness Score
Low	18-27	9-23
Medium	28-31	24-27
High	32-35	28-35

3.4 Results

3.4.1 Validation of Takeaway Questionnaire

Data was collected from a convenience sample of undergraduate and postgraduate students at LJMU studying Food, Design and Technology, Nutrition, Food and Nutrition, Community Nutrition or Public Health. The questionnaire was distributed to students via a link in an email. To assess the scales test-retest reliability, students were asked to complete the questionnaire on two occasions, four weeks apart. In total, 67 respondents completed the questionnaire once and of these, 23 completed it a second time resulting in a low test-retest response rate of 34.3%. The test-retest response rate for the undergraduates was 20% (10/50), compared with 76% for the postgraduate students (13/17). Of the 23 participants who completed the questionnaire twice, three were excluded from data analysis due to incomplete questionnaires. The final sample size consisted of 20 participants (4 male, 16 female) who had completed the questionnaire twice (n = 40 for test-retest). The mean age was 28 years (SD = 10.7) and the mean interval between test 1 and test 2 was 43.8 days (SD = 17.2).

3.4.1.1 Internal Validity

Two questions "I think takeaway food is unhealthy" and "I think takeaway food is healthy" were compared to see if respondents were answering this question the same way during both rounds (answers to these two questions would be expected to be opposite to each other). For the first round of the questionnaire, only one respondent agreed takeaway food was healthy and two respondents strongly disagreed that takeaway food was unhealthy. In the second round, only one respondent agreed that takeaway food was healthy, and none disagreed that takeaway food was unhealthy.

3.4.1.2 Test-Retest – Frequency of takeaway food consumption

The frequency of takeaway food consumption (categorical variable) was compared between the two time-points (Figure 3.1) to produce a Cohen's kappa value which can be used as a measure of the agreement between frequencies of two sets of data collected on two different occasions (Yu, 2005). The analysis produced a Cohen's kappa value of 0.490, suggesting a moderate strength of agreement between the two time-points (Portney and Watkins, 2008). This value of kappa was significantly different from zero (κ=0.490, p <0.001).

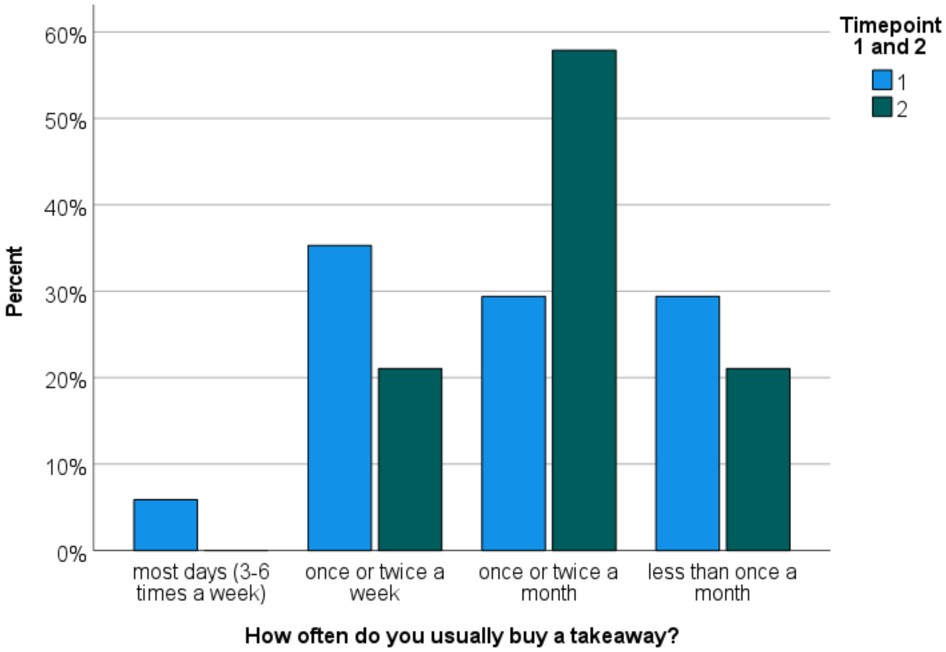

Figure 3.1 Frequency of takeaway food consumption at two different timepoints

3.4.1.3 Internal Consistency Reliability

Internal consistency reliability was assessed using Cronbach's alpha coefficient (α). Ranging from 0 to 1, higher scores of Cronbach's α represent greater internal reliability. Bland and Altman (1997) advise scales with Cronbach's alpha values between 0.7 and 0.8 as satisfactory when comparing groups. Scale questions for both sections ("Takeaway Opinions" and "Changes to Takeaway Food") had satisfactory internal consistency reliability (Table 3.6). For the "Takeaway Opinions" (*Health Score*) section, $\alpha = 0.784$ and the "Changes to Takeaway Food" (*Receptiveness Score*) section, α = 0.700.

Table 3.6 Cronbach's α for Internal Consistency Reliability

Knowledge Section (maximum score)	**Internal consistency reliability Cronbach's α**	**Mean Score (SD)**
Takeaway Opinions *Health Score*	0.784	30.48 (3.5)
Changes to Takeaway Food *Receptiveness Score*	0.700	26.55 (4.3)

3.4.1.4 Test-Retest Internal - Consistency Reliability

Internal consistency was also assessed separately for timepoint 1 and timepoint 2 (Table 3.7). The α values for timepoint 1 are above 0.7 and considered sufficiently reliable (Bland and Altman, 1997). The Cronbach's α value for Takeaway Opinions was higher for timepoint 2 whereas the α value for Changes to Takeaway Food was lower at timepoint 2. This lower value for could be due to a number of reasons such as length of time between test-retest and the assumption that the opinions and attitudes do not change over time (Polit, 2014; Morera and Stokes, 2016).

Table 3.7 Cronbach's α for Test-Retest Reliability

Knowledge Section (maximum score)	Timepoint 1 Cronbach's α	Mean Score (SD)	Timepoint 2 Cronbach's α	Mean Score (SD)
Takeaway Opinions	0.740	30.40 (3.6)	0.796	26.35 (5.0)
Changes to Takeaway Food	0.841	30.55 (3.5)	0.511	26.75 (3.5)

3.4.1.5 Test-Retest Reliability – Intraclass Correlation Coefficient

Figures 3.2 and 3.3 show the range of responses for Health score and Receptiveness score at timepoint 1 and timepoint 2. A two-way mixed-effects model was used to calculate the ICC for the *Health Score* and the *Receptiveness Score*. Overall, a positive and good correlation was observed between the two timepoints. Portney and Watkins (2008) suggest ICC values of 0.75 and above indicates good reliability while values of 0.75 and below indicates poor to moderate reliability. The correlation for the *Health Score* between timepoints 1 and 2 was moderate (ICC [average measures] = 0.708, 95% CI 0.246, 0.885, p = 0.006). The mean *Health Score* was 30.4 at timepoint 1 and 30.6 at timepoint 2. For the *Receptiveness Score*, the correlation between the two timepoints was good (ICC [average measures] = 0.781, 95% CI 0.444, 0.914, p = 0.001). The mean *Receptiveness Score* was 26.4 at timepoint 1 and 26.8 at timepoint 2. The scores for both health and receptiveness were equivalent to medium knowledge at both timepoints (Table 3.5).

Table 3.8 ICC with 95% CI for Scores on Questionnaire

Scales	Intraclass correlation*	95% Confidence Interval	*p*-value
Health Score	0.708	0.246, 0.885	0.006
Receptiveness Score	0.781	0.444, 0.914	0.001

*ICC values using two-way mixed effect model (Model 3), absolute agreement, average measures

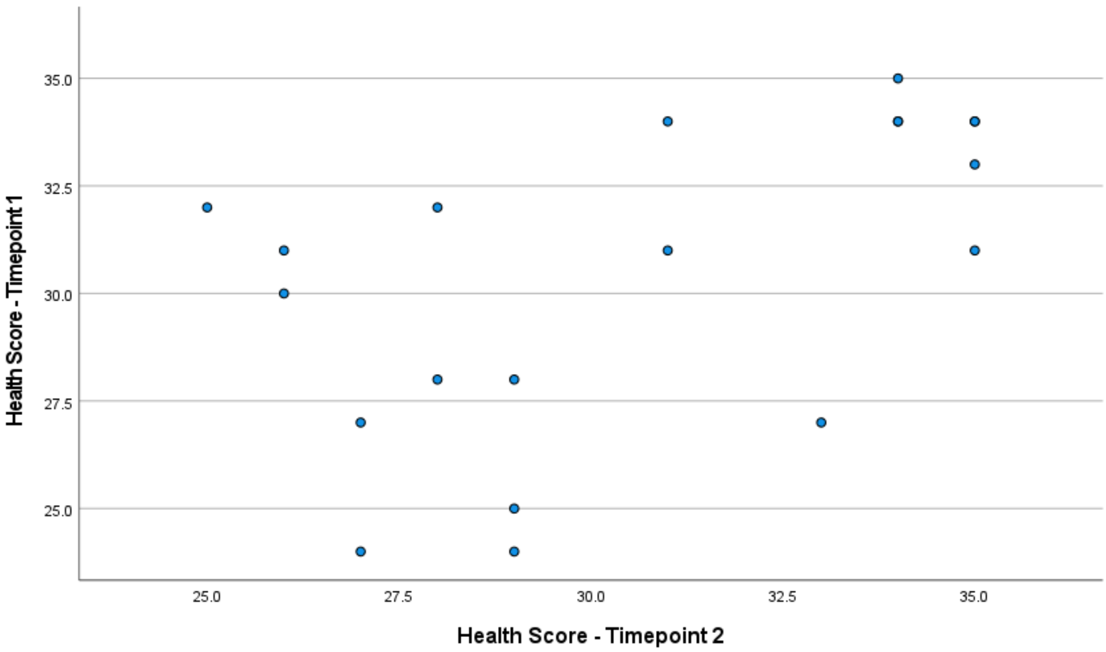

Figure 3.2 Health Score responses for Timepoints 1 and 2

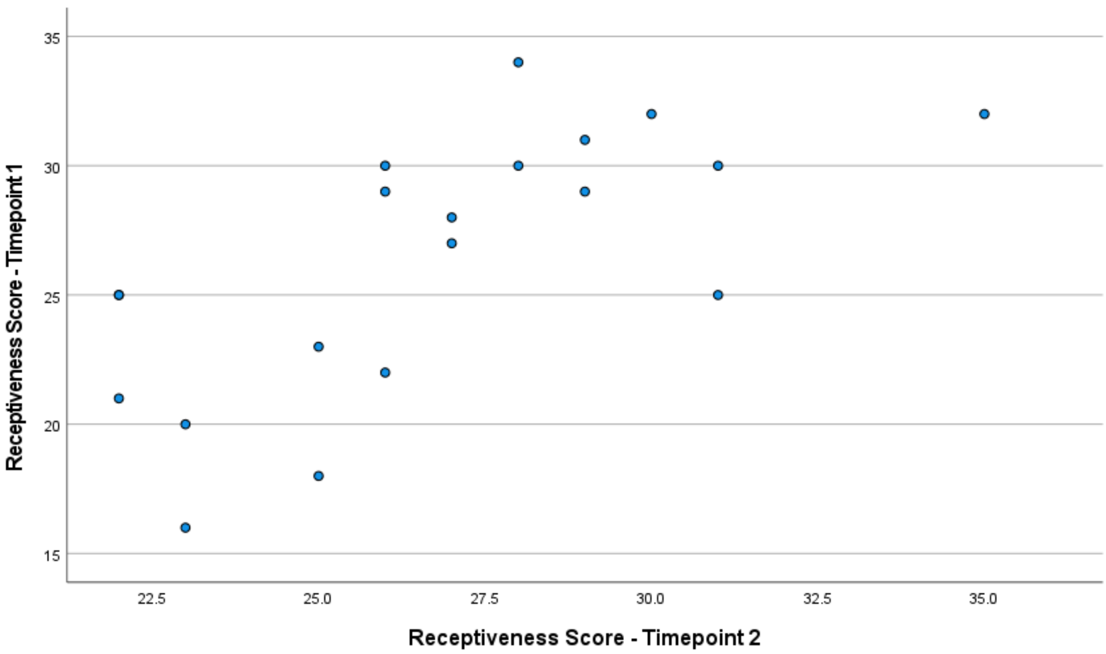

Figure 3.3 Receptiveness Score responses for Timepoints 1 and 2

3.4.1.5.1 Limitations of Test-Retest Reliability

Test-retest reliability is influenced by the construct being measured over time (Shou, Sellbom and Chen, 2022). Eating habits are dynamic and may change depending on a variety of factors, hence they are not something that can be easily measured. It should be noted that 75% of the respondents (n = 15) completed the first pass of the questionnaire during October and the start of November and the second pass during December and the Christmas holiday season, when they may have been less receptive to healthy eating.

Furthermore, these effects will be affected by the interval time between administrations (Shou, Sellbom and Chen, 2022). The duration between administrations can lead to differences in measurements between the first and second test and the test-retest interpretation assumes that a respondent’s performance is consistent at both time points (Polit, 2014). Respondents can be influenced by the memory effect (might recall their responses from the first time they completed it) and the practice effect (familiarity from having completed it before) (Shou, Sellbom and Chen, 2022). Respondents may also have changed their opinion as to whether takeaway food is healthy or unhealthy or high or low in salt as they have had more time to think about it after completing the questionnaire for the first time (Polit, 2014).

Other factors that can affect test-retest reliability include sample size, data variability, measurement error, correlation strength and systematic difference between time points (Qin et al., 2019). In the present study, the sample size for the validation study was small (n = 20). Additionally, the respondents were a convenience sample of students studying Public Health or Food and Nutrition related courses which could mean they are more knowledgeable of the nutritional content of takeaway food and more interested in healthier diets. However, the median health score and median receptiveness scores were both equivalent to “medium” and not “high” indicating this did not seem to be the case.

3.4.2 Validation of Final Takeaway Questionnaire

3.4.2.1 Reliability Analysis of the Scores

A Cronbach's α coefficient was calculated for the two scores to assess internal consistency reliability. Higher values of Cronbach's α represent greater internal reliability (Crosby et al., 2015). The Cronbach's α coefficient for both scores were considered sufficiently reliable with α values above 0.7. For the "Takeaway Opinions" score (*Health Score*) Cronbach's α was 0.819 (n = 434) and for the "Changes to Takeaway Food" score (*Receptiveness Score*) Cronbach's α was 0.883 (n = 424). The mean for both scores were also equivalent to medium knowledge (Table 3.5).

Table 3.9 Cronbach's α for Internal Consistency Reliability

Knowledge Section (maximum score)	**Internal consistency reliability Cronbach's α**	**Mean Score (SD)**
Takeaway Opinions	0.819	28.8 (3.8)
Changes to Takeaway Food	0.883	25.2 (5.5)

3.4.3 Results - Final Takeaway Questionnaire

In total 490 respondents completed the questionnaire, 461 were considered valid after the removal of spoilt papers and incomplete questionnaires. The number of completed questionnaires was greater than the minimum required sample size (n = 363) previously calculated in section 3.3.7 to provide sufficient power to detect statistical significance.

3.4.4 Demographics

Table 3.10 Respondents Demographics

Characteristics	Mean ± standard deviation	Median	Range	Missing
Age (years)	40.6 ± 11.2	40	18-66	26
Weight (kg)	74.6 ± 16.3	72.1	46.9-158.8	34
Height (m)	1.71 ± 0.1	1.70	1.5-2.0	12
BMI (kg/m^2)	25.3 ± 4.8	24.6	14.8-43.6	35
		n	**%**	
Sex	Women	322	69.8	
	Men	130	28.2	
	missing	9	2.0	
Marital status	Married/Partnership	321	69.6	
	Divorced/Widowed/Separated	35	7.6	
	Single	92	20.0	
	missing	13	2.8	
Housing	On own	41	8.9	
	With parents	40	8.7	
	With friends/students	12	2.6	
	With wife/husband/partner/children	354	76.8	
	missing	14	3.2	
Number of children	0	181	39.3	
	1	79	17.1	
	2	133	28.9	
	3	45	9.8	
	4 or more	13	2.8	
	missing	10	2.2	
Education	Primary/secondary school	45	9.8	
	College	108	23.4	
	University Degree	289	62.7	
	missing	19	4.1	
Employment	Employed/self-employed	422	91.5	
	Unemployed	7	1.5	
	Retired	3	0.7	
	Full-time student	23	5.0	
	missing	6	1.3	

The mean age was 40.6 (SD 11.2) years and ranged between 18 and 66 years. Almost half the respondents had a normal weight BMI (47.3%) and almost a third had a BMI in the overweight category (29.5%)(Table 3.11), the respondents mean BMI was 25.3 (SD 4.8) kg/m^2. There was a higher proportion of female compared with male respondents (69.8% versus 28.2%). Almost two thirds had a university degree (62.7%) and the majority of respondents were employed or self-employed (91.5%); only 1.5% were unemployed and 5% were full time students. One fifth of respondents were single (20%) whilst 69.6% were married or in a partnership. Three quarters of respondents lived with their partner and/or children (76.8%), 8.9% lived on their own and 8.7% with parents. Over half of the respondents (58.6%) had one or more child and 39.3% had no children. Demographics for the respondents are shown in Table 3.10. In terms of how representative these demographics are in terms of takeaway food consumption, they may be under representative of males, single adults, younger adults, and lower socioeconomic groups. As these groups have been found to be more frequent consumers of out of home food in previous studies (Dave et al., 2009; Adams et al., 2015b; Birch et al., 2019), levels of takeaway food consumption may be less than anticipated. However, this study was carried out in Liverpool, one of the most deprived local authorities in England, with a high density of takeaway outlets (PHE, 2018b), therefore a reasonable level of takeaway food consumption is still expected by this sample (van Erpecum et al., 2022).

3.4.4.1 Purchasing of Takeaways

The majority of respondents ate takeaway food, 96.3% compared with only 3.7% who did not (n = 444 and n = 17 respectively).

3.4.4.2 Non-Takeaway Food Consumers

A Mann-Whitney U test found the median age of respondents who never purchase takeaway food was significantly older than those that do, 51 years compared with 40 years ($p = 0.003$; n = 435) (Appendix 3.2, Figure 8.3). There was no significant difference in sex or BMI between takeaway consumers and non-takeaway consumers.

3.4.4.3 Takeaway Delivery Service

Just under half of the respondents used a takeaway delivery service (45.6%). A Kruskal-Wallis test showed respondents using a takeaway delivery service were significantly younger than those that did not ($p < 0.001$), 38 years (30, 46) compared with 43 years (34, 52). Respondents were also significantly heavier ($p = 0.023$) than those that did not, BMI of 25.5 kg/m^2 (21.6, 29.0) compared with 24.1 kg/m^2 (22.1, 26.6) (Appendix 3.2, Figures 8.5 and 8.6).

3.4.4.4 BMI

BMI classifications for self-reported weights and heights are shown in Table 3.11. There were 35 missing entries for BMI due to height, weight or both not being entered. BMI ranged from 14.8 to 43.6 kg/m^2. The BMI for around half of respondents (47.3%) were in the normal weight category and almost a third in the overweight category (29.5%) (Appendix 3.2, Figure 8.7).

Table 3.11 BMI Class calculated using self-reported weight and height

BMI Class (kg/m^2)		**Frequency**	**%**	**Valid %**
Underweight	(<18.5)	11	2.4	2.6
Normal Weight	(18.5-24.99)	218	47.3	51.2
Overweight	(25-29.99)	136	29.5	31.9
Obese/Very Obese	(30+)	61	13.2	14.3
Total		426	92.4	100.0
Missing		35	7.6	
Total		461	100.0	

3.4.4.5 Education and BMI (self-reported height and weight)

A Chi-Square test revealed a significant association between being educated to a lower level (school or college rather than university) and being overweight or obese, χ^2 (2, n = 415) = 8,750, *p* = 0.013, Cramer's V = 0.145 (Figure 3.4).

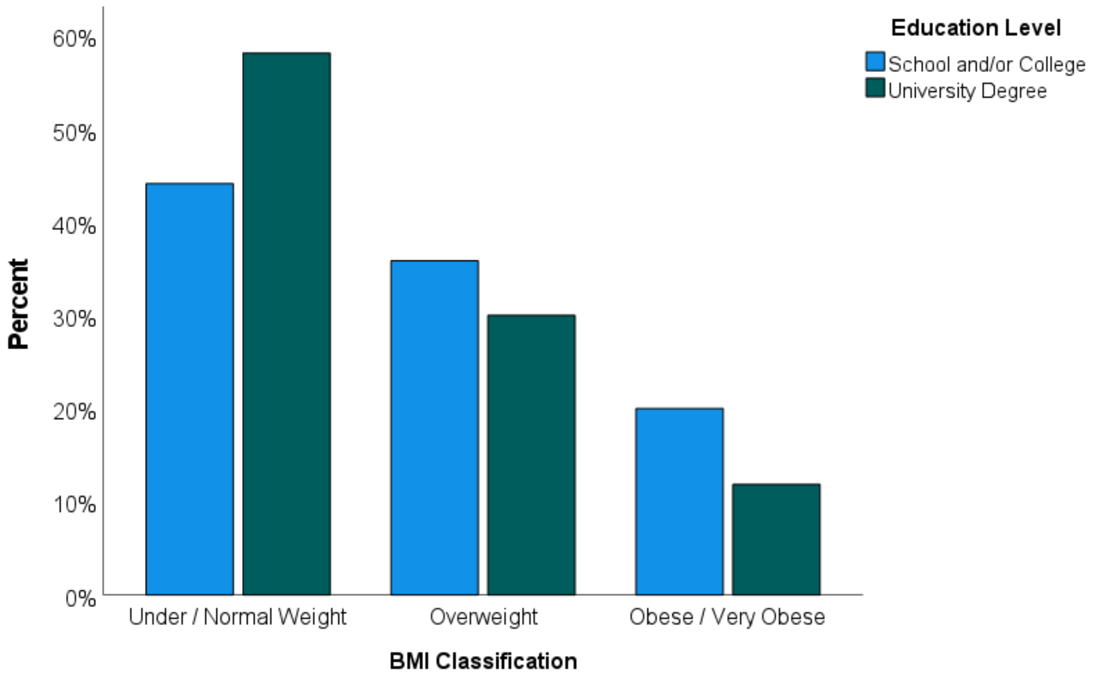

Figure 3.4 Education level and BMI Classification for respondents

3.5 Objective 1

- Determine frequency of takeaway food consumption in Merseyside and its predictors.

3.5.1 Frequency of Takeaway Consumption

Seventeen respondents (3.7%) advised they never buy takeaway foods whilst a quarter (26%) ate them less than once a month. Just over one-fifth (22.1%) of respondents reported they ate takeaways once or more a week and almost half (48.4%) ate them once or twice a month (Table 3.12, Figure 3.5). Most takeaway consumers (96.8%, n = 426) advised they ate takeaways for dinner compared with 0.2% for breakfast, 2.0% for lunch and 0.9% as a snack.

Table 3.12 Frequency of takeaway consumption

Frequency of Takeaway Consumption	n	Percentage
most days (3-6 times a week)	5	1.1
once or twice a week	97	21.0
once or twice a month	223	48.4
less than once a month	119	25.8
never	17	3.7
Total	461	100.0

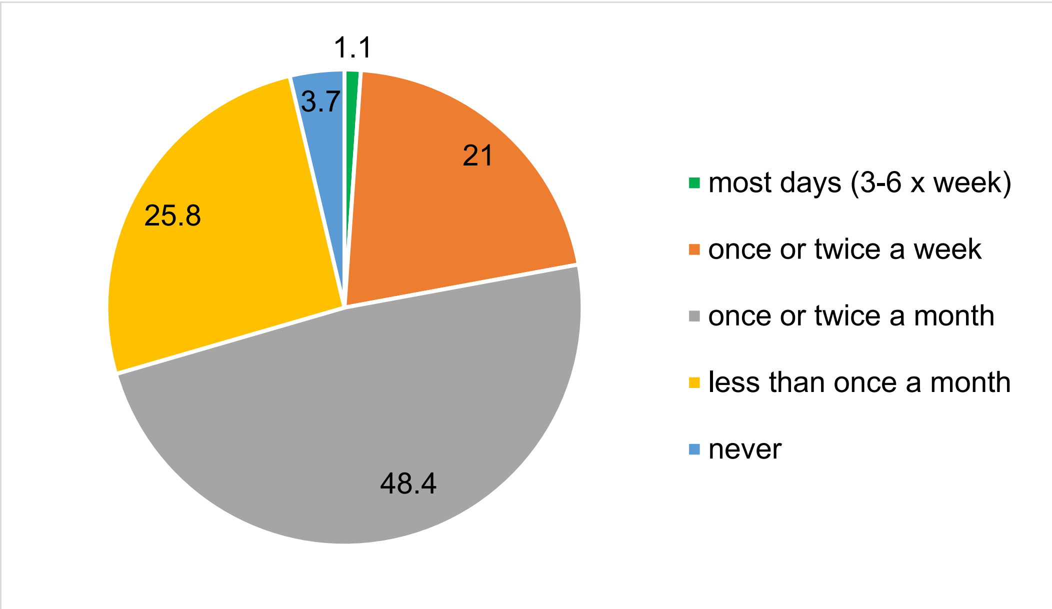

Figure 3.5 Frequency of Takeaway Consumption (%)

3.5.1.1 Types of Takeaway Meals Purchased

The most popular choice of takeaway meal type was Chinese takeaway (44%), followed by fish and chips (15%) and Indian takeaway (15%) (Table 3.13). Figure 3.6 shows the popularity of different types of takeaway meals.

Table 3.13 Most frequently chosen type of takeaway meal

Takeaway Type	**n**	**Percentage**	**Valid %**
Chinese	202	43.8	46
Fish and chips	71	15.4	16.2
Indian	70	15.2	15.9
Pizza	49	10.6	11.2
Chips	28	6.1	6.4
Kebabs	13	2.8	2.8
Fried chicken	6	1.3	1.3
Total	439	95.2	100

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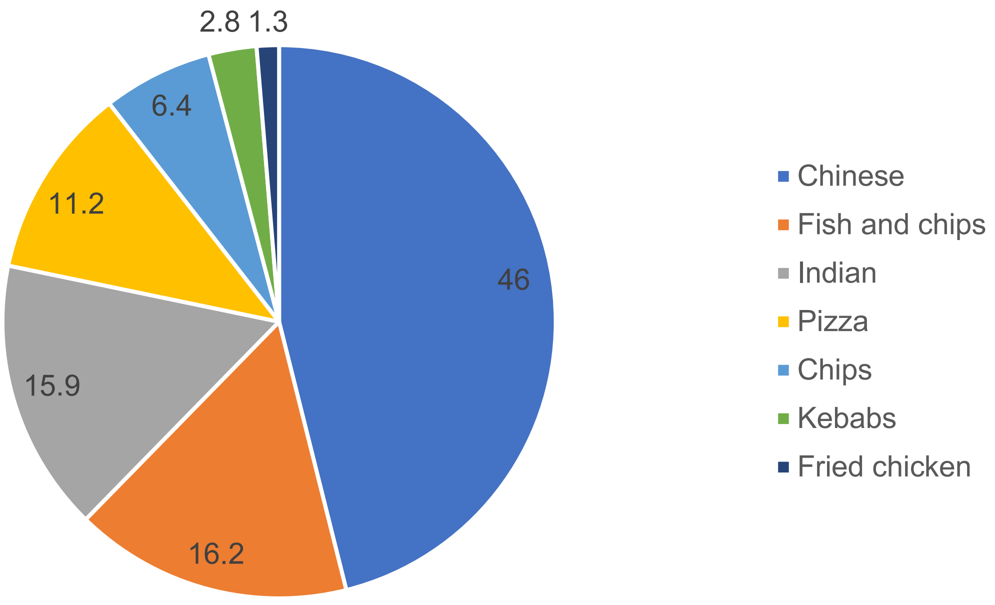


Figure 3.6 Most frequently chosen type of takeaway meal

3.5.1.1.1 *Takeaway type by Sex*

Chinese takeaway, fish and chips and Indian takeaway were the most popular choices for males, whilst the most popular choices for females were Chinese takeaway, Indian takeaway and fish and chips (Figure 3.7).

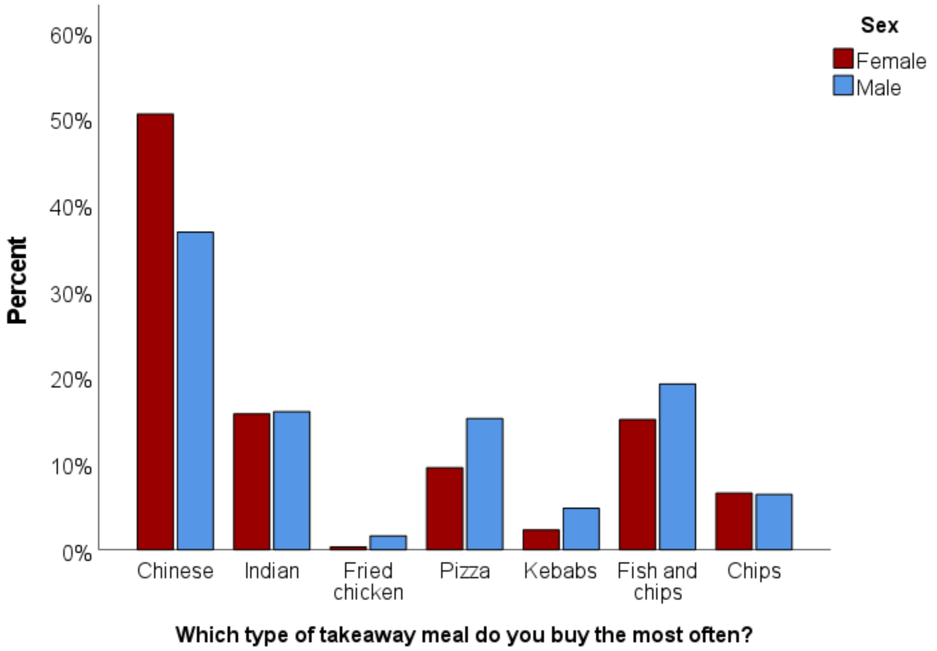


Figure 3.7 Most frequently chosen type of takeaway meal by Sex

3.5.1.1.2 *Takeaway type by Age*

Chinese takeaway, fish and chips and Indian takeaway were also the most popular choices for the older age groups (35-46 and 47-66). Chinese takeaway followed by pizza were the most popular choices for the younger age group (18-34) (Figure 3.8).

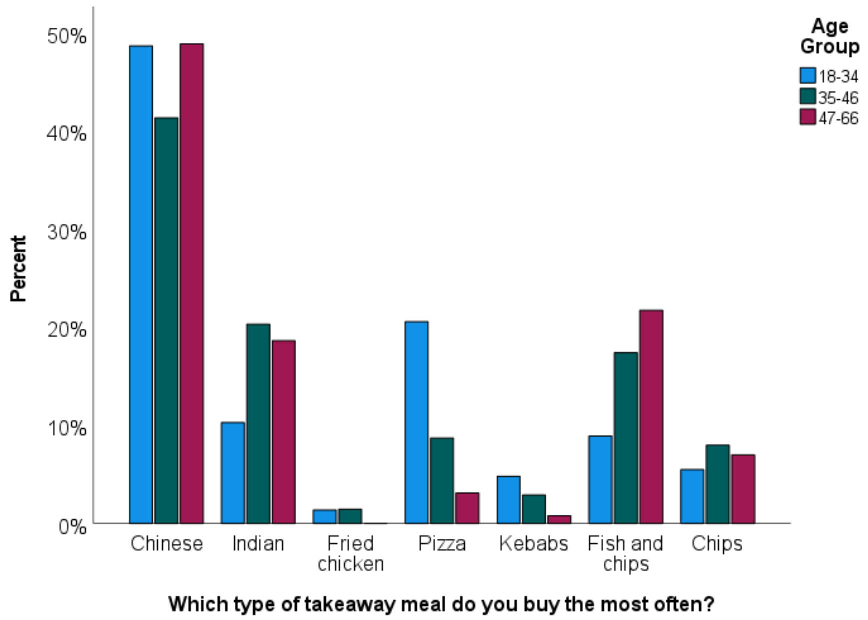


Figure 3.8 Most frequently chosen type of takeaway meal by Age

3.5.1.1.3 Takeaway type by BMI

Chinese takeaway was the most popular choice for each of the BMI categories (Figure 3.9).

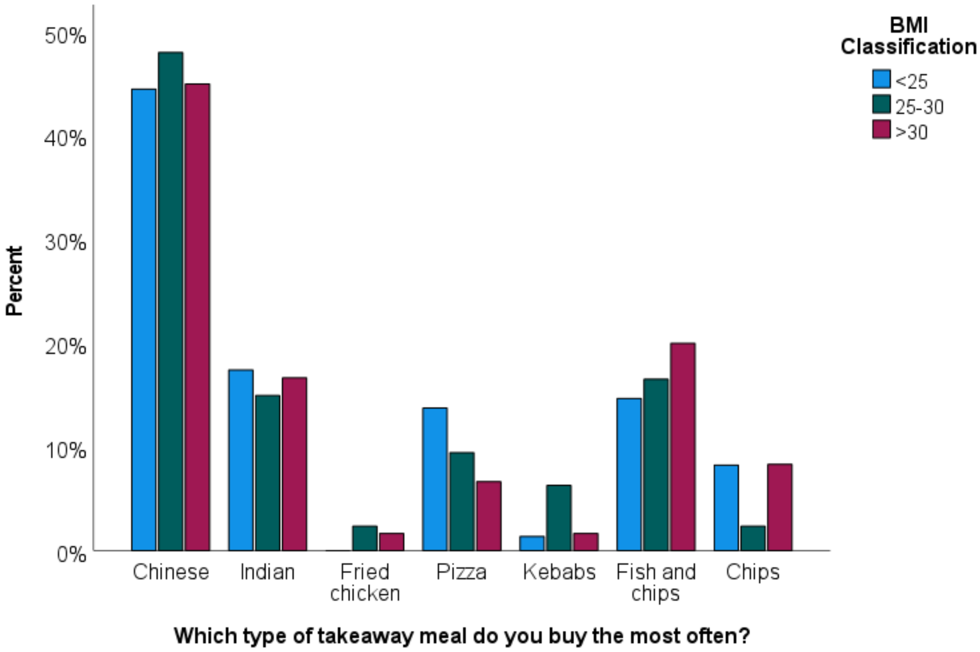


Figure 3.9 Most frequently chosen type of takeaway meal by BMI

3.5.2 Frequency of Takeaway Consumption by Group

Due to the small sample sizes in some of the categories for frequency of takeaway consumption, takeaway consumers were divided into three groups according to how frequently they consumed takeaway food: frequent, fairly frequent, and infrequent (Table 3.14, Figure 3.10) to enable statistical analysis.

Table 3.14 Frequency of Takeaway Consumption by Group

Takeaway Frequency	**Frequency of Takeaway Consumption**	**n**	**Percentage**
Frequent	most days / once or twice a week	102	22.1
Fairly Frequent	once or twice a month	223	48.4
Infrequent	less than once a month	119	25.8

(Table excludes respondents who never eat takeaway food, n = 17, 3.7%)

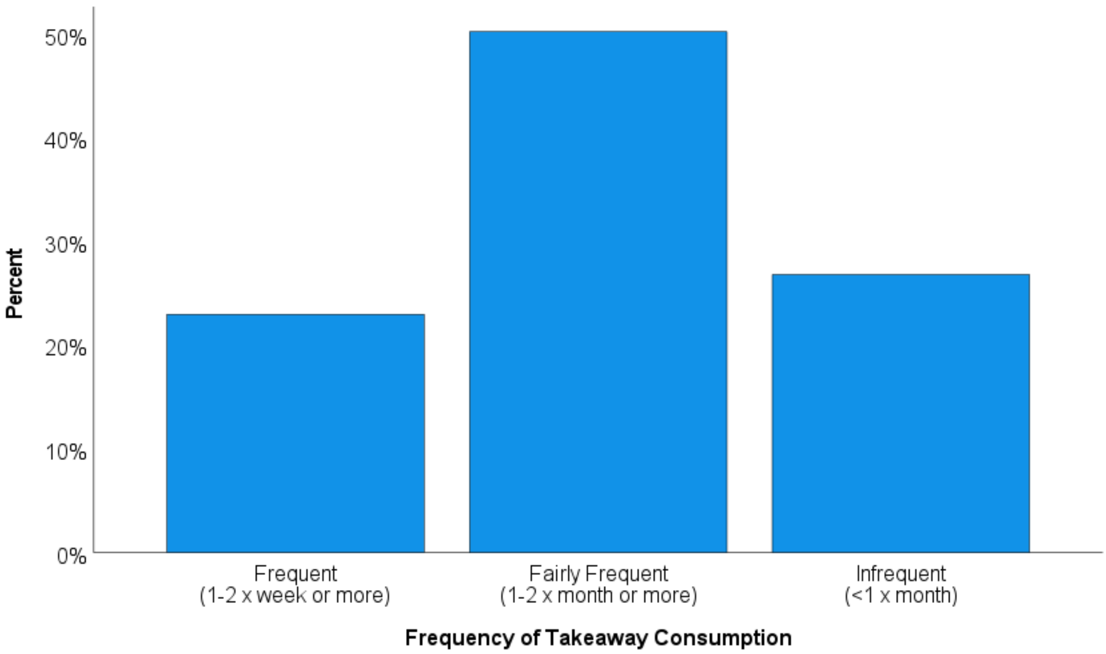


Figure 3.10 Frequency of Takeaway Consumption by Group

3.5.2.1 Sex

A Chi-Square test showed a significant association between frequency of takeaway consumption and sex, with males consuming takeaway food more *frequently* than females and less *fairly frequent* and *infrequently* than expected, χ^2 (2, n = 435) = 9.816, *p* = 0.007, Cramer's V = 0.150 (Figure 3.11).

Summary: Males were more frequent takeaway consumers than females (*p* = 0.007)

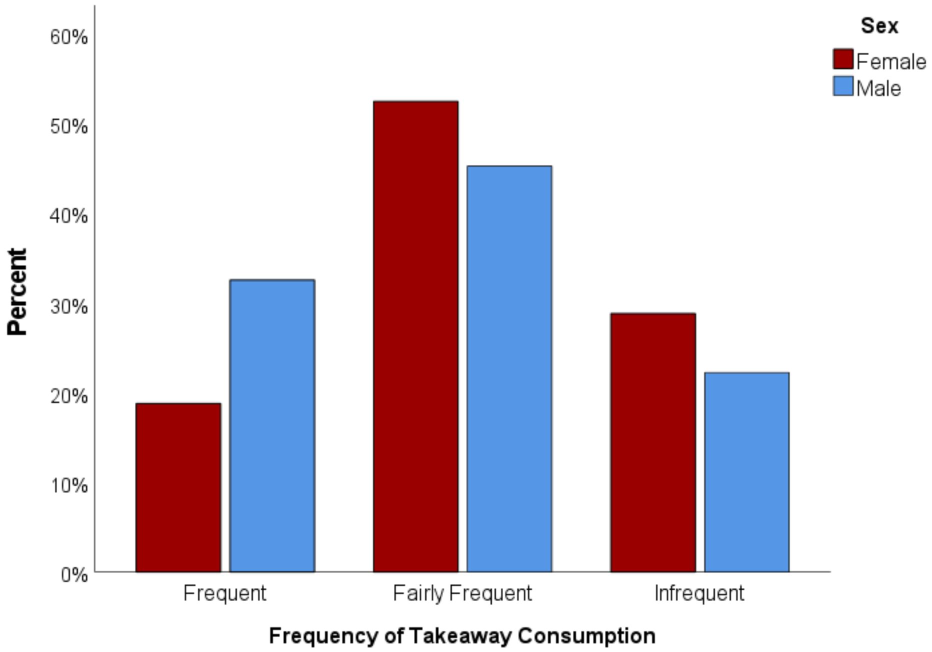


Figure 3.11 Frequency of takeaway consumption compared with Sex

3.5.2.2 Age

A Kruskal-Wallis test showed a statistically significant difference in age across the three different takeaway frequencies (Group 1, n = 97: frequent; Group 2, n = 212: fairly frequent; Group 3, n = 109: infrequent), $\chi^2(2, n = 418) = 14.67$, $p < 0.001$. A Mann-Whitney U test revealed consumers who ate takeaways less than once a month (infrequent) were significantly older (median age 44) than fairly frequent consumers (median age 40, $p = 0.005$) and frequent consumers (median age 36, $p < 0.001$), although the effect size was small (Table 3.15).

Summary: Consumers who ate takeaways infrequently (less than once a month) were significantly older than fairly frequent consumers ($p = 0.005$) and frequent consumers ($p<0.001$) (Figure 3.12).

Table 3.15 Frequency of takeaway consumption compared with Age

Takeaway Frequency	**n**	**Age Years (median IQRs)**	***p* (<0.017)[a]**
Frequent*	97	36 (30, 47)	
Fairly Frequent**	212	40 (31, 48)	
Infrequent	109	44 (35, 54)	$p < 0.001$, $p = 0.005$

a - *p* value Bonferroni adjustment 0.05 / 3 = 0.017; *r* (effect size) = $z / \sqrt{n}$
*$p < 0.001$, $U = 3685.0$, z = 3.752, n = 206, $r = 0.26$ (small)
**$p = 0.005$, $U = 9319.5$, n = 321, $r = 0.16$ (small)

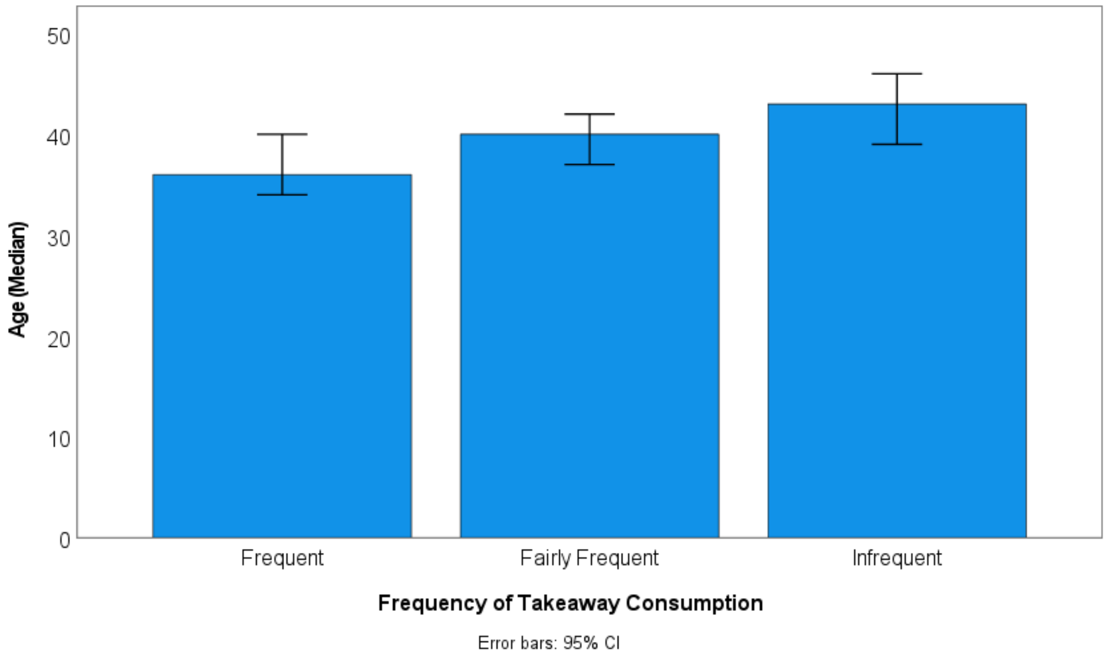


Figure 3.12 Frequency of takeaway consumption compared with Age

3.5.2.3 BMI

A Kruskal-Wallis test showed a statistically significant difference in BMI across the three different takeaway frequencies (Group 1, n = 92: frequent; Group 2, n = 207: fairly frequent; Group 3, n = 111: infrequent), $\chi^2(2, n = 410) = 8.992$, $p = 0.11$). A Mann-Whitney U test revealed consumers who ate takeaway food less than once a month (infrequent) had a significantly lower BMI (23.1 kg/m^2 median) when compared with frequent (25.5 kg/m^2 median, $p = 0.014$) and fairly frequent consumers (24.9 kg/m^2 median, $p = 0.006$), although the effect size was small (0.02) (Table 3.15).

Summary: Consumers who ate takeaway food infrequently (less than once a month) had significantly lower BMIs (p <0.017) (Figure 3.13).

Table 3.16 Frequency of takeaway consumption compared with BMI

Takeaway Frequency	**n**	**BMI kg/m^2 (median IQRs)**	***p* (<0.017)a**
Frequent*	92	25.5 (22.1-28.9)	
Fairly Frequent**	207	24.9 (22.3-27.7)	
Infrequent	111	23.1 (21.3-26.4)	$p = 0.014$; $p = 0.006$

a - p value Bonferroni adjustment 0.05 / 3 = 0.017; r (effect size) = $z / \sqrt{n}$
*$p = 0.014$, $U = 4080.0$, $z = 2.462$, n = 203, $r = 0.17$ (small)
**$p = 0.006$, $U = 9349.0$, z = 2.738, n = 318, $r = 0.15$ (small)

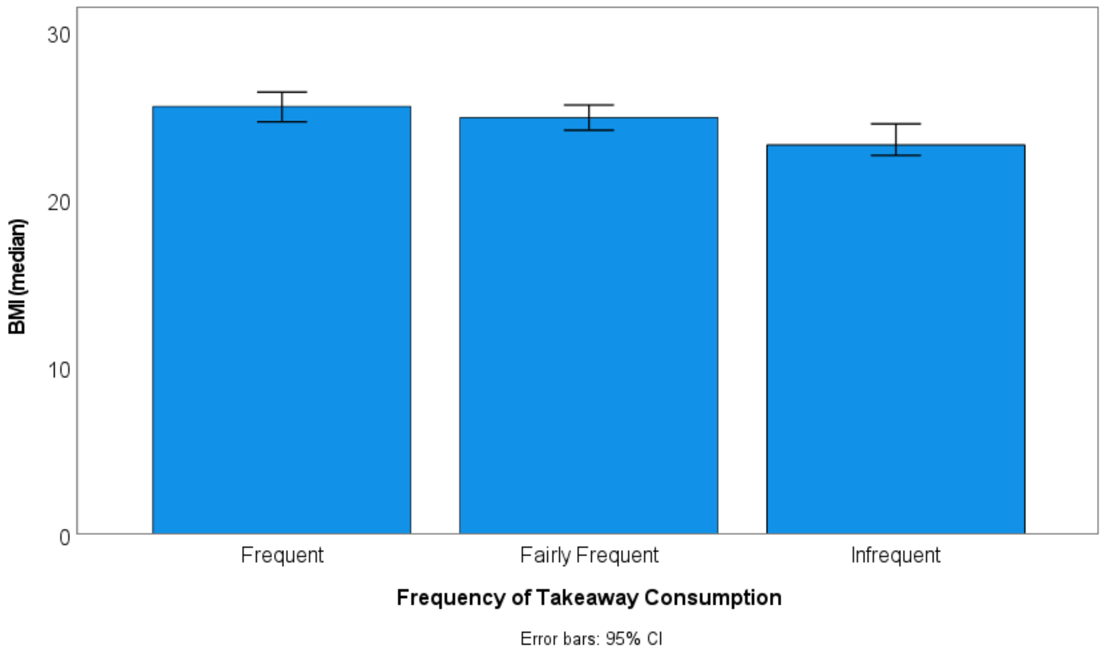


Figure 3.13 Frequency of takeaway consumption compared with BMI

3.5.2.4 Marital Status

A Chi-square test showed a significant association between frequency of takeaway consumption and marital status (Figure 3.14), with divorced/separated respondents consuming takeaway food less frequently than respondents who were single or married/in a partnership, χ^2 (4, n = 431 = 10.165, *p* = 0.038, Cramer's V = 0.109.

Summary: Significant association between divorced/separated respondents eating takeaway food infrequently (*p* = 0.038).

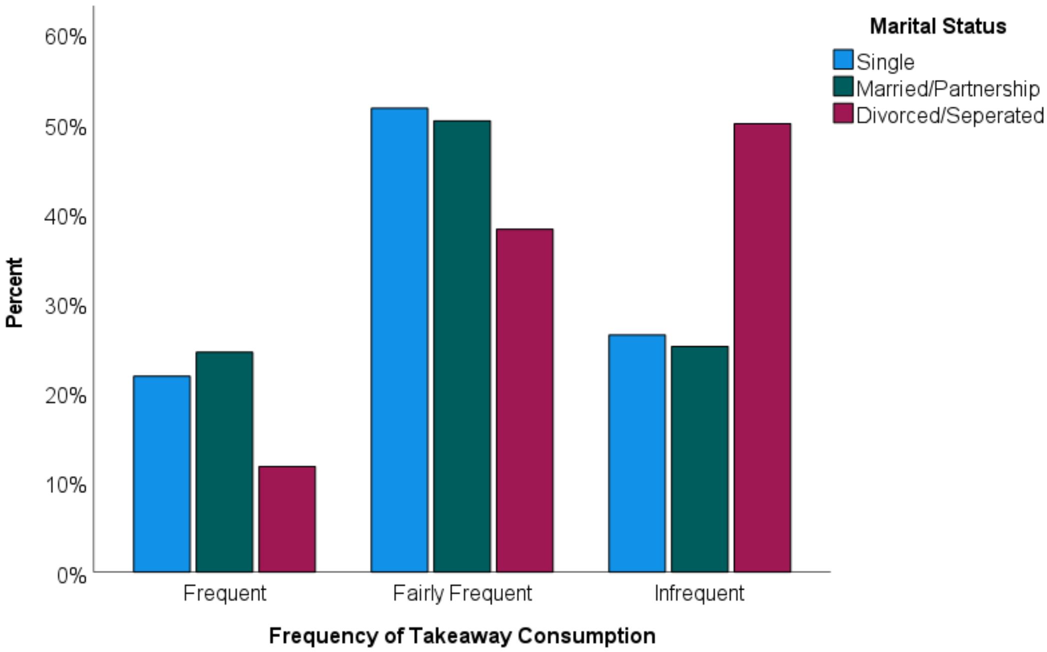


Figure 3.14 Frequency of takeaway consumption compared with Marital Status

3.5.2.5 Other demographics

No significant association was found between frequency of takeaway consumption and having/not having children, level of education or employment status.

3.5.3 Logistic Regression – Takeaway Frequency and Demographics

A binary logistic regression was performed to assess the impact of a set of predictor variables on the odds that respondents were infrequent or frequent takeaway consumers. Frequency of takeaway consumption was collapsed into a dichotomous variable: takeaway consumers were classed as *frequent* consumers if they ate takeaway food once a month or more and *infrequent* consumers if they ate takeaway food less than once a month (Table 3.17). Frequent consumers included those who ate takeaways most days (n=5), once or twice a week (n=97) or once or twice a month (n=223). Infrequent consumers consisted of those who ate takeaway food less than once a month (n=119). The percentages for each group were 70.5% and 25.8%. The alternative would have been to combine the once or twice a month consumers with the less than once a month consumers, which would have resulted in a larger percentage of consumers (74.2%) classed as infrequent consumers and would have reduced statisitical power (Tables 3.12 and 3.14).

Table 3.17 Frequency of Takeaway Consumption for Logistic Regression

Takeaway Frequency	Frequency of Takeaway Consumption	n	Percentage
Frequent	Once a month or more	325	70.5
Infrequent	Less than once a month	119	25.8

Model 1 shows the unadjusted odds ratio for each of the predictors, where each predictor was entered in the model individually with the dependent variable (Table 3.18). The model shows an unadjusted odds ratio of 1.07 for BMI. This value is greater than 1, indicating that for each unit increase in BMI, the odds were 1.07 times higher that respondents would report frequent takeaway consumption. When the unadjusted odds were calculated for BMI categories, the results showed that adults who were living with overweight were 1.8 times more likely to be frequent takeaway consumers and adults who were living with obesity were 2.2 times more likely. The unadjusted odds ratio of 0.96 for age was less than 1, indicating that for each additional year in age, the odds were 0.96 times lower that respondents were frequent takeaway consumers (OR 0.96 (CI 95% 0.944, 0.983), p <0.001). The unadjusted odds of being a frequent takeaway consumer was also 0.36 times lower for respondents who were divorced/separated (OR 0.36 (CI 95% 0.16, 0.82), p = 0.015).

Table 3.18 Binary Logistic Regression Model 1: Unadjusted predictors of frequency of takeaway food consumption (no covariates)

Predictor[a]	**Category**	**Unadjusted Odds Ratio**	**95% CI**	***p* value**	***R^2***
Age	*continuous*	**0.963**	0.944-0.983	**<0.001**	0.045
Age	*categorical*				
	18-34	Ref			0.039
	35-46	**0.439**	0.249-0.774	**0.004**	
	47-66	**0.426**	0.241-0.754	**0.003**	
Sex	Women	Ref			
	Men	1.416	0.870-2.304	0.161	0.007
BMI	*continuous*	**1.073**	1.020-1.129	**0.006**	0.029
BMI	*categorical*				
	Underweight / healthy weight	Ref			0.029
	Overweight	**1.802**	1.088-2.982	**0.022**	
	Obese / very obese	**2.182**	1.070-4.447	**0.032**	
Education	School/college	Ref			
	University	1.071	0.686-1.673	0.761	0.000
Marital Status	Single	Ref			0.029
	Married	1.061	0.608-1.851	0.836	
	Partner	1.101	0.526-2.304	0.799	
	Divorced/ Separated	**0.359**	0.158-0.819	**0.015**	
Children Status	0	Ref			0.013
	1	0.585	0.322-1.065	0.080	
	2	0.668	0.396-1.130	0.133	
	3+	0.673	0.339-1.337	0.258	

a. Individual predictor entered in model with takeaway frequency as dependent variable

The following tables show the adjusted odds ratios for the predictors of takeaway food consumption. In Model 2, the predictors were adjusted for age and sex (Table 3.19), in Model 3, age, sex and BMI (Table 3.20), in Model 4, age, sex, BMI and education (Table 3.21) and in Model 5 Age, Sex, BMI, Education, Marital Status and Children Status (Table 3.22).

Table 3.19 Binary Logistic Regression Model 2: predictors of frequency of takeaway food consumption adjusted by Age and Sex

Predictor[a]	**Category**	**Adjusted Odds Ratio**	**95% CI**	***p* value**
Sex (cat)	Female	Ref		
	Male	1.349	0.812-2.239	0.247
Age (cat)	18-34	Ref		
	35-46	**0.409**	0.230-0.726	**0.002**
	47-66	**0.409**	0.229-0.731	**0.003**

a. Predictor(s) entered on Model 2: Age and Sex

Table 3.20 Binary Logistic Regression Model 3: predictors of frequency of takeaway food consumption adjusted by Age, Sex and BMI

Predictor[a]	**Category**	**Adjusted Odds Ratio**	**95% CI**	***p* value**
Sex (cat)	Female	Ref		
	Male	1.321	0.780-2.235	0.300
Age (cat)	18-34	Ref		
	35-46	**0.398**	0.218-0.725	**0.003**
	47-66	**0.342**	0.186-0.629	**<0.001**
BMI (cat)	Normal weight <25 kg/m^2	Ref		
	Overweight (25-30 kg/m^2)	**2.006**	1.168-3.445	**0.012**
	Obese/very obese (> 30 kg/m^2)	**2.353**	1.122-4.934	**0.023**

a. Predictor(s) entered on Model 3: Age, Sex and BMI

Table 3.21 Binary Logistic Regression Model 4: predictors of frequency of takeaway food consumption adjusted by Age, Sex, BMI, and Education

Predictor[a]	**Category**	**Adjusted Odds Ratio**	**95% CI**	***p* value**
Sex (cat)	Female	Ref		
	Male	1.363	0.798-2.327	0.257
Age (cat)	18-34	Ref		
	35-46	**0.406**	0.222-0.743	**0.003**
	47-66	**0.300**	0.160-0.564	**<0.001**
BMI (cat)	Normal weight <25 kg/m^2	Ref		
	Overweight (25-30 kg/m^2)	**2.025**	1.171-3.503	**0.012**
	Obese/very obese (> 30 kg/m^2)	**2.456**	1.160-5.200	**0.019**
Education (cat)	School and / or college	Ref		
	University	0.836	0.500-1.398	0.495

a. Predictor(s) entered on Model 4: Age, Sex, BMI and Education Level

Table 3.22 Binary Logistic Regression Model 5: predictors of frequency of takeaway food consumption adjusted by Age, Sex, BMI, Education, Marital Status and Children Status

Predictor[a]	**Category**	**Adjusted Odds Ratio**	**95% CI**	***p* value**
Sex (cat)	Female	Ref		
	Male	1.444	0.833-2.503	0.190
Age (cat)	18-34	Ref		
	35-46	**0.391**	0.203-0.752	**0.005**
	47-66	**0.324**	0.161-0.651	**0.002**
BMI (cat)	Normal weight <25 kg/m^2	Ref		
	Overweight (25-30 kg/m^2)	**1.918**	1.093-3.366	**0.023**
	Obese/very obese (> 30 kg/m^2)	**2.248**	1.037-4.871	**0.040**
Education (cat)	School and / or college	Ref		
	University	0.803	0.472-1.367	0.419
Marital Status (cat)	Single	Ref		
	Divorced/Separated	0.856	0.318-2.303	0.759
	Partnership	1.422	0.634-3.189	0.393
	Married	**2.572**	1.231-5.371	**0.012**
Children Status (cat)	None	Ref		
	1 or more	0.631	0.340-1.171	0.144

a. Variable(s) entered on Model: Age, Sex, BMI, Education Level, Marital Status and Children Status

The full model (Model 5) contained six independent variables (sex, age, BMI, education, marital status and having/not having children). The model containing all predictors was statistically significant, χ^2 (10, 372) = 33.885, p <0.001, indicating that the model was able to distinguish between respondents who were infrequent or frequent takeaway consumers. The model correctly predicted 74.2% of cases. As shown in Model 5 (Table 3.22), only three of the independent variables made a unique statistically significant contribution to the model (age, BMI, and marital status). The strongest predictor of being a frequent takeaway food consumer (when controlling for other factors in the model) was marital status with an adjusted odds ratio of 2.57. Compared with single respondents, married respondents were 2.6 times more likely to be frequent consumers (OR 2.6 (CI 95% 1.231, 5.371), p = 0.012). The next strongest predictor was BMI, compared with respondents with a BMI less than 25 kg/m^2, respondents living with overweight, and obesity were 1.9 and 2.2 times respectively more likely to be frequent takeaway consumers. The adjusted odds ratio also decreased with increasing age, compared with the youngest respondents (aged 18 to 34), the odds of being a frequent consumer were 0.4 times lower for 35- to 46-year-olds and 0.3 times lower for 47- to 66-year-olds. Sex, education level and having/not having children were not significant.

3.6 Objective 2

- Explore consumers reasons for takeaway food consumption.

3.6.1 Reasons for Purchasing Takeaway Food (Q8 a-h)

The three most popular reasons for purchasing takeaway food were: for a change/treat, it is easily available and liking the taste.

Table 3.23 Reasons why takeaway consumers buy takeaway food

Reason for buying takeaway food	Response	Count	%
For a change / treat	Yes	390	**84.6**
It is easily available	Yes	335	**72.7**
I like the taste	Yes	325	**70.5**
It is a good alternative to eating out	Yes	217	47.1
I am usually too busy to cook	Yes	109	23.6
I think that takeaway food is cheap / good value for money	Yes	92	20
I do not like to prepare food	Yes	44	9.5
I do not know how to cook	Yes	13	2.8

3.6.2 Takeaway Frequency and Reasons for Purchase

Chi-square tests were used to explore frequency of takeaway consumption (frequent, fairly frequent, or infrequent) and consumer's reasons for purchasing takeaway food. Significant associations were found between consumers who eat takeaway food frequently and "I do not like to prepare food", χ^2 (2, n = 444) = 33.499, p <0.001, Cramer's V = 0.275 (medium effect size) and "I am usually too busy to cook", χ^2 (2, n = 444) = 63.437, p <0.001, Cramer's V = 0.378 (large effect size). There was a significant association for infrequent takeaway food consumers disagreeing with "I like the taste", χ^2 (2, n = 444) = 11.910, p = 0.003, Cramer's V = 0.164 (small effect size) and "It is a good alternative to eating out", χ^2 (2, n = 444) = 8.012, p = 0.018, Cramer's V = 0.134 (small effect size). A significant association was also found between takeaway frequency and purchasing takeaway food "For a change/treat". More frequent consumers disagreed with this than expected whilst more fairly frequent consumers agreed with this than expected, χ^2 (2, n = 444) = 20.742, p <0.001, Cramer's V = 0.216 (medium effect size) (Appendix 3.2, Figures 8.8 to 8.12).

3.6.2.1 Sex

Chi-square tests showed a significant association between sex and “I think that takeaway food is cheap / good value for money” with more males (and less females) agreeing with this than expected, χ^2 (1, n = 435) = 14.180, p <0.001, Phi = 0.187 (small effect size) using Yate’s continuity correction (Appendix 3.2, Figure 8.13).

3.6.2.2 Age

Mann Whitney U tests were carried out on reasons for purchasing takeaway food and age. A significant difference was found between age and consumers thinking takeaway food “is easily available” (U = 11555, z = -3.851, p <0.001, n = 418, r = 0.188, small effect size). The consumers who felt takeaway food was easily available were significantly younger, median 39 years, n = 321 compared with median 44 years, n = 97. There was also a significant difference between age and “I do not like to prepare food” (U = 5703, z = -2.758, p = 0.006; n = 418, r = 0.135, small effect size). The consumers who did not like to prepare food were significantly younger, median 34 years, n = 41 compared with median 41 years, n = 377. A significant difference was also found between age and “I am usually too busy to cook” (U = 12358.5, z = -3.719, p <0.001; n = 418, r = 0.181, small effect size). Respondents who were too busy to cook were significantly younger, 34.5 years, n = 104 compared with 41 years, n = 314. A significant difference was also found between age and “liking the taste” (U = 12358, z = -3.632, p <0.001; n = 418, r = 0.178, small effect size). Respondents who liked the taste of takeaway food were significantly younger, 39 years, n = 315 compared with 44 years, n = 103. (Appendix 3.2, Figures 8.11 to 8.13). Mann-Whitney U test for “I do not know how to cook” was not significant (p = 0.052) but is considered a trend (Appendix 3.2, Figures 8.14 to 8.18).

3.6.2.3 BMI

Mann Whitney U tests were carried out on reasons for purchasing takeaway food and BMI. A significant difference was found between BMI and “I am usually too busy to cook” (U = 13099.5, z = -2.605, p = 0.009, n = 410, r = 0.129, small effect size). Respondents who were usually too busy to cook had a significantly higher BMI, 25.8 kg/m^2, n = 103 compared with 24.2 kg/m^2, n = 307. (Appendix 3.2, Figure 8.14). Mann-Whitney U test for I do not know how to cook was not significant (p = 0.054) but is considered a trend (Appendix 3.2, Figures 8.19 to 8.20).

3.6.3 Logistic Regression - Takeaway Frequency and Reasons for Purchase

A binary logistic regression was performed to assess the impact of *seven* predictor variables (reasons for purchase) on the odds that consumers were infrequent or frequent takeaway consumers. *(*Due to the low response rate the eighth predictor “I do not know how to cook” was omitted from the analysis).

Each predictor was placed individually in the model and the regression was carried out for the independent dichotomous predictor *Takeaway Frequency* (Model 1). The unadjusted odds ratios are shown in Table 3.24. The table also shows R^2, the proportion of variance in takeaway consumption explained by the regression model for each predictor (Nagelkerke, 1991). Five of the predictors were statistically significant, indicating that each model was able to distinguish between consumers who were infrequent or frequent takeaway consumers.

This model shows the strongest reasons for eating takeaway food frequently to be “not liking to prepare food” with an unadjusted odds ratio of 5.6 and “usually too busy to cook” with an unadjusted odds ratio of 4.8.

Table 3.24 Logistic Regression Model 1: Unadjusted predictors of frequency of takeaway food consumption – Each predictor placed individually in the model (no covariates)

Predictor	**Unadjusted Odds Ratio**	**95% CI**	***p* value**	***R²***
It’s good value for money*	**1.800**	1.013-3.198	**0.045**	0.014
It is easily available	1.586	0.993-2.532	0.054	0.012
I do not like to prepare food*	**5.582**	1.695-18.385	**0.005**	0.041
I am usually too busy to cook*	**4.775**	2.396-9.513	**<0.001**	0.085
I like the taste*	**2.175**	1.385-3.417	**<0.001**	0.036
It is a good alternative to eating out*	**1.849**	1.203-2.841	**0.005**	0.026
For a change / treat	0.950	0.497-1.817	0.877	0.000

*Statistically significant p <0.05

Next, a binary logistic regression was performed to assess the impact of all seven predictor variables in the model, on the odds that consumers were infrequent or frequent takeaway consumers The full model containing all seven predictors was statistically significant, χ^2 (7, 444) = 41.386, p <0.001, indicating that the model was able to distinguish between consumers who were infrequent or frequent takeaway consumers (Table 3.25). The model explained 12.9% of the variation in takeaway consumption (R^2) and correctly classified 74.5% of cases. Only two of the independent variables made a unique statistically significant contribution to the model (too busy to cook, like the taste). The strongest predictor of eating takeaway food frequently was “too busy to cook” with an odds ratio of 4.0. This indicated that the odds of being a frequent takeaway consumer were four times greater for consumers who answered that they were “too busy to cook”. The odds of being a frequent takeaway consumer was also 1.9 times greater for consumers who “like the taste” of takeaway food. The predictors “good value for money”, “easily available”, “not knowing how to cook”, “good alternative to eating out” and “for a change/treat” were not significant.

Table 3.25 Logistic Regression Model 2: Adjusted predictors of frequency of takeaway food consumption

Predictor	**Odds Ratio**	**95% CI**	***p* value**
It’s good value for money	1.436	0.770-2.677	0.255
It is easily available	0.737	0.398-1.365	0.332
I do not like to prepare food	2.283	0.650-8.024	0.198
I am usually too busy to cook*	**4.000**	1.930-8.294	**<0.001**
I like the taste*	**1.870**	1.034-3.382	**0.038**
It is a good alternative to eating out	1.352	0.835-2.187	0.220
For a change / treat	1.042	0.507-2.140	0.911

All seven predictors used as covariates in the Model: *statistically significant p <0.05

Finally, a binary logistic regression was performed to assess the impact of each individual predictor in the adjusted model. Each predictor was placed in the model on its own and adjusted for the covariates age, sex, and BMI (Table 3.26).

Table 3.26 Logistic Regression Model 3: Adjusted predictors of frequency of takeaway food consumption

Predictor[a]	**Adjusted Odds Ratio**	**95% CI**	***p* value**
It's good value for money	1.546	0.823-2.904	0.176
It is easily available	1.369	0.801-2.341	0.251
I do not like to prepare food	3.412	0.995-11.704	0.051
I am usually too busy to cook*	**3.932**	1.869-8.275	**<0.001**
I like the taste*	**1.936**	1.160-3.231	**0.011**
It is a good alternative to eating out*	**1.733**	1.073-2.798	**0.025**
For a change / treat	1.093	0.525-2.274	0.812

Each predictor entered individually in model and adjusted for Age, Sex and BMI.
*Statistically significant p <0.05

Having adjusted for the covariates (age, sex, BMI), the strongest predictor was "I am usually too busy to cook" with an adjusted odds ratio of 3.9. This indicated that that the odds of being a frequent takeaway consumer was almost 4 times greater for consumers who answered that they were "usually too busy to cook". The odds of being a frequent takeaway consumer was nearly 2 times greater for consumers who "like the taste" of takeaway food. Furthermore, "It is a good alternative to eating out" became statistically significant in this model, with an odds ratio of 1.7. Compared with the unadjusted odds ratio in model 1, "I do not like to prepare food" was no longer statistically significant (p = 0.051) but was borderline.

3.7 Objectives 3 and 4

- Examine participants knowledge about the healthfulness of takeaway food.
- Investigate participants receptiveness to takeaway food prepared in a healthier way.

3.7.1 Takeaway Opinions

A high proportion of takeaway consumers (90-95%) felt that takeaway food was high in calories, fat, and salt. Furthermore, 85% agreed that takeaway food was tasty. Three-quarters of consumers felt takeaway food was unhealthy and linked with weight gain. As regards to portion sizes, almost two-thirds felt portion sizes were large (Table 3.27).

3.7.2 Changes to Takeaway Food

Reformulation

When takeaway consumers were asked if they would consider purchasing takeaway meals that had been reformulated, around half advised they were interested in reduced fat (57.6%), reduced sugar (47.8%) or reduced salt (42.8%) meals.

Portion Sizes

Almost two thirds of respondents (63.3%) felt that a standard portion was too big for one adult, with 66% advising they would be likely to buy smaller portions at a reduced price.

Nutritional Labelling

Three quarters of respondents (74%) agreed nutritional information on the menu would be useful when purchasing takeaway food and 69.6% agreed consumer guidance would be helpful (for example the Traffic Light system or Guideline Daily Amounts).

Table 3.27 Consumer's knowledge about takeaways and their receptiveness to takeaways prepared in a healthier way

Responses to Questions about Takeaway Food	**%**
Tasty	84.7%
Unhealthy	77.5%
High in salt	90.0%
High in fat	91.6%
High in calories	94.9%
Linked with weight gain	77.9%
Reduced salt meals	42.8%
Reduced fat meals	57.6%
Reduced sugar meals	47.8%
Large portion sizes	63.3%
Purchase smaller portions at a reduced price	66.0%
Nutritional information on the menu	74.0%
Consumer guidance on the menu (e.g., Traffic light system)	69.9%

3.7.3 Health Score and Receptiveness Score

3.7.3.1 Correlations – Age and BMI

Pearson correlations were carried out on the continuous variables Age, BMI, Health score and Receptiveness score and are shown in Table 3.28. There was a very weak significant positive correlation between age and BMI (Pearson's, r = 0.191, p <0.05) and a weak significant negative correlation between health score and age (Pearson's, r = -0.229, p <0.01).

When exploring whether takeaway consumers were receptive to changes to takeaway food to make them healthier, receptiveness score was positively correlated with BMI (r = 0.159, p <0.01). Furthermore, health knowledge was positively correlated with receptiveness to changes (r = 0.177, p <0.01) although both were weak according to criteria devised by Evans (1996) (Table 3.1).

Table 3.28 Pearson Correlations for Health Score and Receptiveness Score

	Age	**BMI**	**Total Health Score**	**Total Receptive Score**
Age	1			
N	435			
BMI	**0.191****	1		
N	410	426		
Total Health Score	**-0.229****	-0.07	1	
N	415	406	434	
Total Receptive Score	-0.085	**0.159****	**0.177****	1
N	405	395	407	424

* Correlation is significant at the 0.05 level (2-tailed);
** Correlation is significant at the 0.01 level (2-tailed).

3.7.3.2 Mann-Whitney U tests – Sex, Education, Children and Marital Status

The distribution of health score was significantly different between males and females, with females having a higher median health score than males, 29 (n = 306) compared to 28 (n = 124) respectively ((15527.500, z = -2.963), p = 0.003, n = 430, r = 0.142, small effect). The distribution of receptiveness score was also significantly different between males and females, with females having a higher median receptiveness score than males, 27 (n = 303) compared to 24 (n = 118) respectively ((14042.500, z = -3.430), p = 0.001, n = 421, r = 0.167, small effect).

In addition, distribution of health score was significantly different over education levels, with takeaway consumers who attended university having a significantly higher median health score than consumers who were school/college educated, 29 (n = 275) versus 28 (n = 147) respectively ((23409.500, z = 2.689), p = 0.007, n = 421). No significant difference was found between the distribution of receptiveness score and education level. There were also no significant associations between health or receptiveness score and marital status (single, married or partnership, divorced or separated).

There was no significant association between having/not having children and health score, however there was an association for receptiveness score. Takeaway consumers who did not have children were more receptive to healthier takeaways, median 27 (n = 170) compared with median 25 (n = 250) (Mann-Whitney U: 18826.000, z = -1.991, p = 0.046, n = 420).

3.7.3.3 Kruskal-Wallis tests – Takeaway Frequency

Health Score

The distribution of health score was found to be significantly different across the three takeaway frequency categories (Group 1, n = 92: frequent; Group 2, n = 212: fairly frequent; Group 3, n = 113: infrequent), $\chi^2(2, n = 417) = 10.094$, p = 0.006. Consumers who ate takeaways less than once a month (infrequent) had significantly higher health scores (median = 29) than frequent (p = 0.003) and fairly frequent consumers (p = 0.013) with median health scores of 28, although the effect size was small (r = 0.15).

Receptiveness Score

The distribution of receptiveness score was also found to be significantly different across the takeaway frequency categories (Group 1, n = 96: frequent; Group 2, n = 201: fairly frequent; Group 3, n = 111: infrequent) $\chi^2(2, n = 408) = 14.446$, p <0.001. Frequent and fairly frequent takeaway consumers had significantly higher receptiveness scores than infrequent consumers, 26 for frequent and 27 for fairly frequent compared with 24 for infrequent consumers, although the effect size was small (r = 0.19).

3.7.4 Logistic Regression - Health Score / Receptiveness Score

3.7.4.1 Takeaway Frequency

Following on from the Kruskal-Wallis tests a direct logistic regression was carried out to assess if Health Score or Receptiveness Score significantly predicted frequency of takeaway consumption. The full model contained two independent variables (health score, receptiveness score) and one dependent dichotomous variable: takeaway frequency (Table 3.17). The full model containing all predictors was statistically significant, χ^2 (2, N = 391) = 29.42, *p* <0.001 indicating that the model was able to distinguish between frequent and infrequent takeaway consumers. The model explained 10.5% of the variation in takeaway consumption (R^2) and correctly classified 74.7% of cases. As shown in Table 3.29, the strongest predictor of takeaway frequency was Health Score with an odds ratio of 0.873, indicating that for each 1 unit increase in Health Score, the odds were 0.87 times lower that respondents were frequent takeaway consumers. For Receptiveness Score, the odds ratio was 1.095, indicating that for each 1 unit increase in Receptiveness Score, the odds were 1.1 times higher that respondents were frequent takeaway consumers.

Table 3.29 Logistic Regression Model 3: Predictors of frequency of takeaway consumption

Variable	Odds Ratio	95% CI	*p* value
Health Score	0.873	0.816-0.933	**<0.001**
Receptiveness Score	1.095	1.049-1.144	**<0.001**

Variables entered on Model 3: Total Health Score (out of 35), Total Receptiveness Score (out of 35)

3.7.5 Linear Regression and Multiple Regression

Following the Pearson correlations, Kruskal-Wallis and Mann-Whitney U tests, linear regression was carried out to investigate whether takeaway frequency, age, sex, BMI, marital status, children/no children, and education level could significantly predict respondents' Health Scores or Receptiveness Scores.

3.7.5.1 Health Score (unadjusted)

A simple linear regression was run to determine the unadjusted β Value for takeaway frequency. The results indicated that the model explained 2.4% of the variance (R^2=0.024) and was a significant predictor of Health Score, F (1, 415) = 10.109, *p* = 0.002. Takeaway frequency was negatively associated with Health Score suggesting that as health score increases, frequency of takeaway consumption decreases.

Table 3.30 Simple linear regression (unadjusted) with Takeaway Frequency as independent variable and Health Score as dependent variable

Linear Regression	β Value	95% CI	*p* value
Takeaway Frequency	-1.333	-2.156 to -0.509	**0.002**

The final unadjusted predictive model was:

Health Score = 29.784 + (-1.333*Takeaway Frequency)

3.7.5.2 Health Score (adjusted)

A hierarchical multiple regression was next used to assess whether takeaway frequency predicted health score after controlling for sex, age, BMI, marital status, children status and level of education. Takeaway frequency was entered at step 1, sex, age and BMI at step 2 and education level, marital status, and children status at step 3. Step 1 explained 2.4% of the variance in health score, step 2 explained 8.7% and step 3 a further 2.4%.

The results from this multiple regression model explained 13.4% of the variance (R^2=0.134) and the model was a significant predictor of Health Score, F (7, 398) = 8.805, p <0.001. Age, sex, marital status, education level and takeaway frequency contributed significantly to the model, whereas BMI and having/not having children did not.

The final adjusted predictive model was:

Health Score = 31.321 + (-0.091*Age) + (-1.278*Sex) + (BMI*0.026) +
(0.938*Marital Status) + (-0.110*Children Status) +
(0.965*Education Level) + (-1.792*Takeaway Frequency)

Table 3.31 Linear regression (adjusted) with determinant variables as independent variables and Health Score as dependent variable

Linear Regression	β Value	95% CI	*p* value
Sex	-1.278	-2.063 to -0.493	**0.001**
Age	-0.91	-0.127 to -0.055	**<0.001**
BMI	0.026	-0.050 to 0.103	0.501
Marital Status	0.938	0.103 to 1.774	**0.028**
Having children	-0.11	-0.934 to 0.713	0.792
Education Level	0.965	0.200 to 1.730	**0.014**
Takeaway Frequency	-1.792	-2.618 to -0.965	**<0.001**

Takeaway frequency, sex and age were negatively associated with Health Score whilst education level and marital status were positively associated with Health Score. These results suggest that greater takeaway knowledge was associated with eating takeaway food less frequently, females, university educated and being married or in a partnership. Decreasing health scores were associated with being male, being older and eating takeaway food more frequently.

3.7.5.3 Receptiveness Score (unadjusted)

A simple linear regression was run to determine the unadjusted β Value for takeaway frequency. The results indicated the model explained 3.7% of the variance (R^2=0.037) and was a significant predictor of Receptiveness Score, F (1, 406) = 15.446, *p* <0.001. Takeaway frequency was positively associated with Receptiveness Score suggesting receptiveness to healthier takeaways increases as takeaway frequency increases.

Table 3.32 Simple linear regression (unadjusted) with Takeaway Frequency as independent variable and Receptiveness Score as dependent variable

Linear Regression	β Value	95% CI	*p* value
Takeaway Frequency	2.384	1.192 to 3.576	**<0.001**

The final unadjusted predictive model was:

Receptiveness Score = 23.415 + (2.384*Takeaway Frequency)

3.7.5.4 Receptiveness Score (adjusted)

A hierarchical multiple regression was next used to assess whether takeaway frequency predicted receptiveness score after controlling for sex, age, BMI, marital status, children status and level of education. Takeaway frequency was entered at step 1, sex, age and BMI at step 2 and education level, marital status, and children status at step 3. Step 1 explained 3.7% of the variance in receptiveness score, step 2 explained 6.5% and step 3 a further 0.6%. The model explained 10.8% of the variance (R^2=0.108) and was a significant predictor of Receptiveness Score, F (7, 387) = 6.670, *p* <0.001. Only sex, BMI and takeaway frequency contributed significantly to the model.

The final adjusted predictive model was:

Receptiveness score = 23.176 + (-0.040*Age) + (-2.237*Sex) + (0.179*BMI) +
(-0.246*Marital Status) + (-0.491*Children Status) +
(-0.796*Education Level) + (2.083*Takeaway Frequency)

Table 3.33 Linear regression (adjusted) with determinant variables as independent variables and Receptiveness Score as dependent variable

Linear Regression	β Value	95% CI	*p* value
Sex	-2.327	-3.491 to -1.163	**<0.001**
Age	-0.040	-0.094 to 0.014	0.144
BMI	0.179	0.066 to 0.293	**0.002**
Marital Status	-0.246	-1.486 to 0.994	0.697
Having children	-0.491	-1.713 to 0.730	0.430
Education Level	-0.796	-1.931 to 0.340	0.169
Takeaway Frequency	2.083	0.857 to 3.310	**<0.001**

Takeaway frequency and BMI were positively associated with Receptiveness Score whilst sex was negatively associated with Receptiveness Score. These results suggest that more frequent takeaway consumption was associated with being more receptive to healthier takeaways, as was increasing BMI and being female.

3.7.5.5 Health Score and Receptiveness Score (unadjusted)

Lastly, a simple linear regression was carried out to test if Health score significantly predicted Receptiveness score. The results of this regression indicated that the model explained 3% of the variance ($R^2 = 0.031$) and that the model was significant, $F(1, 405) = 13.131$, $p < 0.001$. The results show that Health score significantly predicted Receptiveness score ($\beta = 0.255$, $p < 0.001$). The β Value indicates how a 1-unit change in health score affects the dependent variable receptiveness score.

Table 3.34 Linear regression (unadjusted) with Health Score as independent variable and Receptiveness Score as dependent variable

Linear Regression	**β Value**	**95% CI**	***p* value**
Health Score	0.255	0.117 to 0.394	**<0.001**

The final unadjusted predictive model was:

Receptiveness score = 17.803 + (0.255*health score)

3.7.5.6 Health Score and Receptiveness Score (adjusted)

Finally, a hierarchical multiple regression was carried out to assess whether health score predicted receptiveness score after controlling for sex, age and BMI. Health score was entered at step 1 and sex, age and BMI were entered at step 2. Step 1 explained 3.1% of the variance in receptiveness score and step 2 explained 6.4%. The results of the multiple regression indicated that the model explained 9.5% of the variance ($R^2=0.095$) and that the model was a significant predictor of Receptiveness Score, $F(4, 390) = 10.231$, $p < 0.001$. The β value for health score also reduced from 0.255 to 0.209.

Table 3.35 Linear regression (adjusted) with Health Score as independent variable and Receptiveness Score as dependent variable

Linear Regression	**β Value**	**95% CI**	***p* value**
Age	-0.046	-0.095 to 0.003	0.067
Sex	-2.068	-3.238-0.898	**<0.001**
BMI	0.227	0.115-0.338	**<0.001**
Health Score	0.209	0.067 to 0.351	**0.004**

Model adjusted for sex, age, and BMI.

The final adjusted predictive model was:

Receptiveness score = 15.840 + (0.209*health score) +
(-0.046*age) + (-2.068*sex) + (0.227*BMI)

Health score and BMI were positively associated with Receptiveness score whilst sex was negatively associated, suggesting greater receptiveness to healthier takeaways was associated with increasing health score, increasing BMI and being female.

3.8 Discussion

3.8.1 Objective 1

- Determine frequency of takeaway food consumption in Merseyside and its predictors.

Findings from the present study showed takeaway food served by small independent takeaways was a popular choice among respondents with 96.3% advising they eat takeaway food. Takeaway food was defined as food served by small independent takeaway outlets, and not from fast food chains. Takeaway meals purchased for home delivery was also common with almost half the respondents (45.6%) using a takeaway delivery service, and these respondents were significantly younger (p <0.001) and heavier (p = 0.023) than those that did not have food delivered. The most popular types of takeaway food were Chinese meals (44%), fish and chips (15%) and Indian meals (15%). This is in agreement with a recent YouGov survey (n = 1692) of consumers using quick service restaurants in the UK where Chinese meals (25%), Indian meals (17%) and fish and the chips (16%) were the top three takeaway cuisines (YouGov, 2021). Liverpool has the oldest Chinese community in Europe which might have influenced the higher popularity of Chinese meals in Liverpool. Many of the fish and chip shops in Liverpool are Chinese family run and are often referred to as “Chinese chippies” because they sell a large selection of Chinese takeaway meals as well as traditional fish and chip shop type meals (Johnson, 2020).

When examining how frequently takeaway food was purchased, almost half (48.4%) the respondents advised they ate takeaway food once or twice a month, 22.1% ate takeaway food once or twice a week and a quarter (25.8%) less than once a month. Frequent takeaway consumption was associated with sex, age, BMI, and marital status. Although direct comparison with other studies is difficult due to the various definitions of fast food or takeaway food, these results are consistent with other studies in the UK. In the analysis of the NDNS survey by Adams et al. (2015b), the focus was on food prepared outside of the home rather than consumed out of home and there was no distinction between meals purchased from fast food or independent takeaway outlets. Takeaway meals were specified as “more than a beverage or a bag of chips” and participants were asked to include “pizza, fish and chips, Indian, Chinese, burgers, kebab, etc” in their food diaries (Adams et al., 2015b). Results from the four waves of this survey (2008-2012) found 21.1% adults and 21% of children ate takeaway meals at home once per week or more (Adams et al., 2015b) compared with 21% of respondents in the present study who ate takeaway food once or twice a week. More locally, Knowsley’s 2012/13 NHS

Merseyside Lifestyle survey (2,391) found 20% of adults ate takeaway food from a local non-chain outlet at least once a week and 29% once or twice a month or less (Jackson and Cornick, 2013). In the Knowsley survey, takeaway food from independent outlets was more popular with one in five consumers purchasing from a local non-chain outlet (chip shop, pizza, Chinese or Indian) compared with one in seven from a fast food chain (McDonalds, KFC, Burger King or Dominos) (Jackson and Cornick, 2013). Also in Merseyside, the Takeaway for a Change survey on the Wirral found takeaways were purchased more frequently than the present study, with 45% of participants consuming takeaways once a week and 45% twice a week or more (Pulford, 2015). Although this survey had a small sample size (n = 214), the higher rates of consumption may be due to it taking place in Rock Ferry, which was classed as being in one of the 20% most deprived areas in England in 2019 (Wirral Intelligence Service, 2019). The survey involved parents of children attending Rock Ferry primary school or sure start centre, and participants were incentivised to take part in exchange for vouchers to purchase healthier takeaways (Pulford, 2015). During the project, researchers became aware that many of the children attended school with empty stomachs and that many families were most likely having takeaways as much as five times a week with parents reluctant to advise their actual levels of consumption (Pulford, 2015) suggesting that takeaway consumption may be under-reported in deprived areas.

3.8.1.1 Sex

In the present study, a χ^2 test showed frequency of takeaway food consumption was significantly associated with sex, with more men than women being frequent consumers (once or twice a week, p = 0.007), whilst logistic regression showed no association for sex for consumers eating takeaway food more than once a month compared with less than once a month. In the NDNS survey (2008-2012), Adams et al. (2015b) found no difference between sexes for adults eating takeaway meals at home, however girls were less likely to eat takeaway meals at home at least once per week than boys. The NDNS survey also found children living in less affluent households were more likely to eat takeaway meals at home once a week or more (Adams et al., 2015b) which is in agreement with the Takeaway for a Change survey where children in a deprived area were eating takeaways regularly (Pulford, 2015).

Worldwide, numerous studies have found associations for males eating fast food more frequently than females. In the United States of America (USA), a telephone survey of 2,027 adults aged 18 to 65 years and older across 50 states, found 53% of men were more likely to eat fast food than women (42%) (Dugan, 2013). Similarly, in the telephone survey carried out by Dave et al. (2009) in Minnesota, USA, fast food intake was significantly associated with gender, with men eating it almost twice as frequently as women (OR 1.942, (95% CI 1.46, 2.59), p <0.001). In Switzerland, Van Der Horst, Brunner and Siegrist (2011) found males were associated with eating fast food more frequently than females (OR 1.61, (95% CI 1.05, 2.48), p = 0.030) and in a US university employees' study, significant associations were found between fast food consumption and gender (Garza et al., 2016). Other studies have explored takeaway food consumption in adolescents such as Banik et al. (2020) in Bangladesh and university students such as Mahajan and Gothankar (2020) in Pune, India which also found males ate takeaway food more frequently than females.

One reason for the difference in consumption patterns between males and females may be because women are more concerned about putting on weight than men. In the qualitative analysis of fast food consumption by Dunn et al. (2008), 'fear of getting fat' was one of the reasons women did not eat fast food frequently whilst Bolhuis et al. (2016) showed men preferred high fat meals compared with low fat meals when investigating the effects of both fat and salt on ad libitum food intake. Another reason men may eat takeaways more frequently is if they are less confident with meal preparation and cooking skills, particularly if they are aged between 19 and 34 (Adams et al., 2015a). They may also have less knowledge about healthy foods (Hoefkens, Verbeke and Van Camp, 2011; Ozgen, 2017) or be unconcerned about the health impacts of eating unhealthy food (Birch et al., 2019). Women are commonly more responsible for meal planning, food shopping and meal preparation which may be a contributing factor as to why women eat takeaway food less frequently (Lake et al., 2006; Adams et al., 2015a). In the Fenland study in Cambridge (n = 11,326), women had an increased odds of eating at least two home cooked meals a week (OR 1·39; 99% CI 1·12, 1·73) and a decreased odds of consuming takeaway meals twice a week or more (OR 0.68; 99% CI 0.55, 0.84) compared to men (Mills et al., 2018). The 2008/9 NDNS survey (n = 509) also showed women were more likely to prepare at least five main meals at home per week than men (81.9% and 43.5% respectively), although this study had a much smaller sample size compared to the Fenland study (Adams et al., 2015a).

3.8.1.2 Age

In the present study, younger consumers were associated with consuming takeaway food more frequently than older consumers. A χ^2-test showed the number of times a consumer ate takeaway food was significantly associated with age. Frequent and fairly frequent consumers were significantly younger than infrequent takeaway consumers

(p<0.001 and p = 0.005 respectively). Logistical regression also showed age was negatively associated with takeaway food consumption (unadjusted and adjusted). These findings were consistent with other fast food studies in the literature such as Dave et al. (2009) (OR 0.981; 95% CI 0.969, 0.992), Van Der Horst, Brunner and Siegrist (2011) (OR 0.41 ages 40-59 and OR 0.13 for age 60+). In the Gallup survey, Dugan (2013) found 57% of younger adults (aged 18 to 29) ate fast food at least weekly and consumption decreased as consumers got older. In a nationwide Australian fast-food study (n = 20,527, age 14 to 65+), Mohr et al. (2007) showed age was also a significant predictor of fast food consumption, particularly for those aged 45 and under. Zagorsky and Smith (2017) found older adults were less likely to eat fast food compared with younger adults when examining socioeconomic status and fast-food consumption of a large nationally representative sample of Americans using data from the 2008, 2010 and 2012 waves of the NLS79, although respondents were all in their 40s and 50s at the time they were surveyed.

A more recent large online UK study (9,581 adults) carried out in 2019/20 showed a general correlation between age and eating at fast food restaurants, with 16% of younger respondents (18-24 years old) eating fast food at least once a week compared to 4% of those aged 65 and over. Of respondents who ate out at fast food restaurants a few times a month, the prevalence decreased consistently with increasing age, from 38% of 18 to 24 year olds to 22% of 45-54 year olds and 12% of 55 to 64 year olds (dunnhumby Beyond, 2020). Analysis of four waves of the UK NDNS survey (2008 - 2012) also found consumption of takeaway meals eaten at least once per week (at home and outside the home) peaked in younger adults aged 19-29, then decreased with increasing age (Adams et al., 2015b). Likewise in the Knowsley 2012/13 NHS Merseyside Lifestyle survey, takeaway food was more popular with younger adults with fast food frequency decreasing with age and this pattern was observed for both chain and non-chain outlets (Jackson and Cornick, 2013). For non-chain outlets, 34% of 18 to 34 year olds consumed takeaways at least once a week compared to 24% of 35 to 54 year olds and 11% of adults aged 55 and over (Jackson and Cornick, 2013). These findings are supported in the present study, where compared to those aged 18 to 34 years the adjusted odds of eating takeaway food were AOR 0.4 (CI 95% 0.20-0.75) for consumers aged 35-46 and AOR 0.3 (CI 95% 0.16-0.653) for consumers aged 47-66.

It is conceivable that as young adults get older (into their 20s and 30s), eating habits are altered due to changes in responsibilities, for example life events such as finding a partner, getting married or having children (Van Der Horst, Brunner and Siegrist, 2011) or have less disposable income due to financial commitments such as a mortgage. All of which could be contributing factors as to why people eat more meals prepared in the home as they get older. Tiwari et al. (2017) surveyed adults aged 21 to 55 in the Seattle Obesity study (n = 437). They examined frequency of home-cooked dinners versus eating out in relation to the Healthy Eating Index and food expenditure. Frequent home-cooked dinners were associated with eating out less frequently, being married, unemployed, larger households and children under 12 (Tiwari et al., 2017). Respondents who were unmarried or employed or living in single person households or households without children were significantly more likely to eat meals away from home (overall $p<0.05$ for each). They also found frequent consumption of home cooked dinners was associated with a higher quality of diet whereas frequent eating of meals away from home was associated with lower diet quality (Tiwari et al., 2017). In relation to home cooked meals in the UK, evaluation of the 2008/9 NDNS survey showed younger adults aged 19 to 34 were less likely to prepare five main meals at home per week than adults aged 35 and over (Adams et al., 2015a).

More than a quarter of men and a third of women aged 65 and over in the UK population currently live alone (Centre for Ageing Better, 2022). This could be a contributing factor towards people changing their eating habits as they get older. Other influencing factors could include but are not limited to a decrease in appetite, changing food preferences, having to reduce money spent on food, bereavement or loneliness may reduce pleasure from eating, cooking for one, cooking skills (particularly for bereaved men), medication or health problems which result in reduced saliva production, needing to avoid certain foods due to digestive problems or having decreased oral health which makes it diifficult to eat dry or chewy foods (Blais et al., 1986; Whitelock and Ensaff, 2018).

3.8.1.3 BMI

In the present study, consumers living with overweight or obesity were found to eat takeaway food more frequently than consumers who were a healthy weight. A χ^2-test showed an association between frequency of takeaway consumption and BMI, with frequent and fairly frequent consumers being significantly heavier than infrequent consumers (p = 0.014 and p = 0.006 respectively). Additionally, logistical regression showed BMI was a strong predictor of more frequent takeaway consumption with an unadjusted OR of 1.073 (95% CI 1.020, 1.129). The adjusted odds ratio showed consumers who were living with overweight (BMI 25-30 kg/m^2) or obesity (BMI > 30 kg/m^2) were twice as likely to eat takeaways once a month or more (AOR 1.9 and 2.2 respectively). These findings are consistent with other studies such as Zagorsky and Smith (2017) who found frequent fast-food eaters (more than three times over seven days) in the 1979 cohort of the National Longitudinal Survey of Youth had significantly higher BMIs than infrequent fast-food eaters. In the Michigan Behavioral Risk Factor Survey, Anderson et al. (2011) found prevalence of obesity increased with frequency of fast food consumption with the odds of being obese almost 50% greater when consuming fast food two to three times a week (OR 1.49 (95% CI 1.16-1.91)) compared with less than once a week. In a cross-sectional survey by Fulkerson et al. (2011), overweight or obesity was associated with families purchasing at least one away from home dinner in the past week (OR of 1.2 and 2.6 respectively).

Bhutani et al. (2018) investigated associations between frequency of eating at fast-food and sit-down restaurants with BMI. Fast food restaurants were defined as chains like McDonalds, Pizza Hut, and Burger King. Their results showed an association where for each one meal per week increase in fast food consumption, BMI increased by 0.8 kg/m^2 (Bhutani et al., 2018). In the CARDIA study, eating one extra fast food meal per week was associated with changes in body weight (0.15 kg (95% CI, 0.06-0.24), p <0.001) and waist circumference (0.12 cm (95% CI, 0.04-0.20), p <0.001) 13 years later; an increase in frequency of three times a week was associated with a 0.45 kg weight gain (Duffey et al., 2009). Smith et al. (2009) showed consuming takeaway food twice a week or more was associated with higher prevalence of moderate abdominal obesity in both men and women in a cross-sectional study of young adults (aged 26-36). In their later study, consuming takeaway food at least twice a week was associated with cardio-metabolic risk factors in young women (Smith et al., 2012). In a US study of university employees (mean age 42 ± 12 years), Garza et al. (2016) found significant associations between fast food consumption and gender, education and BMI which ties in with the present study. Their findings suggested males ate fast food more frequently than women, fast food consumption was lowest in those who were higher educated and healthy weight respondents consumed fast food less frequently than participants living with overweight or obesity (Garza et al., 2016) although they found no association between fast food consumption and age, marital status, or household income (Garza et al., 2016).

Albalawi, Hambly and Speakman (2022) studied the association between different types of meals and body composition using a sample of 5,197 adults (aged 40 to 69 years) from the UK Biobank. Analysis was carried out using self-declared consumption of homemade meals and meals purchased from various sources over the previous 24 hours. Their results showed BMI and percent body fat (unadjusted and adjusted) were higher in participants who reported having eaten takeaway and/or a delivery meal the previous day (Albalawi, Hambly and Speakman, 2022). They also found that as BMI and precent body fat increased, the likelihood of the participants having eaten homecooked or home-prepared meals over the previous 24 hours decreased, suggesting that increased consumption of home cooked or home-prepared meals could have a positive impact on health (Albalawi, Hambly and Speakman, 2022).

The findings from the logistic regression in the present study are interesting as they show significant differences between consumers who are eating takeaway food less than once a month compared with consumers eating takeaway food once a month or more. The present study is cross-sectional in design so inferences about takeaway food causing obesity cannot be made however one can speculate that frequently consuming foods high in energy density, particularly high in fat and refined carbohydrates may lead to weight gain. Energy dense foods high in fat, sugar, refined carbohydrates can affect central reward systems, encourage overeating, induce insulin resistance and suppress satiety signals which may lead to weight gain (Drewnowski and Levine, 2003). Furthermore, these types of food tend to be more appealing, palatable, and less satiating than lower bulkier energy density foods (Drewnowski, 1998). Compared with normal weight consumers, frequent takeaway consumers who are overweight or obese may crave these types of food more. For instance, Roefs et al. (2019) found overweight participants (n = 57) reported more frequent food cravings for high-caloric high-palatable foods, particularly at non-eating moments than normal weight participants (n = 43) in their Dutch study of adults in their 20s to 40s.

The importance of these findings is that people are habitually used to eating a constant weight of food whilst only having a weak ability to comprehend its energy density (Jaworowska et al., 2013). This was shown by Bell and Rolls (2001) who examined the influence of energy density (low: 5.23 kJ/g or high: 7.32 kJ/g) on energy intake whilst varying fat content in meals to be similar to a typical American diet (25%, 35% and 45% of energy). Their results showed participants consumed 20% less energy daily when foods low in energy density were included in the diet compared with foods which were high in energy density (whilst maintaining palatability). Furthermore, even though participants were consuming 450 kcal less, there were only small differences in hunger and fullness ratings (Bell and Rolls, 2001). Each day, the participants also consumed similar volumes of food, but not weight, suggesting that food intake is influenced by cues related to volume as well as weight. The authors concluded that reducing a diets energy density could be a useful strategy for weight management due to the reduction in calories consumed whilst not experiencing major differences in hunger or fullness (Bell and Rolls, 2001).

3.8.1.4 Marital Status

A χ^2 test showed an association between marital status and frequency of takeaway consumption, with divorced or separated consumers eating takeaway food infrequently. These findings may partly be attributed due to the increase in the number of people living alone in the UK. Changes in family structures has led to an increase in the number of single or divorced people in mid life and older (Centre for Ageing Better, 2022). Logistic regression also showed marital status to be a significant predictor of takeaway frequency. When compared with single consumers, the unadjusted model showed a negative association between being divorced or separated and eating takeaway food once a month a more (OR 0.36, (95% CI 0.16, 0.82)) whilst the adjusted model found married consumers were 2.6 times more likely to eat takeaway food once a month or more (OR 2.6 (95% CI 1.23, 5.37)). When looking at the literature this is inconsistent with other findings, with previous research showing single respondents typically eat takeaway food more frequently and married consumers consume takeaway food less frequently. The Seattle Obesity Study found respondents living in single person households were significantly more likely to eat meals away from home (although eating out in this study included fast food places as well as restaurants, food stands, grocery stores and vending machines). Frequent consumption of these away from home foods were associated with lower-quality diets and higher food expenditures (Tiwari et al., 2017). Single participants were more likely to consume fast food compared with those living with a partner or spouse in the New Zealand survey by Smith et al. (2014). Whilst Dave et al. (2009) found respondents who were married/partnered (OR 0.514 (95% CI 0.356, 0.743)) or divorced / separated / widowed (OR 0.495 (95% CI 0.291, 0.844)) were 50% less likely to eat fast food than those who were single in their USA survey. In the Knowsley 2012/13 NHS Merseyside Lifestyle survey, single people were more likely to consume takeaway food than married people with a third of single people having a takeaway meal at least once a week (34%) compared to one in five married people (22%) (Jackson and Cornick, 2013).

One speculative reason for this might be because adults living alone are less interested in cooking for themselves, additionally adults who are divorced/separated may have less disposable income to spend on fast food, for instance, in the present study 70% of the participants were female. Furthermore, a high proportion of respondents who completed the questionnaire were married (57%), university educated (62%) and the average age was 40 which may be contributing factors as to why married consumers were found to eat takeaway food more frequently than single consumers, which contradicts findings mentioned previously. This study found no significant association for education which is in agreement with Smith et al. (2014) but not Van Der Horst, Brunner and Siegrist (2011) and no association was found for having or not having children.

This study is unique in that it focuses on takeaway food served by small independent takeaway outlets and not fast food; however, the findings are not dissimilar with results from fast food studies. Based on the evidence from the present study and other literature, one could speculate the profile of more frequent takeaway consumers would be younger adults (aged 18 to 34 years), male, single, married or in a partnership, with an elevated BMI. Infrequent takeaway consumers would be female, divorced or separated, have a BMI < 25 and be aged 35 years or above.

3.8.2 Objective 2

- Explore consumers reasons for purchasing takeaway food.

The most popular reasons for eating takeaway food were ‘for a change/treat’ (85%), ‘it’s easily available’ (73%) and ‘liking the taste’ (71%). Chi-square tests showed significant associations for five of the predictor reasons for consumption including frequent takeaway eaters being associated with “I do not like to prepare food” and “I am usually too busy to cook” (p <0.001). Associations were also found for males thinking takeaway food was “cheap / good value for money” (p <0.001) and for younger consumers thinking takeaway food was “convenient” or “easily available” (p <0.001).

Logistic regression showed the strongest predictors of eating takeaway food once a month or more were also “do not like to prepare food” and “usually too busy to cook”, with unadjusted odds ratios of 5.6 and 4.8 times respectively (Table 3.24). When each of the predictors were individually adjusted for age, sex and BMI, the adjusted odds showed consumers who were “too busy to cook” were four times more likely to eat takeaway food frequently and consumers who “like the taste” were twice as likely (Table 3.25). Other studies have shown “dislike of cooking” or “being too busy to cook” are associated with increased consumption of away from home foods. For instance, in the Swiss fast food and takeaway survey (n = 918), respondents who were male, younger (under 40), had fewer cooking skills or spent less time preparing meals (p <0.05) were more likely to consume fast food more than once a month (Van Der Horst, Brunner and Siegrist, 2011). Their findings were the same for takeaway food however education, income, and mental effort to prepare food were also significant. Middle educated respondents were less likely to eat takeaway food whereas respondents who perceived more mental effort towards cooking and those with higher incomes were more likely to eat takeaway food frequently (Van Der Horst, Brunner and Siegrist, 2011). Their definition of fast food was consumption of products from a fast-food company (takeaway and eating in such as Burger King, McDonalds) whereas takeaway food was defined as all foods consumed as takeaway (but excluding fast foods) and included similar meals to the present study such as pizzas, kebabs but also sandwiches which deviates a little from the present study. Dave et al. (2009) also found dislike of cooking and perceived convenience of fast food were significantly associated with frequency of fast-food consumption. In the eating out study by Bhutani et al. (2018), perceived lack of cooking skills was also associated with frequent fast food and sit-down meal consumption in the USA whilst in a large study of Australian adults, ‘eating on the run’ was a major predictor of takeaway consumption, as well as associations for ‘lesser love of cooking’ and ‘lower fitness consciousness’ (Mohr et al., 2007).

Time constraints have also been shown to be a factor for increased fast-food consumption. In a large cross-European study, time related barriers such as irregular working hours and busy lifestyle were associated with reduced consumption of vegetables and home cooked meals and increased consumption of fast food (Pinho et al., 2018). A study which explored out of home food eating in five European countries, determined fast food consumption by asking respondents “How many days each week do you eat out in a fast-food restaurant” (D'Addezio, 2014). In this study, participants who felt obesity was due to not having enough time to prepare healthy meals were 95% more likely to eat fast food whilst those who felt it was due to lack of willpower to exercise or eat healthily were 64% less likely to eat fast food (D'Addezio, 2014). In the present study, consumers who were “too busy to cook” were four times more likely to eat takeaway food frequently. These studies show time constraints and lack of cooking knowledge are key motivators for consuming fast food.

Three-quarters of consumers in the present study (73%) advised takeaway food was convenient (easily available) and this finding was similar to findings in the Takeaway for a Change study which took place in a socially deprived area on the Wirral. Three-quarters of respondents advised they ate takeaway food due to convenience and eating as a family was a key factor for doing so (Pulford, 2015). One reason for this could be due to a lack of confidence when preparing meals. The NDNS survey found lower-socioeconomic groups (and younger respondents) to be least likely to report confidence when preparing meals from ready-made or basic ingredients (Adams et al., 2015a). Women and respondents aged 35 and over were most likely to report confidence with cooking techniques (Adams et al., 2015a). Lack of cooking knowledge and time constraints were also demonstrated by Dunn et al. (2011) via a questionnaire survey (n = 404) carried out in Adelaide, Australia. Not knowing how to cook, busy lifestyles, long working hours and cravings for fast food were all influencing factors for fast food consumption. Motivators of eating fast food in their earlier telephone study included working long hours, eating alone and being unable to prepare meals (Dunn et al., 2008). Decisions to consume fast food were impacted by feeling exhausted, depressed, or experiencing cravings and participants also referred to feelings of guilt and regret after consuming fast food (*ibid*). In the present study, there was a very low response rated for “I do not know how to cook” (n = 13), so lack of cooking skills was not a large motivator for frequent takeaway consumption, however, consumers who were “too busy to cook” were four times more likely to eat takeaway food frequently and these consumers were significantly younger and heavier as were the consumers who “do not like to prepare food”. This corresponds with the previously mentioned motivators in other studies such as “lesser love of cooking” (Mohr et al., 2007), “dislike of cooking”, perceived convenience (Dave et al., 2009), busy lifestyles, working long hours and cravings for these types of food (Dunn et al., 2011). Whereas in the Cambridge Fenland Study, being female, older, not working overtime and higher socioeconomic status (measured by education and household income) were associated with more frequent home cooked food consumption (Mills et al., 2018). Furthermore, eating home cooked meals more frequently was associated with greater likelihood of normal range BMI and normal percentage body fat (Mills et al., 2017). These studies highlight the importance of teaching cooking skills in schools. Moreover, providing young people with practical knowledge and skills which may encourage them to adopt healthier eating practices (Caraher and Seeley, 2010). Policies which target working patterns may also be beneficial (Mills et al., 2018).

Taste and convenience have also been shown to be drivers for fast food and takeaway food consumption in other studies. Anderson et al. (2011) found respondents ate fast food at least once per month because they were quick and convenient (63.8%), followed by taste (16.4%), sociability (8.3%) and cost (6.1%). Rydell et al. (2008) studied reasons why people eat at fast food restaurants, the most popular reasons were quick (92%), easy to get to (80%) and taste (69%). In the present study, taste was a significant predictor with consumers twice as likely to eat takeaway food frequently if they liked the taste. Salt has been shown to promote passive overconsumption of dietary fat (Bolhuis et al., 2016) and Chapter 4 has shown high levels of salt and fat in takeaway food. Bolhuis et al. (2016) studied the effects of salt and fat on healthy adults (n = 48) who were asked to attend four lunchtime sessions after a standardized breakfast and consume a meal containing different combinations of salt and fat (low salt/low fat, low salt/high fat, high salt/low fat, high salt/high fat) in random order. Their results showed the high salt meals (~0.6 g salt per 100 g compared to ~0.1 g in the low-fat meals) increased food (p = 0.022) and energy intakes (p = 0.031) by 11%, independent of fat concentration. Moreover, pleasantness was increased by the addition of salt but not fat suggesting that salt stimulates the intake of savoury fatty foods and promotes the overconsumption of dietary fat (Bolhuis et al., 2016). Increasing dietary fat from 0.6 g per 100 g in the low-fat meals to 15.5 g per 100 g in the high fat meals did not influence food intake by weight but did result in a 60% higher energy intake (p <0.001) (Bolhuis et al., 2016). In a Canadian cross-sectional study which explored adherence to healthy eating guidelines (n = 1147, ages 18-65), men were shown to have a stronger liking for salty foods than women, furthermore liking salty foods was associated with lower consumption of fruit and vegetables, whole fruits, dark green and orange vegetables and whole grains and higher intakes of saturated fat and sodium (Carbonneau et al., 2021). These findings suggest liking salty foods is linked to a poorer diet quality overall and the consumption of less healthy foods, hence interventions which are designed to improve the healthiness of food habits for individuals, especially men, with a strong liking for salty foods are needed (Carbonneau et al., 2021).

The majority of these studies are based on fast food consumption rather than takeaway food consumption. This study is unique in that it focuses purely on food served by small independent takeaway outlets. The importance of this is that these kinds of takeaways do not come under the same regulations as larger fast-food chains, so are not required to display nutritional labelling. Furthermore, they are likely to be higher in calories, fat, salt, and sugar than food served by fast food chains and potentially more detrimental to health (Chapter 4).

3.8.3 Objectives 3 and 4

- Examine participants knowledge about the healthfulness of takeaway food
- Investigate participants receptiveness to takeaway food prepared in a healthier way

This study found better knowledge about the healthfulness of takeaway foods (health score) was associated with consumers who ate takeaway food less frequently, were university educated, younger, female, married or in a partnership. The findings suggested consumers with greater health scores consumed takeaway food less frequently than consumers with lower health scores. As regards changes to takeaway food (receptiveness score), the results showed a greater receptiveness to healthier takeaways was associated with more frequent takeaway consumption, heavier consumers and being female, suggesting that consumers who eat takeaway foods infrequently, men and lower weight consumers were less receptive. Additionally, frequent consumers were more receptive to nutritional labelling, smaller portion sizes and purchasing reformulated takeaway foods.

This study found women were more knowledgeable about takeaway food and more receptive to healthier takeaways which agrees with other studies which have shown women to be more interested in diet and nutrition than men. For instance, Hieke and Newman (2015) showed females made healthier choices than males when presented with nutrition label information on a fixed baseline (per 100 g or ml). Smith et al. (2014) found females made more healthier choices than males in their dietary recall survey, with women more likely to choose vegetables from fast food sources. Bates et al. (2009) showed gender differences exist in their study which provided calorie and nutrient information on away from home food. Females chose substantially fewer less-healthy items than males, furthermore, females purchase intentions were affected more strongly with the provision of calories (Bates et al., 2009). Other studies have also shown females score higher than males for nutrition knowledge (Yahia et al., 2016; Kalkan, 2019). Likewise, Ozgen (2017) used surveys to explore the nutrition knowledge and attitudes of students in both Turkey and the US (n = 1674, students aged 16-27). Female students were found to have significantly higher mean scores on both the nutritional attitude and nutritional knowledge scale when compared with males (Ozgen, 2017). In a US fast-food consumption survey, university students (n = 259) were asked whether “the nutritional content of food is important to me” (Morse and Driskell, 2009). The survey found significant differences for gender with more females than males agreeing to this statement (85% compared with 70%). Additionally, more females than males agreed with the statement “I order what I think to be my healthiest option”, 32% and 13% respectively (Morse and Driskell, 2009).

Hoefkens, Verbeke and Van Camp (2011) explored the perceived importance of nutrients and found significant interactions for gender, age, and health consciousness. Females had consistently higher mean importance scores compared to males (p <0.001), with the difference in mean being greater for energy, fat, SFA, salt, and sugars compared to fibre, vitamins/minerals (Hoefkens, Verbeke and Van Camp, 2011). They also found that perceived importance of these nutrients increased with increasing age and with level of health consciousness. Furthermore health consciousness was still significant after controlling for gender, indicating a stronger health consciousness in women than men (Hoefkens, Verbeke and Van Camp, 2011). Females were found to be significantly more health conscious than males in a study of university students in Pennsylvania, USA which examined differences between health consciousness and nutritional knowledge (Hwang and Cranage, 2010). Infrequent fast-food consumers (less than once a week) were significantly (*p* <0.05) more health conscious than frequent consumers (more than twice a week). Furthermore, females were significantly more health conscious than males when asked to what extent they consider nutrition, calories and fat content when choosing menu items from fast food restaurants (Hwang and Cranage, 2010).

A review of fast-food perceptions by Min et al. (2018) also found Americans in the USA were more likely to consume fast food less frequently if they had negative perceptions of fast food. These findings are consistent with the present study, where increasing health score was associated with eating takeaway food consumption less frequently. In the study by (Dave et al., 2009) fast food was perceived to be less unhealthful as the number of people in the household (p <0.01) and number of children (p <0.05) in the household increased. Conversely, in a nationally representative phone survey of 2,027 Americans, only 20% of respondents felt fast food was fairly good for you compared with 76% who felt fast food was not good for you. Despite these findings, 47% of respondents reported eating fast food weekly or more frequently (Dugan, 2013).

In respect to education, Miura, Giskes and Turrell (2012) showed lower educated groups consumed takeaway foods more frequently in a study of socioeconomic differences in takeaway food consumption. Participants were more likely to choose “less healthy” options such as potato chips, savoury pies, fried fish, fried chicken, and non-diet soft drinks compared with the higher educated groups (Miura, Giskes and Turrell, 2012). Their later study, which focused on the contribution of psychosocial factors, found significant associations between education, beliefs about diet-health relationships and nutritional knowledge (Miura and Turrell, 2014). Participants with lower levels of education (no vocational or post-school qualifications) were less likely to believe in the relationship between diet and health and were more likely to have lower nutritional knowledge *(Ibid)*. Furthermore, participants with lower nutritional knowledge were significantly more likely to consume “less healthy” takeaway food, as were the participants who perceived takeaway food as a pleasure or good value for money or whose belief in the diet-health relationship was weak (*Ibid*).

A prominent predictor of takeaway consumption in a large survey of Australians (n = 20,527) was a lack of concern of the link between diet and health (Mohr et al., 2007). Furthermore, Schröder, Fito and Covas (2007) showed frequent fast-food consumption was associated with low adherence to a Mediterranean diet (OR 4.3 (95% CI 1.8, 10.0)) and healthy eating diet (OR 3.9 (95% CI 1.7, 9.0)). Their study also showed frequent fast-food consumption was inversely associated with diet quality, exceeding recommended energy intakes, and directly related to increased risk of obesity (Schröder, Fito and Covas, 2007). Similarly, in a study which examined dietary patterns of takeaway food consumers in the Northwest of England (such as Chinese, Indian, kebabs), three distinct dietary patterns were revealed. The ‘Convenience’ dietary pattern consisted of a habitual unhealthy diet which included foods such as refined grains, cakes, pastry and crisps as well as takeaway food (Janssen et al., 2018). Likewise, Anderson et al. (2011) found regular fast food consumers were associated with engaging in lower levels of physical activity and eating fruit and vegetables less frequently. Furthermore, Zagorsky and Smith (2017) found adults who checked ingredients (“always”/ “often”) when buying a food for the first time, ate fast food less frequently (16-23% fewer); however, checking of nutrition labels and frequency of fast-food consumption was not significant. They also found less interest in health, less leisure time and greater access to fast food was associated with more frequent consumption of fast food (Zagorsky and Smith, 2017). In the US fast-food study, Morse and Driskell (2009) found low intakes of fruit and vegetables in students with more than half of the students agreeing they were “not eating enough fruit and vegetables” and up to a third agreeing that their diets included too much fat, SFA and TFA. Low intakes of fruit and vegetables have been shown in adult populations in the UK and elsewhere. In the Australian Diabetes, Obesity, and Lifestyle Study (AusDiab), fruit and vegetable intake were assessed using a food frequency questionnaire over 3 time periods (1999/00 (baseline), 2004/05, and 2011/12; n = 8,966) (Hill et al., 2020). Participants with adequate fruit and vegetable knowledge were more likely to be female, younger, non-smokers, married, more educated and engage in regular physical activity (*Ibid*). Furthermore, they ate more fruit and vegetables than participants with inadequate knowledge, however, consumption of fruit and vegetables was lower than the recommended dietary guidelines for the whole cohort (*Ibid*).

Low intakes of fruit and vegetables have also been shown in analysis of three waves (collected between 2010 and 2017) of the UK Household Longitudinal Survey by Ocean, Howley and Ensor (2019). Their study found women ate significantly more fruit and vegetables than males, however they interpreted this with caution, advising this could be interpreted as women actually eating more fruit and vegetables than men or that women could be over reporting their consumption due to social desirability, which is usually found to be higher in women than men (Ocean, Howley and Ensor, 2019). An interesting finding from this study was that fruit and vegetable consumption was associated with a dose response relationship with mental well-being, and this was seen with the number of portions eaten as well as the number of days in a week an individual eats fruits or vegetables (Ocean, Howley and Ensor, 2019) suggesting strategies to improve public health should focus on increasing fruit and vegetable consumption. Furthermore, if takeaway consumers were assisted in reducing takeaway food consumption whilst increasing their consumption of fruit, vegetables, and home cooked meals, this could have a positive effect on their health and well-being.

In the present study, information about fruit and vegetable intake is not available however frequent consumption of takeaway food (unhealthy food) was found to be associated with greater receptiveness to healthier takeaways, perhaps because these individuals do not wish to reduce their takeaway consumption, and reformulating takeaway food to make it healthier will help justify their food choice and allow them to feel less guilt about eating it (Blow et al., 2019b). Pinho et al. (2018) explored perceived barriers to healthy eating and dietary behaviours in a large cross-European study (n = 5900). All eight barriers to healthy eating (derived from a previous attitudinal survey) were positively and significantly associated with fast food consumption. Respondents were twice as likely to consume fast food at least twice a week if they reported irregular working hours, busy lifestyles, lack of willpower or found healthy foods unappealing compared with respondents who did not report these barriers (Pinho et al., 2018). Respondents were also 50% less likely to consume home cooked meals if they reported irregular working hours, lack of willpower or busy lifestyles (Pinho et al., 2018). Furthermore, lack of willpower was the strongest barrier to healthy eating, with respondents who reported this barrier having the lowest odds of consuming high levels of home cooked meals, fruit, vegetables, or fish (Pinho et al., 2018). Their findings are interesting as the barriers were more pronounced for younger participants and women, compared to the present study where younger participants and women were associated with higher scores regarding knowledge about how unhealthy takeaway food is and frequent consumers, heavier consumers and women were more receptive to healthier takeaways.

Preparing a healthy meal in the home involves several factors, such as meal planning and food shopping to ensure the ingredients are available, cooking skills, time, and physical effort to prepare the food, all of which could contribute to the barriers mentioned previously by Pinho et al. (2018). For instance, Begley et al. (2019) determined three different food literacy behaviours from a survey of participants aged 18 and over on the Food Sensations for Adults programme (n = 1626) in Western Australia. Compared with participants who can cook almost anything, participants with low scores in the “plan and manage” and “low preparation” groups were 8 times and 14 times respectively more likely to report they cannot or do not cook. Participants in the plan and manage group were also less likely to be responsible for shopping, report lower intakes of fruit and vegetables and were more than five times more likely to consume fast food three times or more times per week (Begley et al., 2019). The low preparation group also reported lower intakes of fruit and vegetables, were twice as likely to have no responsibility for meal choice and preparation and were four times more likely to consume fast food three or more times per week. They were also three times more likely to answer, ‘not sure’ and twice as likely to ‘agree’ that healthy food costs more than unhealthy food (Begley et al., 2019). Findings from the Food Sensations study suggest that food literacy programmes that aim to improve behaviours to achieve diet quality should focus on recruiting participants who feel that healthy foods are expensive, have low self-rated cooking skills, consume low quantities of fruit and vegetables and high intakes of fast food and sugar sweetened beverages (Begley et al., 2019).

Although consumers are often aware of the negative effect takeaway meals can have on their health it does not necessarily deter them from purchasing them or motivate them to remove them completely from their diet. In their study of the determinants of fast-food consumption, Dunn et al. (2011) showed that participants with a good level of nutritional knowledge did not completely remove fast food from their diet. Furthermore, obesogenic environments can make it difficult for consumers to withstand the temptation and opportunities they provide (Pinho et al., 2018). The complexity of sociocultural influences on decisions around food choice and takeaway food consumption were also shown by Blow et al. (2019b) in a study which took place in a low-socioeconomic ward in Manchester, England. Participants who valued healthy eating exhibited damage limitation behaviours when it came to takeaway consumption (Blow et al., 2019b). For example, if they or a family member really desired a takeaway, the participant rationalised their behaviour by trying to choose healthier meals, ordering less food to share between them or trying to limit the amount they will eat by ordering smaller portions (Blow et al., 2019b).

One way to reduce the effects of fast-food consumption is to reduce portion sizes. This was successfully shown in a study in North Carolina, USA when customers were ordering lunch in a Chinese fast-food restaurant located on a university campus (Schwartz et al., 2012). When ordering one of three different side dishes containing 400 calories or more, customers were asked if they wanted to downsize the portion which would result in a reduction of approximately 200 calories. Their results showed that one third of the customers accepted the offer and that these customers did not compensate for the reduction by ordering a higher calorie main dish. The study also showed that purchasing fewer calories did not impact on the amount of food left uneaten, meaning the calories saved during purchase continued to be saved at consumption (Schwartz et al., 2012).

Another part of the study involved the provision of calorie labelling however this did not increase the number of customers who accepted the offer. On the contrary it seemed to be less effective as only 14% downsized their portion when calorie labelling was provided compared to 21% when it was not (Schwartz et al., 2012). The findings from this US study show that it is possible to reduce portion sizes served by a takeaway outlet which are acceptable to the consumer, although the research was carried out in a Chinese fast-food restaurant on a university campus and not in a deprived area.

Nevertheless, a project carried out in Merseyside has shown that people living in a deprived area can be receptive to healthier takeaways. In the "Takeaway for a Change" project which was carried out in a highly deprived area on the Wirral, the majority of participants (97%) advised they would try healthier takeaway food. Of the initial cohort who completed the follow up survey, 93% of adults and 86% of children said they enjoyed the healthier option, and 39% said that more vegetables and less grease and salt enhanced the flavour (Pulford, 2015). The most popular healthy option choices chosen by the participants were Chinese meals (78%), kebabs and pizza (22%) and chips as a side (20%). More than half of the participants (59%) were able to differentiate between the original and the healthy option, with 87% of these participants preferring the changes. Of the 41% who could not taste the difference, 94% advised it would be healthier for them so felt this was a good thing. Only 10% said they would not choose the healthy option based on the meal consumed (Pulford, 2015). The findings from "Takeaway for a Change" are promising however larger studies with a more representative sample of socioeconomic status are needed.

These findings may not be generalisable due to differences in dietary intake and eating patterns in different countries, however these findings suggest that interventions which support independent takeaway outlets to serve smaller portion sizes or produce healthier takeaway meals could be an effective public health measure. Additionally, areas of health promotion could target improving knowledge about nutrition, diet, and health (Miura and Turrell, 2014), promoting healthier dietary practices such as increasing fruit and vegetable intake, reducing takeaway consumption and barriers to preparing meals in the home.

3.9 Strengths and Limitations

A strength of this study is that it provides insight into takeaway food consumption among adults in Merseyside. The questionnaire assessed the consumption of popular takeaway food items such as Chinese meals, Indian meals, fish and chips, kebabs and pizzas typically purchased from small independent takeaway outlets rather than food purchased from fast food chains. This study found 22% of respondents ate takeaway food once or twice a week or more which has been associated with increased rick of NCDs (obesity, type 2 diabetes, hypertension) in other studies (Duffey et al., 2009; Smith et al., 2009; Smith et al., 2012). As shown in studies of fast-food consumption, frequency of takeaway consumption was associated with sex, age and BMI and logistic regression showed age and BMI were significant predictors of takeaway consumption. The study was able to link more frequent takeaway consumption with males, younger adults, and heavier adults. Furthermore, main predictors for takeaway consumption were being too busy to cook and liking the taste, which is consistent with other studies. This study also showed frequent takeaway consumers, heavier consumers, and females were the most receptive to healthier takeaways which will be useful when designing public health interventions. Insight gained from this questionnaire could lead to interventions, such as takeaway trials with a focus on takeaway consumers who are male, heavier or are too busy to cook, providing them with healthier takeaways to investigate the effects on health.

There were several limitations to this study. Firstly, it was a cross-sectional study capturing dietary habits and attitudes to takeaway food in Merseyside, so may not be representative of other areas. The generalisability of the findings may also be limited due to the high proportion of respondents who had attended university or were in full time employment. There was a disproportionate number of single respondents compared with married/partnered respondents and also female respondents compared with males (70% compared to 30%), future studies should consider how to increase male participation. Future studies of longitudinal design would be more informative. Participants were also recruited via convenience sampling and snowball sampling due to time and budget constraints. The survey was also limited to participants aged 18 or over and children and adolescents were excluded.

The results are based on respondents self-reported answers which might be subject to recall bias or social desirability bias. With recall bias, respondents may not accurately recall their food intake. There are several ways to overcome recall bias and obtain more accurate results including the use of 24-hour dietary recalls, food diaries taken over a number of days or validated food frequency questionnaires (FFQs) which measure eating habits of individuals throughout the year (Gunes et al., 2015). However, food diaries are burdensome to the participants (Satija et al., 2015) and a simple self-administered questionnaire allows the researcher to be absent when the survey is completed and allows the respondents to complete the survey anonymously and at their own convenience. Nevertheless, respondents may have under reported the frequency they consumed takeaway food. Furthermore, this survey explicitly requested they only advise about takeaway food from independent takeaway outlets, so consumption of fast food from chains is unknown. It is possible that as well as consuming takeaway food, respondents also consume fast food frequently which would increase their consumption of unhealthy food and risk of obesity, hypertension and other NCDs.

With social desirability bias, respondents can have strong emotional associations with food causing them to underreport socially undesirable activities and overreport socially desirable ones. Respondents may regard takeaway food as being unhealthy and therefore under-report their consumption (Hebert et al., 1997). Evaluation of the European Prospective Investigation into Cancer and Nutrition (EPIC) study showed participants living with overweight or obesity were significantly more likely to underestimate energy intake, and women were more likely to underreport than men (OR 4.8 (95% CI 4.11, 5.61) compared with OR 3.5 (95% CI 2.91, 4.26)) (Ferrari et al., 2002). Hence underreporting of takeaway consumption may have occurred due to the high percentage of female respondents. Furthermore, underreporting dietary intake has been associated with respondents with negative body image and higher body fat percentage for both males and females, with females being twice as likely to underreport if they have negative body image when adjusting for age, body fat percentage and physical activity level (Kanellakis et al., 2021). Women with lower incomes, higher BMI, social desirability score and body dissatisfaction score were also more likely to be under-reporters in a study which examined women's energy intake using doubly labelled water (Scagliusi et al., 2009). In the present study, there was a significant association (p = 0.013) between being educated to a lower level (school or college rather than university) and being overweight or obese, respondents were able to complete the questionnaire online and anonymously which may have helped to decrease social desirability bias (Grimm, 2010).

The questionnaire asked participants to self-report their weight and height which means the calculated BMI is subject to bias and error. A number of studies such as (Bolton-Smith et al., 2000; Nikolaou, Hankey and Lean, 2017; Lipsky et al., 2019) have shown adults are likely to underreport self-reported weight and overreport height although this varies depending on the population being studied (Connor Gorber et al., 2007). In their study of emerging adults, Lipsky et al. (2019) found BMI was underestimated by 0.5 to 1 kg/m^2, participants living with overweight or obesity were more likely to underreport weight and overreport height compared with normal weight participants, and males did more height overreporting than females but less weight underreporting. This is dissimilar to a study of Scottish adults aged 25 to 64 years, which found males and females underreported both their height and weight (Bolton-Smith et al., 2000).

A large proportion (two-thirds) of the respondents in the present study were attending or had attended university compared with a third who were school, or college educated, suggesting lower educated groups were underrepresented. Furthermore, there is no information available on the non-responders who are more likely to be from disadvantaged groups, have unhealthy behaviours (Tolonen et al., 2005) and lower socioeconomic status (Scagliusi et al., 2009) which could have affected the results. When examining the difference between respondents and non-respondents across 27 populations, Tolonen et al. (2005) found certain demographic groups were more likely to be non-responders, particularly those who were young, single, less educated with poorer lifestyles and health profiles. In the present study, lower educated and single consumers were underrepresented which could be why married participants were more likely to frequently consume takeaway food than single consumers and why no difference was found between takeaway consumption and school/college, or university educated participants. Although a significant association was found between school/college educated and participants who were living with overweight or obesity.

As this study was cross-sectional in design, takeaway frequency and weight/height were only recorded at one time point so causal interpretations cannot be made as to whether takeaway food consumption is contributing towards weight gain or whether other unhealthy lifestyle factors are responsible (Rosenheck, 2008). If this study were repeated, questions about income, socioeconomic status, dietary behaviour (including separate questions for takeaway and fast-food consumption), and other lifestyle choices (for example smoking status, alcohol consumption, levels of physical activity, time spent watching television) would be merited to limit confounding. Future studies of longitudinal design which involve repeated measures of takeaway consumption and weight may also be informative.

3.10 Conclusions

Takeaway food was a popular meal choice, with younger, heavier, or married consumers being more likely to consume takeaway food frequently. The main reasons for consumption were being too busy to cook and liking the taste. Having good knowledge about takeaway food being unhealthy was associated with less frequent takeaway consumption, females, being married, younger or university educated. Consumers who were more receptive to reformulated takeaways were more likely to be frequent consumers, female or living with overweight or obesity. These results show that consumers are interested in eating takeaway meals prepared in a healthier way. Covert interventions (where takeaways are reformulated without the consumers knowledge) may be useful when targeting men and less frequent consumers whereas overt interventions (signposting healthier meals or promoting smaller portion sizes) may be aimed at frequent consumers, heavier consumers, or women. Reasons for consuming takeaway food are complicated and consumption is unlikely to decrease due to easy-to-use apps and companies like Just Eat, Uber Eats and Deliveroo making it even more convenient with takeaway delivery. With consumers unlikely to reduce consumption, it is essential that takeaway outlets are motivated and supported to produce healthier takeaway food. Even small reductions in energy, fat, salt, or sugar have the potential to improve health and would link in with existing reformulation strategies in the food production sector.

Chapter 4

Nutritional Composition

4 Nutritional Composition

4.1 Introduction

Local Authority's Trading Standards teams are legally required to visit food premises such as cafes, restaurants and FFOs (Food Standards Agency, 2020a). Trading Standards ensure correct provision of allergen information, assess levels of food hygiene, collect food samples for microbiological analysis (to ensure it is safe to eat or as advertised) and composition analysis (to determine the veracity of menu descriptions or nutritional information) (Food Standards Agency, 2020a). Once collected, Trading Standards sends the food samples to an accredited public analyst laboratory (PAL) for analysis. Trading Standards may request (but are not limited to), the analysis of calories, fat, SFA, TFA, carbohydrates, protein, salt, or sugar content to determine the nutritional composition of the sample.

Some councils have investigated the nutritional composition of food sold by small independent takeaway outlets in their region. The nutritional analysis of 494 samples of donner kebabs collected by 76 individual councils was combined into one report by the Local Authority Coordinators of Regulatory Services (LACORS, 2009). Results found portion size and calorie content of donner kebabs varied considerably (120 to 677 g and 365 to 1990 kcals respectively). The report also found high levels of fat, SFA and salt, for example the average salt content was 5.9 g, roughly the daily recommended level for an adult (6 g) in one meal (SACN, 2003; LACORS, 2009). North Yorkshire County Council purchased 25 meals from takeaways in North Yorkshire for analysis. British, Middle Eastern, Indian, and Chinese meals were included in the selection taken from the standard menu descriptions on display (Hudson, 2007). If there was a choice of size and meals then medium or regular sized items were purchased, meals were submitted to PAL with no added condiments, or items such as extra salt (*Ibid*). The results showed that almost all the meals contained 50% or more of the GDA for energy (calories) (n = 17), fat (n = 19), TFA (n = 6) or salt (n = 10) (*Ibid*).

In Antrim, Northern Ireland, the Healthier takeaways project analysed fish and chip meals from 9 different takeaways. In some cases, meals contained 100% or more of the GDA for fat and SFA, some meals were high in TFA and all were high in salt, some containing almost 5 g (Antrim Borough Council, 2009). Goffe et al. (2016) analysed the salt content in portions of fish and chips purchased from fish and chip shops in Northern England. A distinction was made between salt added at the counter using saltshakers with a different number of holes. The study involved analysing sodium content in meals purchased from

61 fish and chip shops (29 takeaways using 5-hole saltshakers (5HSS) and 32 takeaways using 17-hole saltshakers (17HSS)). Analysis found the relative sodium content was significantly lower (22% or 40 mg per 100 g) in meals purchased from takeaways using 5HSS compared with 17HSS (Goffe et al., 2016). For chips only, 5HSS portions contained 32% less sodium (42 mg per 100 g). This shows how a simple change in practice can reduce sodium content of fish and chip meals served in takeaways.

Trading Standards South East investigated the nutritional composition of fast food and simpler eating out options from catering establishments in West-Sussex (Brown, 2007). The project involved purchasing Indian and Chinese takeaway foods, as well as fish and chips and traditional pub food. These samples were analysed for salt, fat, and SFA content. The results showed large portion sizes as well as high levels of salt, fat and SFA in a large number of English, Chinese and Indian meals (Brown, 2007). On average, the takeaway meals contained 69.4 g of fat and 9.1 g of salt per portion, equivalent to an adult's total daily reference intake of fat (70 g) and one and a half times the recommended daily amount of salt for an adult (6 g) (Department of Health, 2016). Due to large portion sizes, pub food and fish and chips also contained enough fat to provide all of an adult's recommended daily intake and just under a day's intake of salt (Brown, 2007).

In Glasgow city, a study of SFA and TFA was carried out based on areas of deprivation in Scotland. Donner kebabs and popular deep fried items were collected from 52 takeaway outlets (Food Standards Agency, 2014b). Takeaway outlets included fish and chip shops, Chinese/Oriental takeaways, Indian takeaways, Kebab shops and Pizza shops. Findings from the study showed overall levels of TFA in the deep-fried food samples were low (full meals averaged 1.5 g per portion); however, donner kebabs contained higher levels with an average content of 3.7 g TFA per portion. The high levels of TFA in the donner kebabs could partially be due to the naturally occurring TFA that occurs in lamb meat (Food Standards Agency, 2014b). However, high intakes of TFA have been associated with an increased risk of CHD and CVD due to their adverse impact on serum lipids and lipoproteins (de Souza et al., 2015). Levels of SFA were also very high in donner kebabs, with an average content of 29.7 g per portion and ranged considerably from 14.6 g to 71.4 g per portion (Food Standards Agency, 2014b).

*Safe*food has carried out several surveys on different types of takeaway foods in the Republic of Ireland and Northern Ireland. *Safe*food was set up under the British-Irish Agreement Act 1999 and promotes awareness and knowledge of food safety and nutrition on the island of Ireland (IOI) (*safe*food, 2021). For the Chinese meals survey, 220 Chinese meals samples were purchased in duplicate from 35 takeaway outlets on the IOI (*safe*food, 2012b). The Indian meals survey purchased 280 Indian food samples in duplicate from 36 takeaway outlets across 12 locations on the IOI (*safe*food, 2015). Duplicate samples were purchased, with one sample analysed for energy and the other for fat, SFA, protein, and salt content (*safe*food, 2012b; *safe*food, 2015). Both surveys found wide variations in portion sizes for the same meal, for example sweet and sour chicken weighed between 378 and 735 g (*safe*food, 2012b; *safe*food, 2015). The Chinese meals survey also found high salt content in beef curry and king prawn satay meals, with both providing more than 100% of the adult GDA (*safe*food, 2012b). In the Indian meal survey, chicken tikka masala and chicken jalfrezi both contained more that 75% of the adult GDA for salt (*safe*food, 2015).

For the 'Local Authorities Food Standards Survey 14', the Local Government Group (2011) coordinated 30 local councils in 7 different regions throughout England and Northern Ireland to collect food samples from Indian, Chinese, and Asian food businesses. In total, 409 samples of chicken tikka masala with pilau rice and sweet and sour chicken with fried rice were chosen for the detailed survey (*Ibid*). Results showed a significant variation in the composition of the meals between food businesses, for example, the average chicken tikka meal provided 60 g of fat (85% of the GDA for a woman) and the average sweet and sour meal provided 45 g of fat (*Ibid*). The tikka masala meals contained high levels of SFA, in addition both tikka meals and sweet and sour meals contained high levels of salt. Another cause for concern was the high levels of sugar found in the sweet and sour chicken meals with an average portion containing 67.7 g of sugar (*Ibid*).

In the West Midlands, Sandwell has high levels of deprivation, limited transport options and a high proliferation of hot food takeaways. Sandwell is considered to be a 'food swamp' due to the large density of establishments selling readily available, cheap, energy dense food, whilst simultaneously providing a 'food desert' due to the limited access to fresh fruit and vegetables (Saunders, Saunders and Middleton, 2015). For this reason, Sandwell PCT commissioned the purchase of 252 takeaway food items during 2013-2014 (*Ibid*). The items were purchased informally so the proprietors were unaware the samples were being sent for testing. Samples included 47 portions of fried rice, 36 portions of fries, 34 fish, 28 pizzas, 25 sweet and sour chicken, 23 lamb jalfrezis and 14 donner kebabs. Analysis of the samples found high levels of fat, SFA, and salt with 81% containing more than 50% of the GDA for SFA (*Ibid*).

These studies provide evidence that when compared with UK dietary guidelines, takeaway food can have a poor nutritional composition. This investigation of takeaway food could add to the evidence base to support the development of informed strategies to encourage consumers to make healthier choices as well as support independent takeaways improve the nutritional composition of the meals they serve. As discussed earlier (chapter 2, section 2.5), frequent consumption of takeaway food can lead to increased risk of NCDs such as obesity, hypertension, T2D and other health related problems (Smith et al., 2009; Smith et al., 2012). Furthermore, these studies show a lack of research carried out in the Merseyside region, hence the motivation for the focus of the present study. At the time of this research starting, no detailed nutritional analysis of takeaway food served by independent takeaway outlets in the Merseyside area existed. Since then, we have published three papers on the nutritional composition of takeaway food. Analysis of the data on salt from Liverpool and Wirral only (Jaworowska et al., 2012), nutritional composition data (Jaworowska et al., 2014) and SFA and TFA data (Davies et al., 2016). Part of this chapter includes some of these results in addition to analysis of other nutrients. This chapter also includes additional analysis of the data, such as comparison with UK dietary reference values and exploring the effect takeaway meals have on energy and macronutrient intake.

4.2 Aim and Objectives of the Present Study

4.2.1 Aim

To determine the nutritional composition of a sample of takeaway meals prepared at independent takeaways in Liverpool, Knowsley, and the Wirral, using PAL results provided by Local Councils Trading Standards teams.

4.2.2 Objectives

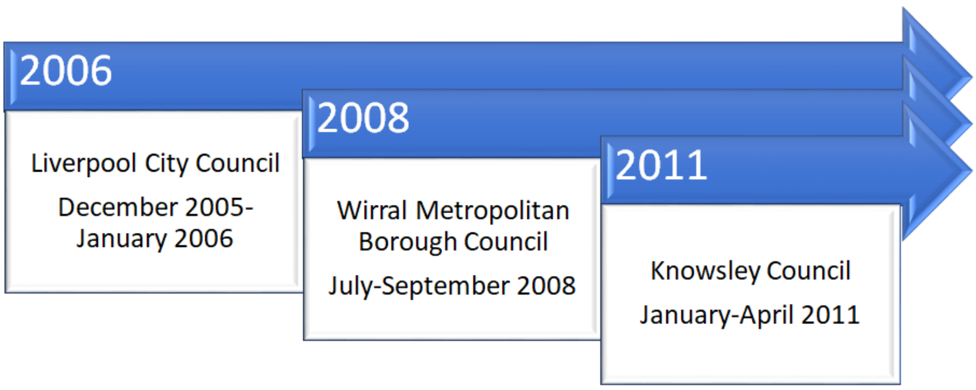
1) Determine the nutritional composition (per serving and per 100 g) of takeaway meals across various takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs) with a focus on energy, total fat, SFA, TFA, salt and sugar.
2) Compare the nutritional profile of takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs) with UK daily nutritional guidelines for adults aged 19 to 50.
3) Explore the effect of additional takeaway meals or replacing regular meals with takeaway meals on energy, salt, and macronutrient intake (where an average meal is 30% of the UK daily guidelines).

4.3 Methods

4.3.1 Collection of takeaway meals

As part of their ongoing project work to investigate the nutritional quality of foods in their area, the Trading Standards teams of Liverpool City, Wirral Metropolitan Borough, and Knowsley Councils collected takeaway meals (food samples) from small independent takeaways. The meals were collected in 2006, 2008 and 2011 respectively. For this study, a takeaway meal was defined as food purchased from out of home food outlets or ordered for home delivery, which was ready for immediate consumption and not eaten in outlets. The takeaway meals were collected from a random sample of takeaway outlets: 140 on the Wirral, 75 from Liverpool and 59 from Knowsley (n = 274). All meals were frozen immediately after collection and stored frozen at –18◦C until sent for analysis at an accredited public analyst laboratory. The types of meals purchased were chosen by the Trading Standards team and were based on them being popular takeaway meals in the UK at the time (Mintel, 2005; Mintel, 2006a; Mintel, 2006b). The takeaway meals were classified into five meal categories according to their origin: *Chinese, Indian, English, Pizzas,* and *Kebabs*.

4.3.1.1 Trading Standards Takeaway Meal Collection and Analysis by PAL



Liverpool City Council

In 2006, LCC Trading Standards collected fifteen different types of takeaway meals from a selection of takeaway outlets in Liverpool. In total, each meal was purchased in singlet approximately twenty times (n = 293), each time from a different takeaway outlet, with no repeat measures from the same takeaway (Table 4.1).

Wirral Metropolitan Borough Council

Similarly, in 2008, Wirral Metropolitan Borough Trading Standards collected thirteen different types of takeaway meals from a selection of takeaway outlets located on the Wirral. Each meal was purchased a minimum of ten times (n = 150) from a different takeaway outlet (Table 4.1).

Knowsley Council

In 2011, Knowsley Council Trading Standards collected eight different types of takeaway meals (n = 68) and four different takeaway meals (main component only) without rice or chips (n = 46) within the Knowsley borough (n = 114 in total; Table 4.1).

Table 4.1 Number of takeaway meals collected by each local council

	Region/Location			
Cuisine	**Liverpool**	**Wirral**	**Knowsley**	**Total**
Chinese	64	60	61	185
Indian	65	30	6	101
English	65	30	24	119
Pizzas	34	20	11	65
Kebabs	65	10	12	87
Total	293	150	114	557

In total, twenty-eight different types of complete takeaway meals (Table 4.3) (n = 511) and four different types of takeaway meals (main component, no rice or chips, n = 46) were collected (Table 4.2).

Table 4.2 Number of takeaway meals (main component only) collected by each local council

<table>
<tr><th rowspan="2">Cuisine</th><th rowspan="2">Takeaway Meal
(No rice or chips)</th><th colspan="3">Region/Location</th><th rowspan="2">Total</th></tr>
<tr><th>Liverpool</th><th>Wirral</th><th>Knowsley</th></tr>
<tr><td rowspan="2">Chinese</td><td>Beef, green peppers and blackbean sauce</td><td>0</td><td>0</td><td>12</td><td>12</td></tr>
<tr><td>Sweet and sour chicken</td><td>0</td><td>0</td><td>28</td><td>28</td></tr>
<tr><td rowspan="2">Indian</td><td>Chicken tikka massalla</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Lamb rogan josh</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td></td><td>Total</td><td>0</td><td>0</td><td>46</td><td>46</td></tr>
</table>

Table 4.3 Number of takeaway meals collected by each local council, by type of cuisine

Cuisine	Takeaway Meal	Region/Location			Total
		Liverpool	Wirral	Knowsley	
Chinese	Beef, green peppers and blackbean sauce with fried rice	21	10	0	31
	Prawn chow mein	21	0	0	21
	Sweet and sour chicken with boiled rice	0	10	0	10
	Char siu chow mein	0	10	0	10
	Chicken satay with fried rice	0	10	0	10
	Kung po king prawns with boiled rice	0	10	0	10
	Special fried rice	0	10	11	21
	Chicken chow mein	0	0	10	10
	Sweet and sour chicken with chips	22	0	0	22
Indian	Lamb bhuna with chips	22	0	0	22
	King prawn rogan josh with pilau rice	22	0	0	22
	Chicken tikka massalla with keema rice	21	0	0	21
	Lamb rogan josh with pilau rice	0	10	0	10
	Chicken korma with pilau rice	0	10	0	10
	Vegetable biryani	0	10	0	10
English	Fish and chips	22	30	12	64
	Chicken and chips	22	0	3	25
	Mushroom omelette and chips	21	0	0	21
	Chips and curry sauce	0	0	9	9
Pizza	Pepperoni pizza	11	0	1	12
	Seafood pizza	11	0	0	11
	Margherita pizza	12	0	0	12
	Ham and pineapple pizza	0	10	0	10
	Meat pizza	0	10	10	20
Kebab	Donner kebab	0	0	12	12
	Donner kebab and chips	22	10	0	32
	Chicken kebab	22	0	0	22
	Shish kebab	21	0	0	21
	Total	293	150	68	511

4.3.2 Nutritional Analysis

Analysis was carried out at Public Analyst Scientific Services Limited (Wolverhampton) for Knowsley Council, and by Eurofins Laboratories Ltd., Chester, UK for Wirral Metropolitan Borough Council and Eurofins Laboratories Ltd., Birkenhead, Wirral, UK for LCC. Upon receipt by PAL the meal samples were weighed to determine the portion size and then homogenized in a blender to enable nutritional analysis to be carried out. For each meal sample, the following information was determined (per 100 g and total weight): energy content (kJ and kcal), protein, carbohydrates, total fat, SFA, sodium and/or salt. Total sugar (n = 399) was also determined for Liverpool (n = 286) and Knowsley councils (n = 113). TFAs (n = 264) were also assessed for Knowsley and Wirral Metropolitan Borough councils (n = 114 and n = 150 respectively).

The following methods were used by PAL to determine the nutritional composition of the meal samples:

Energy

Atwater energy equivalents were used to calculate the energy value of analysed meals (Atwater and Woods, 1896). The energy values are 17 kJ/g (4.0 kcal/g) for carbohydrates, 17 kJ/g (4.0 kcal/g) for protein and 37 kJ/g (9.0 kcal/g) for fat (Food and Agriculture Organization of the United Nations, 2003).

Protein

Protein was calculated by determining the amount of nitrogen in the sample and then multiplying by a nitrogen conversion factor of 6.25. Nitrogen was calculated using the Dumas thermal combustion method which converts nitrogen in the sample to nitrogen oxide as a result of high temperature combustion at 800-1000°C (Jung et al., 2003). The organic sample is burned at a high temperature in an oxygen/carbon dioxide (CO_2) atmosphere. The residual oxygen and gases other than CO_2 and nitrogen gas (N_2) are removed and the resulting N_2 is then measured by thermal conductivity (Möller, 2010). The Dumas method is a relatively safe procedure as it avoids the use of corrosive and hazardous chemicals, it also takes less than 5 minutes per sample and can be semi-automated (Jung et al., 2003).

Fat

Total fat content was determined with the Weibull–Berntrop gravimetric method according to British Standards 4401-4 (British Standards Institution, 1970) using a rapid fat extraction method (Gerhardt Soxtherm). The samples were broken down with boiling hydrochloric acid to free the fat then cooled, filtered, and dried. The fat was then extracted from the filtered residue with petroleum ether, the solvent removed and the remaining substances weighed (James, 1995). SFA and TFA were determined by gas-liquid chromatography (GLC) using a capillary column and flame ionisation detector (British Standards Institution, 1990). The free fatty acids (FFA) were separated from other fatty-acid components, derivatized to form volatile derivatives (converted to fatty acid methyl esters) and then analysed by GLC (Tserng et al., 1981). Identification of the fatty acid peaks was made by comparing their GLC retention times with known methyl fatty acid standards (Tserng et al., 1981).

Carbohydrates

Available carbohydrates were calculated by difference, so equivalent to subtracting total moisture, ash, fat and protein, where all values are in g per 100 g. Moisture content was determined by mixing a sample thoroughly with sand and water which was then pre-dried by placing on a boiling water bath and then dried out by placing in a drying oven at 102 ± 2°C, based on BS 4401-3 (British Standards Institution, 1997). Ash content was measured by incinerating a sample at 525 ± 25°C and then weighing the mass of the residue.

Sugars

Total sugars were extracted with aqueous ethanol, the solution was clarified, and sugars determined, before acid inversion for reducing sugars, and after acid inversion for total sugars, by the reducing action of glucose on copper (II). The unused copper (II) was reacted with iodide to liberate iodine. The amount of iodine and hence the amount of sugar was determined by titration with thiosulphate ((EC) No. 152/2009)) (European Commission, 2009).

Salt

To determine sodium, samples were first dry ashed to destroy organic material. Then nitric acid was used to extract the ash and transfer it quantitatively to a volumetric flask before inductively coupled plasma optical emission spectrometry (ICP-OES) was employed to determine the concentration of sodium in the sample (Kira et al., 2004). Total salt content was calculated by multiplying the sodium concentration by 2.542 (Borrelli et al., 2020).

4.3.3 Nutritional Guidelines

For objectives 2 and 3, meals were compared to the UK daily nutritional guidelines for adults (Table 4.4).

Table 4.4 Daily Nutritional Guidelines for adults as a percentage of food energy (Population average)

		Men	Women
Energy (kJ/d)	Estimated Average Requirements (EAR)	10.60	8.10
Energy (kcal/d)		2550	1940
	Dietary Reference Values (DRV) (% without alcohol)		
Carbohydrate (g/d)	50%	340.0	258.7
Free sugars (g/d)	< 5%	34.0	25.9
Fat (g/d)	35%	99.2	75.4
Saturated fat (g)	< 11%	31.2	23.7
Polyunsaturated fat (g/d)	< 6.5%	18.4	14.0
Monounsaturated fat (g/d)	< 13%	36.8	28
Trans unsaturated fat (g/d)	< 2%	5.7	4.3
	Reference Nutrient Intake (RNI)		
Protein (g/d)	19-50 years	55.5	45.0
Sodium (g/d)		1.6	1.6
Salt (g/d)		4.0	4.0

Notes: Nutrient intakes are shown as a proportion of food energy (without alcohol); protein RNIs for all adults aged 19 years and over are 0.75 g/kg/d.

(Department of Health, 1991; SACN, 2007; SACN, 2015; SACN, 2019)

4.3.4 Statistical Analysis

The information was collated, and analysis was carried out using IBM SPSS (version 27, IBM Corp, Armonk, NY, USA). Only complete meals were considered for the analysis of the meal categories (Chinese, Indian, English, Pizza, Kebab) thus 46 samples of takeaway meals collected by Knowsley Council (where rice or chips were excluded) were omitted from comparisons by meal category. Normal distribution of the data was assessed with histograms, Kolmogorov–Smirnov and Shapiro–Wilk tests. Due to the non-normal distribution of data, results were expressed as medians with interquartile range (25th and 75th percentiles). Median levels of all considered nutrients (energy, protein, carbohydrate, sugars, total fat, SFA, MUFA, PUFA, TFA, and salt) were expressed per portion and per 100 g.

Objective 1: *Determine the nutritional composition of takeaway meals across various takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs).*

For objective one, the variation of the nutritional content between takeaway meal categories and between different types of meals in the same category was determined with the use of the Kruskal–Wallis test and the Mann–Whitney U-test. The Kruskal-Wallis between groups test showed all takeaway categories were significantly different. As five takeaway categories (groups) were being compared, the *p* value of 0.05 was divided by 10 as per Bonferroni calculation to account for multiple testing and the Bonferroni-corrected significance level of 0.005 was used to account for the increased possibility of type-I error (Bland and Altman, 1995). Data was analysed to explore the nutritional composition of takeaway meals in relation to portion size and per 100 g as follows: energy, total fat, SFA, TFA, salt and sugar content (where available). Median levels and IQR are shown in boxplots and tables in Figures 4.1-4.26 and Tables 4-5-4.9 to enable comparisons between cuisine types and meal types. When interpreting the box plots, the horizontal black lines indicate the median; the boxes indicate the interquartile range (IQR) (25th percentile to 75th percentile); the whiskers represent observations within 1.5 times the IQR. Outliers 1.5 times away from the IQR are marked as circles. Extreme outliers are marked as *. Additional tables and boxplots for carbohydrates, protein, PUFA, MUFA can be found in Appendices 4.1 to 4.3.

Objective 2: *To compare the nutritional profile of takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs) with UK dietary reference values.*

For objective two, the takeaway categories were compared with the current UK's daily nutritional guidelines (Table 4.4) to assess the nutritional profile. The nutritional composition for each takeaway category was compared with the estimated average requirements (EAR) for food energy and DRVs for fat, carbohydrate, and sugars; protein and salt levels were compared to RNI for men and women aged 19-50 years (Figures 4.27-4.29 and Tables 4.10-4.11). As the UK does not have a DRV for total sugars, the total sugars were compared with the UK DRVs for free sugars for men and women which is a maximum of 5% total dietary energy.

Objective 3: *To explore the effect of an additional takeaway meal or replacing meals with a takeaway on an average UK diet over a week.*

For objective three, nutritional analysis was performed using the UK daily nutritional guidelines (Table 4.4) for estimated average requirements (EAR) for food energy, DRVs for fats and sugars and RNI for salt for men and women aged 19-50 years (DOH, 1991).

An average meal (30% of the UK daily guidelines) was replaced with a corresponding average value for takeaway food, calculated by combining the five takeaway meal categories. This was carried out to determine what the effect would be on an adult's average weekly diet when eating just one takeaway a week, a few a week (3) or a takeaway everyday (7) (Figures 4.30-4.35 and Tables 4.12-4.13).

4.4 Results and Discussion

4.4.1 Nutritional composition of takeaway meals (objective 1)

The aim of this section was to determine the nutritional composition of takeaway meals across various takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs) using PAL results provided by Local Councils Trading Standards for meals prepared at independent takeaways in Liverpool, Knowsley, and the Wirral. The results are centred on takeaway meal category (*cuisine type*) and takeaway meals (*meal type*). Due to non-normal distributions, the results are presented and discussed using medians with interquartile range (25th and 75th percentiles) as shown in Tables 4.5 to 4.9 and Figures 4.1 to 4.26.

4.4.1.1 Portion Size

The results show most portion sizes were large (Figure 4.1, Table 4.6), ranging from a minimum of 418 g (Kebabs: median 491 g, 418-636 g) up to a maximum of 935 g (Chinese meals: median 803 g, 694-935 g). The portion sizes for the Chinese and Indian categories were significantly larger (p <0.005) than the English, Pizza, and Kebab categories. Studies have shown that portion size significantly influences energy intake and that repeated exposure to large portion sizes can also increase the amount of food individuals usually eat (Rolls, Roe and Meengs, 2007). More recently, a Cochrane review of portion, package or tableware size found adults regularly eat more food and drink when presented with larger sized portions or packages or using larger items of tableware compared with exposure to smaller sized versions (Hollands et al., 2015). The study concluded that removing larger portions from the diet could lower the average daily energy intake by up to 16% and 29% for UK adults and US adults respectively (Hollands et al., 2015). This would be equivalent to a difference in average daily energy intake from food and non-alcoholic drinks for UK adults of between 215 and 279 kcal. Reducing energy intake by this level has the potential to improve health by reducing obesity and other risk factors for NCDs.

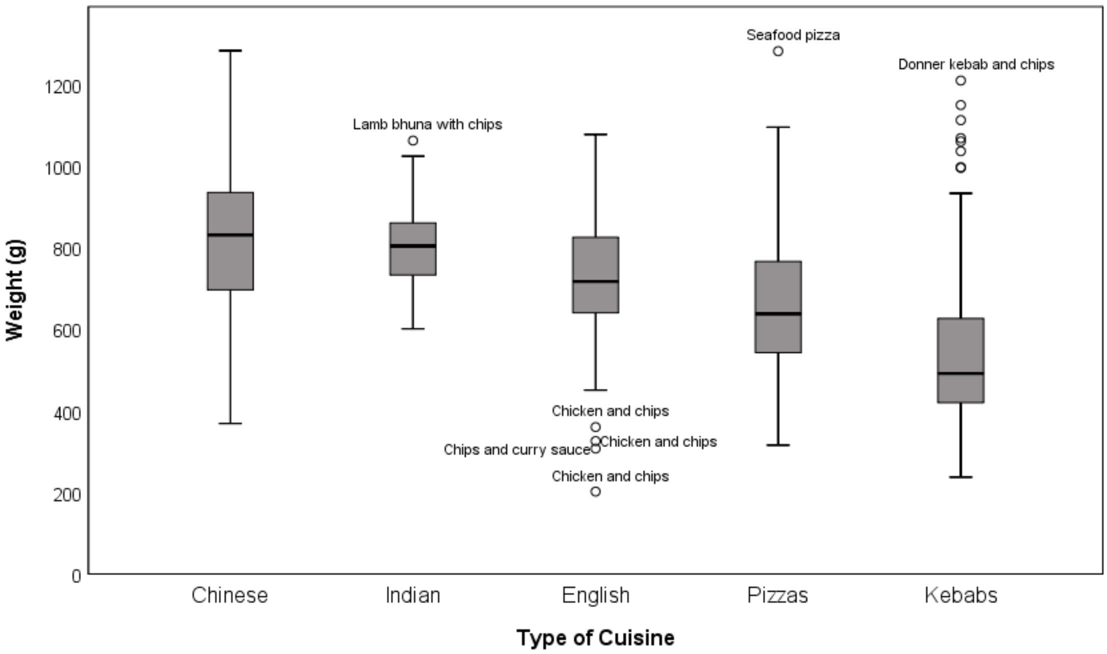


Figure 4.1 Median portion size for each type of cuisine

(Outliers marked as º, extreme outliers marked as *)

4.4.1.1.1 Portion Size of Individual Takeaway Meals

The results show wide variation in portion size not only for the different cuisine categories (Table 4.6) but also for the same takeaway meal served by different takeaway outlets (Table 4.8). Figure 4.2 shows the full range of data and demonstrates the variability in meals prepared by different outlets. This will largely be due to the use of different recipes, ingredients, and meal preparation practices. Some of the largest portions were in the Chinese category, for example, a median portion of sweet and sour chicken with chips weighed 931 g (785-1199 g). The next largest meals were beef in black bean sauce with fried rice (915 g, (871-1013 g)) and chicken satay with fried rice (891 g, (781-1063 g)). Of the English meals, fish and chips were the largest (749 g (656-827 g)) and in the Kebab category, donner kebab with chips (751 g (561-979 g) (p <0.008) was 50% larger than shish kebab (386 g (334-478 g)), the smallest meal in that category. Seafood pizza (765 g (690-971 g)) was also significantly larger than ham and pineapple pizza and meat pizza (p <0.005). Large portion sizes for fish and chips were also found by Goffe et al. (2016) where the mean weight of fish and chips was 724.4g (SD = 145.2, n = 61). This sector is driven by high competition and takeaway outlets tend to offer large portions because they want to offer value for money (Ledikwe, Ello-Martin and Rolls, 2005; Riis, 2014; Goffe et al., 2019). Additionally, fish and chip shops make large profits from selling chips (70%) rather than fish (10%), condiments and drinks (20%) (Cobweb Information, 2008 cited in: Bagwell and Doff, 2009).

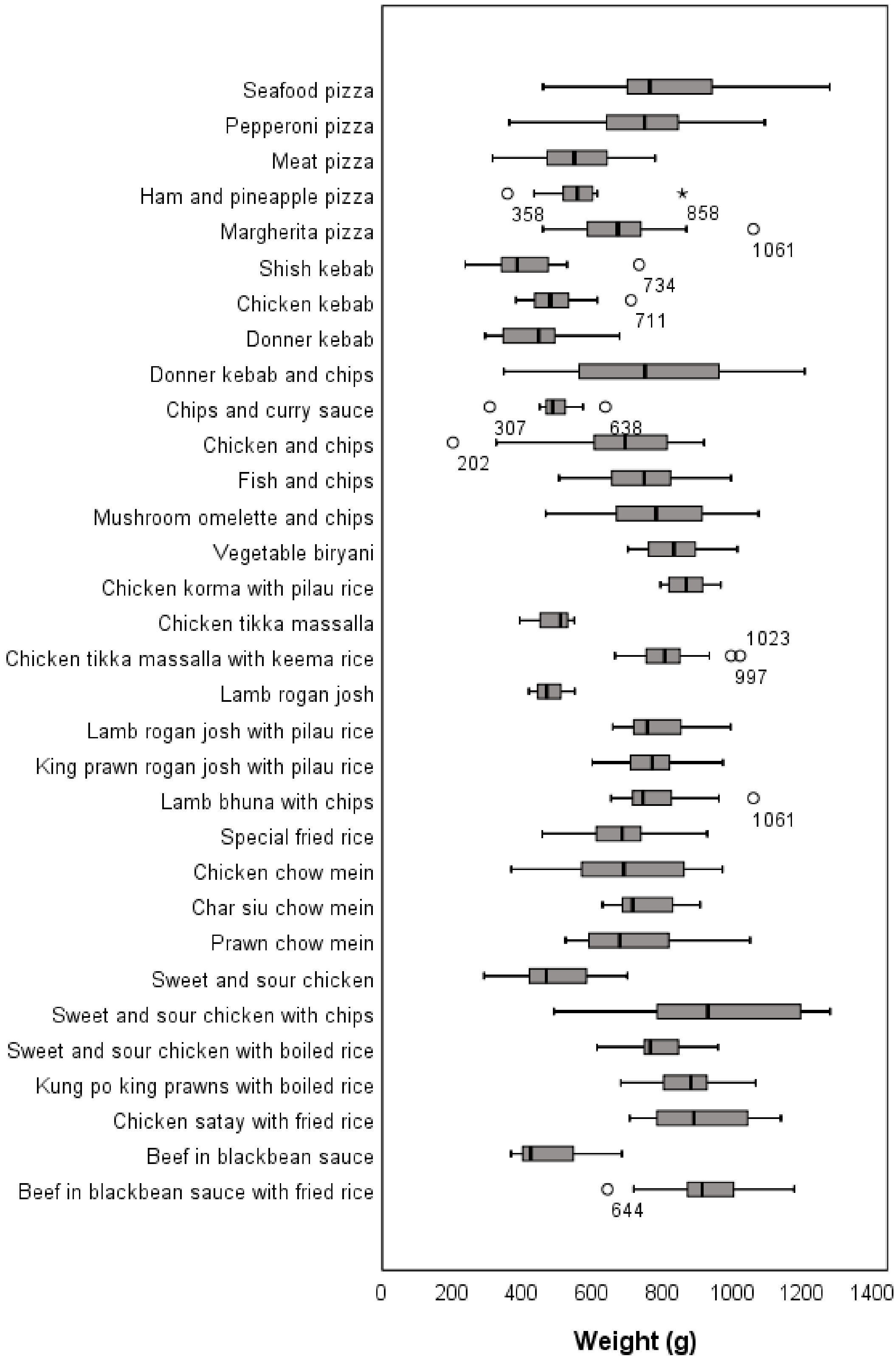


Figure 4.2 Median portion size for each meal type

Meals without sides

Included in the individual takeaway meal analysis are four meals that would usually have rice or chips served with them: sweet and sour chicken (n = 28), beef and black bean sauce (n = 12), lamb rogan josh (n = 3) and chicken tikka masala (n = 3) (Tables 4.7 and 4.8). As they are main meal components (without sides), it is possible to compare the weights of these dishes using reference values in the Food Portion Sizes guide (Food Standards Agency, 2002). This guide includes information collected during weighed dietary studies in the UK and provides average weights for individual food items as well as average portion sizes (Food Standards Agency, 2002).

The Food Portion Sizes guide suggests that a takeaway portion of boiled or fried rice weighs a maximum of 300 g (Food Standards Agency, 2002); however, this data is not available for comparison in the present study. The guide also suggests a typical sweet and sour dish or tikka masala dish weighs 300 g (Food Standards Agency, 2002). In the present study, a median portion of sweet and sour chicken was 56% heavier, weighing 469 g (419–586 g IQR) and a median portion of chicken tikka masala was 70% heavier, weighing 510 g (393 - 549 IQR).

Subtracting the individual meal component from the sweet and sour chicken served with rice or chips, the results show that a median serving of boiled rice weighs 297 g which is in agreement with the 300 g suggested by the food portion sizes guide. A median serving of chips served with sweet and sour chicken weighed 462 g, 92.5% more than the 240 g suggested by the food portion sizes guide. In the present study, beef in black bean sauce weighed 424 g (compared with the suggested 360 g for Chinese meal beef dishes), and a serving of fried rice weighed 491 g, 63% more than the suggested 300 g for a serving fried rice. Some of the differences could be because the Food Portion Sizes guide was written a number of years ago (the first edition was published in 1988 and this study used the third edition published in 2002); however, these results suggest that portion sizes have increased since the book was researched and published.

When comparing results from the present study with the 'Local Authorities Food Standards Survey 14', similar findings were made for portion size and energy content for the two dishes (Local Government Group, 2011). An average portion of sweet and sour chicken weighed 473 g (min 259 g – max 717 g) and contained 859 kcal and an average portion of chicken tikka masala weighed 514 g (min 338 g – max 836 g) and contained 886 kcal (Local Government Group, 2011).

4.4.1.2 Energy

In terms of energy per portion, pizzas were significantly higher in energy (1820 kcal/meal (1469-2152 kcal); p <0.005) than all other categories and the ranking order was pizzas > English > Indian > Chinese > kebabs (Table 4.5 and Figure 4.3). For energy density (kcal/100 g), the ranking order was slightly different: pizzas > English > kebabs > Indian > Chinese. Pizzas were significantly higher in energy density (283 kcal (260-304 kcal); p<0.005) when compared with all other categories and Chinese meals were significantly lower (150 kcal (124-189 kcal); p <0.005) (Table 4.6 and Figure 4.4).

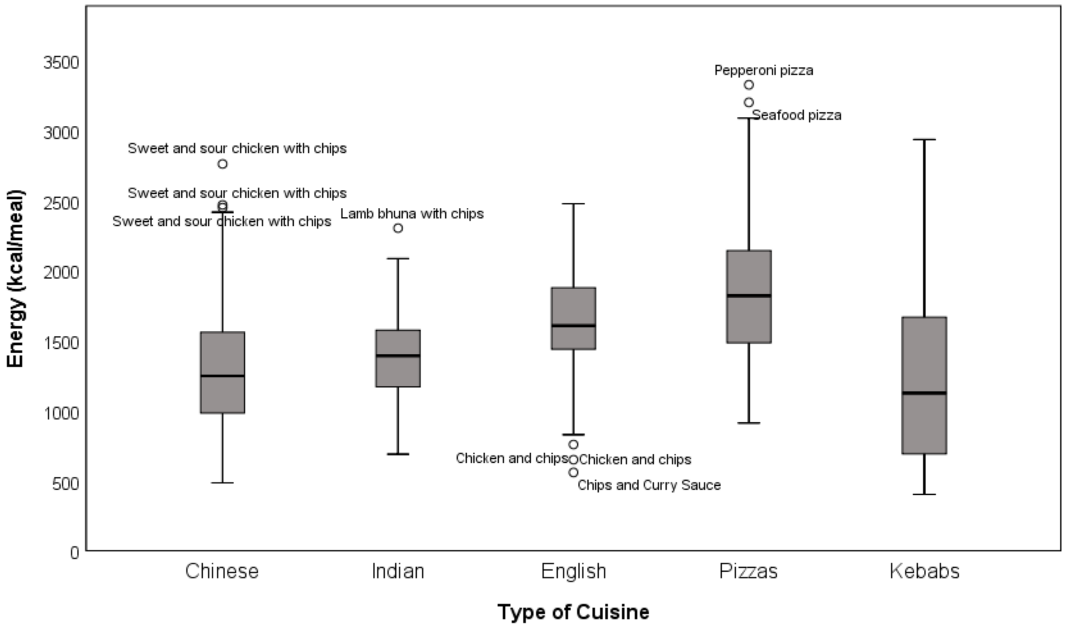


Figure 4.3 Median energy per portion for each type of cuisine

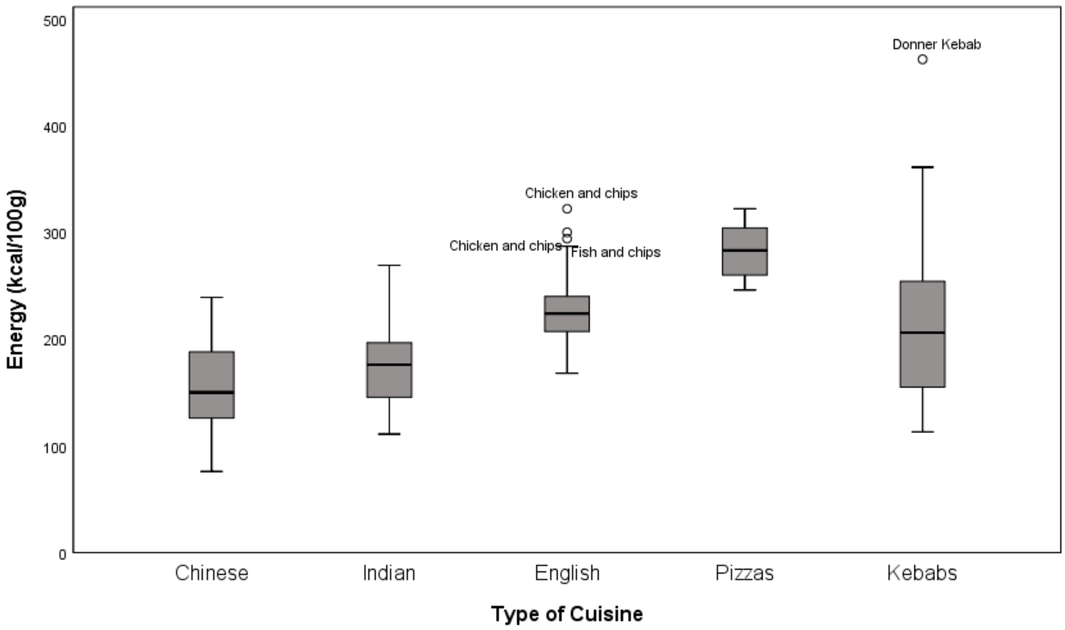


Figure 4.4 Median energy per 100 g for each type of cuisine

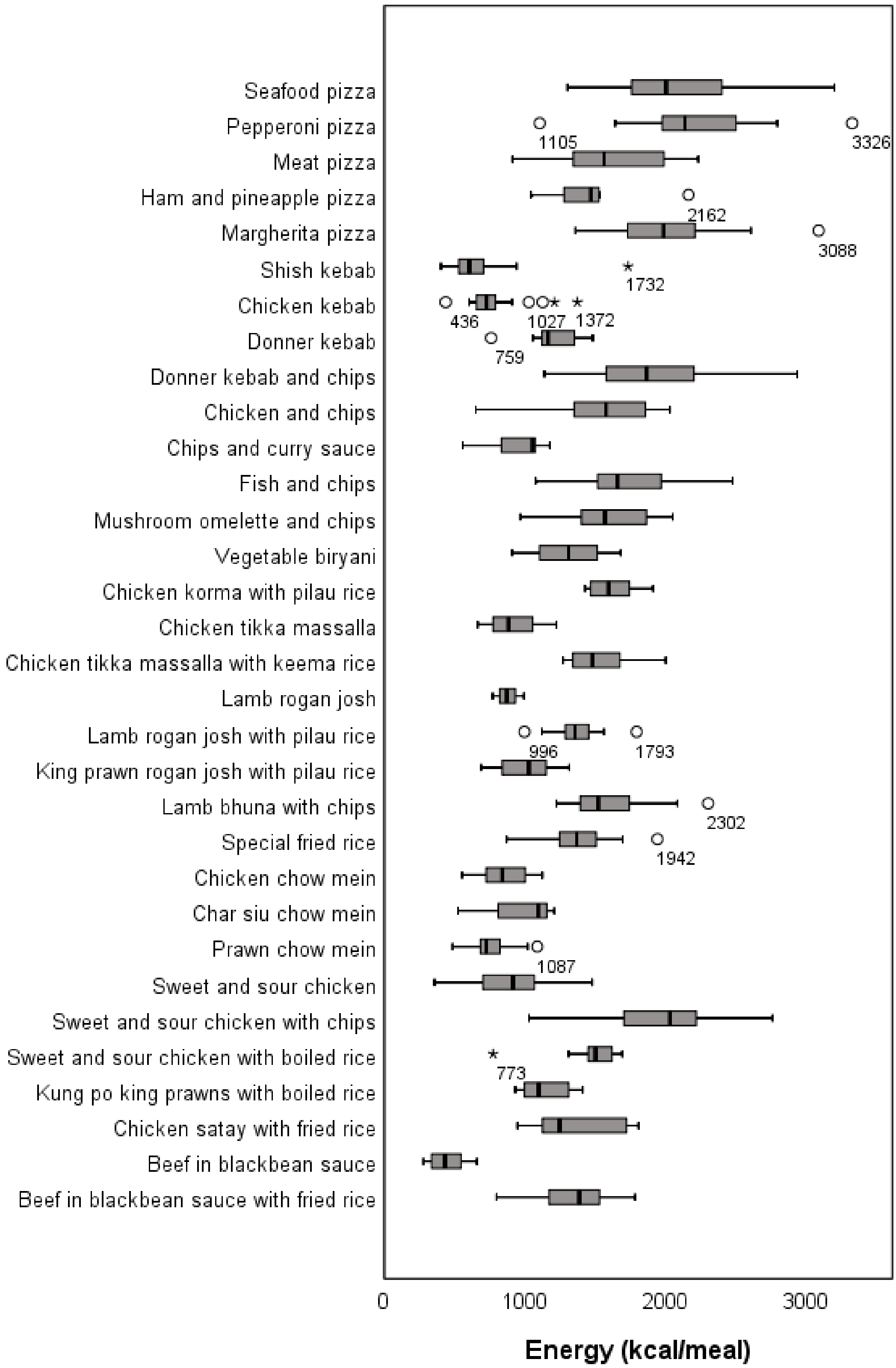


Figure 4.5 Median energy per portion for each meal type

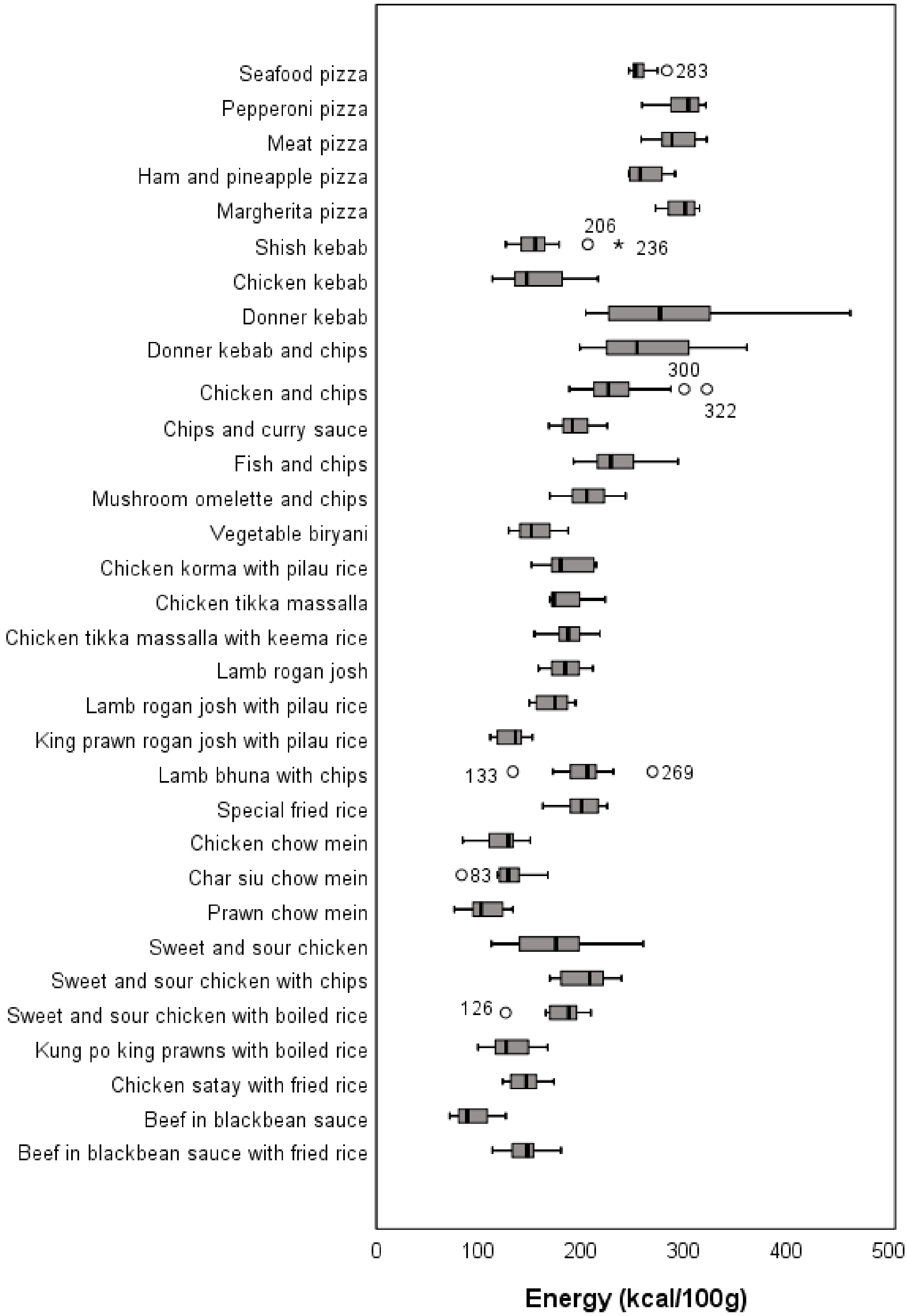


Figure 4.6 Median energy per 100g for each meal type

4.4.1.2.1 Energy Content of Individual Takeaway Meals

As with portion size, the results show a wide range in energy not only for all the different cuisine categories (Table 4.6) but also for the same takeaway meal served by different takeaway outlets (Table 4.8). Furthermore, three pizzas (pepperoni, seafood, margherita) and one Chinese meal (sweet and sour chicken with chips) contained more than 1940 kcal, the recommended EAR for a woman aged 19-50 for the whole day (Table 4.4).

Public Health England's 'One You' social marketing programme advises that most adults in the UK are consuming between 200 and 300 excess calories each day (PHE, 2018a). In a bid to promote lower calories and hence fit in with the UK nutritional guidelines, the 'One You' campaign encourages adults (men and women) to eat 400 kcal for breakfast, 600 kcal for lunch and 600 kcal for dinner, plus healthy snacks and drinks in between (PHE, 2018c). As shown in Figure 4.3, the median energy (kcal/meal) provided by each of the cuisine types is greater than the recommended 600 kcal/meal and for some cuisines, energy content is more than double this. Only two meals would meet the 600-kcal recommendation: shish kebab or beef in black bean sauce (no side) as shown in Figure 4.5.

When comparing these results with a typical British diet, an adult woman (aged 16-64 years) consumes approximately 160 kcal/100g of food (Prentice and Jebb, 2003). An adult woman consuming a healthier diet with no more than 35% energy from fat and a minimum of 400 g of fruit and vegetables a day consumes approximately 125.5 kcal/100g (Prentice and Jebb, 2003). In the present study, two-thirds (66%) of the takeaway meals contained more than 160 kcal/100g and 93% contained more than 125.5 kcal/100g (Figure 4.6). Only two meals, prawn chow mein or beef with black bean sauce (served without rice or chips) contained less than 125.5 kcal/100g. Pepperoni pizza contained nearly double the energy density for a woman's typical diet (160 kcal/100 g), containing the highest energy density of 304 kcal/100g (Table 4.10). With two-thirds of the meals having an energy density greater than a typical British diet, these results show how eating these kinds of foods can contribute towards an adult consuming excess calories in their diet. While many of the meals are excessive in portion size, it is not known whether individuals are consuming whole meals or sharing with friends or family. Furthermore, it is important to consider whether side orders and additional sugar-sweetened beverages are being consumed.

Chinese Meals

Prawn chow mein had the lowest energy content of all the Chinese meals, both per portion (725 kcal (651-884 kcal)) and per 100g (102 kcal (93-124 kcal)) and was significantly lower in energy when compared with all other Chinese meals except for chicken chow mein and char sui chow mein (Figures 4.5, 4.6 and Tables 4.7, 4.8). Two of the meals had an energy density greater than or equal to 200 kcal/100g: sweet and sour chicken and chips, special fried rice. Furthermore, sweet and sour chicken with chips was significantly higher in energy per portion than many of the other Chinese meals (*p* <0.0001), containing 2031 kcal, which is more than the UK recommended daily allowance for an adult woman (Table 4.4). The second highest energy containing meal was sweet and sour chicken with boiled rice weighing 766 g and providing 1501 kcal (Table 4.7). These results are similar to findings in the *safe*food Chinese meals study where an average portion of sweet and sour chicken with boiled rice weighed 843 g and provided 1673 kcal (*safe*food, 2012b). Like the present study, most meals were large in portion size and calories.

Indian Meals

Lamb bhuna and chips had the highest energy density in this group with 206 kcal/100g and was significantly higher in energy per portion compared with lamb rogan josh with pilau rice, vegetable biryani and king prawn rogan josh with pilau rice (Figure 4.6). King prawn rogan josh with pilau rice had the lowest energy content of all the Indian meals, per portion (1027 kcal (838-1155 kcal)) and per 100g (136 kcal (117-142 kcal)). Three of the meals provided more than 1500 kcal per portion, namely chicken korma with pilau rice, chicken tikka masala and keema rice and lamb bhuna with chips (Figure 4.5 and Table 4.8). A median portion of chicken korma with pilau rice weighed 869 g and provided 1595 kcal; and this was comparable to results in the *safe*food Indian meals study where an average portion of chicken korma with pilau rice weighed 807g and provided 1774 kcal (*safe*food, 2015).

English Meals

Most of the meals in this group contained more than 1500 kcal/portion: fish and chips, chicken and chips, mushroom omelette, and chips (Figure 4.5 and Table 4.7). Only one meal was lower in calories, and this was chips and curry sauce (1053 kcal/portion (830-1124 kcal)) and was significantly lower in calories than the three other meals in this category (*p* <0.0001). Energy density in this group was high, with the four different meal types containing between 191 and 229 kcal/100g (Figure 4.6 and Table 4.9), both chicken and chips and fish and chips were significantly higher in energy density than mushroom omelette and chips and chips and curry sauce (*p* <0.0001).

Pizzas

Pizza size ranged from 10” to 12” on the form sent with the pizza to the PAL. However, there was no consistency in how pizzas were sold by size between outlets, the majority were labelled as medium whilst some large pizzas were labelled as 12”. Energy ranged from 1469 to 2137 kcal/portion (Figure 4.5 and Table 4.7), energy density was also high, ranging from 253 to 304 kcal/100g (Figure 4.6 and Table 4.9). Pepperoni pizza had the highest energy density and content and was the second largest pizza (750 g (639 g-855 g)) (Table 4.7). Three of the five types of pizzas also contained more than the EAR of daily calories for a woman (1940 kcal). These results correspond with the *safe*food pizza study, which also found high energy content in 12” pizzas. They collected 80 samples of thin and deep-based pizzas from takeaways on the IOI. In their findings, a 12” portion of pepperoni pizza ranged between 231g-937g and provided 745-3712 kcal/portion (*safe*food, 2012a). The mean energy content was 1630 kcal which is lower than the 2137 kcal (1928-2598 kcal) for pepperoni pizza in the present study.

The high calorie content of most pizzas highlight how it would be sensible for an individual to share a pizza with one or more person then to eat a whole one by themselves. For a sensible serving size, “The Fun of Pizza, the Balance of Good Nutrition” by Nestlé (2013) recommends picturing your hand as a benchmark for a slice of pizza, and to only eat one or two slices. This would take into account smaller serving sizes for women and children (Nestlé, 2013). Using the guide of eight slices per medium pizza (PHE, 2020d), from the present data a median slice of pepperoni pizza would weigh approximately 80 g and contain 267 kcal. To meet the government guidelines in the ‘One You’ campaign (PHE, 2018c), an adult would need to limit themselves to eating two slices of pepperoni pizza or three slices of ham and pineapple pizza to consume less than 600 kcal for lunch or dinner.

Kebabs

In this category, the healthier choices would be shish kebab 604 kcal (509-709 kcal) or chicken kebab 726 kcal (650-819 kcal). Per kebab, both were significantly lower in energy content than donner kebab or donner kebab and chips (p <0.0001). The median energy content of a donner kebab was 1164 kcal (1121-1355 kcal) and weighed 447 g (338-503 g) (Figure 4.5 and Table 4.7). Although the present study shows the data using median and IQR, the results are comparable to the LACORS (2009) kebab study, where an average donner kebab weighed 301 g and contained 1006 kcal. In the LACORS study, portion size of donner kebabs ranged from 120 to 677 g and from 365 to 1990 kcal calories per portion (*Ibid*). Per 100g, donner kebabs in the LACORS study contained an average of 336 kcals compared to 277 kcal (223-325 kcal) in the present study (Table

4.9) (*Ibid*). The LACORS (2009) study also found the average donner kebabs varied on a regional basis; containing significantly less calories when purchased in Northern Ireland (843 kcal) or London (912 kcal) compared to the rest of the UK and contained the most calories in the Northwest of England (1101 kcal/portion). Furthermore, kebabs in the LACORS study were requested without accompaniments such as salads and sauces, so calorie content will most likely be under represented (*Ibid*).

4.4.1.3 Total Fat

UK dietary guidelines state the population should aim to eat no more than 35% of dietary energy as total fat (Department of Health, 1991; SACN, 2019). Reviews have been carried out of studies investigating the ideal fatty acid composition that makes up this dietary energy (Schwab et al., 2014; SACN, 2019). Evidence suggests that eating refined carbohydrates or SFA is damaging to health, due to their detrimental impact on the lipid profile and other cardiometabolic risk markers (Mente et al., 2017; Kelly et al., 2021). Other dietary studies of fatty acids have found differences in their effect on health depending on the types of SFA, MUFA, PUFA or TFA being consumed. Zong et al. (2016) investigated the association between long term intake of individual SFAs and the risk of CHD in two large cohort studies (Nurses' Health Study and the Health Professionals Follow up study). The study showed that not all SFAs have the same association, replacing 1% of daily energy intake from total SFA with equivalent energy in PUFA, whole grain carbohydrates or plant proteins was associated with a reduction in CHD events and reduction in total mortality (Zong et al., 2016). When studying individual SFAs, there was a 10-12% reduction in CHD risk when replacing 1% daily energy intake of palmitic acid (16:0) with equivalent energy in PUFA, whole grain carbohydrates or plant proteins and for the combined fatty acid group: lauric acid (12:0), myristic acid (14:0), palmitic acid (16:0), and stearic acid (18:0) there was a 6-8% reduced risk in CHD (Zong et al., 2016). Palmitic acid is found in meat, dairy, palm and coconut oil (Velisek, 2013) and is frequently used in processed foods and for frying purposes in takeaway outlets (Mba, Dumont and Ngadi, 2015; Ismail et al., 2018).

In a matched case-control study of 2,428 postmenopausal women nested in the Women's Health Initiative Observational Study, Liu et al. (2019) found the type of PUFA consumed made a difference to CHD risk and concluded that long-chain SFA may be associated with increased risk of CHD. This is in agreement with recent analysis from the UK Biobank study, a population-based cohort study of predominantly healthy middle aged adults of White ethnicity. Analysis of 24,639 participants found substitution of 5%

energy intake of SFA with PUFA to be associated with lower low-density lipoprotein-cholesterol (LDL-C) and triglycerides (Kelly et al., 2021).

Dietary MUFAs can come from both plant and animal sources, Guasch-Ferre et al. (2019) calculated consumption of MUFA-Ps (plant based) and MUFA-As (animal based) using dietary information collected through validated food frequency questionnaires on the Nurses Health Study and the Health Professionals Follow-Up Study. They investigated associations of *cis*-MUFA intake from plant and animal sources with total and cause-specific mortality. They observed a significantly lower mortality risk when 5% energy of SFA, 5% energy of refined carbohydrates or 2% energy of TFAs were replaced with plant based MUFAs but not animal MUFAs (Guasch-Ferre et al., 2019).

The above literature highlights the potential benefit of replacing SFA with PUFA or MUFA in takeaway meals. In the present study, many takeaway meals had a high total fat and SFA content with at least 30% containing more than the recommended daily DRV for total fat and SFA for a woman aged 19-50 (Table 4.4); increasing NCD risk if consumed regularly. When considering total fat content per portion, English meals contained the highest amounts followed by Pizzas, Indian meals, Kebabs and Chinese meals. Per 100g, the ranking was slightly different with Pizzas, English meals, Kebabs, Indian meals, Chinese meals (Figures 4.7, 4.8 and Tables 4.5, 4.6).

4.4.1.3.1 Total Fat Content of Individual Takeaway Meals

With respect to total fat per portion of individual meals (Table 4.8), the highest total fat content was observed in donner kebab and chips (100.5 g (83.6-118.3 g)) which exceeds the daily DRV of fat for men of 99.2 g and 75.4 g for women (Table 4.4). Pepperoni pizza (95.4 g (75.3-130.7 g)), mushroom omelette and chips (92.3 g (79.9-114.3 g)) and seafood pizza (91.8 g (66.9-109.5 g)) were the next highest meals in total fat content (Table 4.8). Per 100 g, the highest fat content was found in donner kebab (15.6 g (12.5-20.4 g)), followed by pepperoni pizza (14.3 g (10.9-15.0)) and donner kebab and chips (13.3 g (11.2-18.1 g)) (Table 4.9).

Kebabs

In the LACORS kebab report (n = 494), the average total fat content for the sampled donner kebabs was 62.3 g with 34% containing more than 70 g, the maximum GDA for fat for a woman (LACORS, 2009). Likewise, in the present study fat content in donner kebabs was high (71.8 g (63.1 - 82.1g)) and one outlier portion contained an extremely high total fat content of 115 g. Chicken kebab and shish kebab were both significantly lower in fat than donner kebab, per portion and per 100g.

Pizza

Per pizza, pepperoni pizza and seafood pizza had the highest fat content with 95.4 g and 91.8 g respectively, and both were significantly higher in fat (p = 0.002) than ham and pineapple pizza. This ties in with the high energy values provided by pepperoni pizza and seafood pizza compared with ham and pineapple pizza (Tables 4.7 and 4.8). Conversely, per 100 g, pepperoni pizza, margherita pizza and meat pizza contained more than 12 g fat / 100 g and meat pizza was significantly higher in fat (p = 0.001) than seafood pizza and ham and pineapple pizza (Table 4.9). Similarly, in the *safe*food pizza study carried out on the IOI, fat content of pepperoni pizza was greater than Hawaiian pizza (ham and pineapple) and margherita pizza (cheese and tomato) for both thin base and deep base pizzas (*safe*food, 2012a). Thin base pizzas were lower in fat content than deep base pizzas, for example the mean fat content of pepperoni pizza was 54.7 g (SD = 20.8) for thin base and 62.7 g (SD = 22.4) for deep base, providing between 80-90% GDA for an adult (*safe*food, 2012a). Hawaiian pizza and margherita pizza contained less fat but still as much as 60-70% GDA for fat and 117-130% GDA for SFA (*safe*food, 2012a). Unfortunately, in the present study, when the pizzas were sent for analysis they were not labelled as thin or deep base to enable an in-depth investigation as to whether the deep base pizzas contained more fat than the thin base pizzas.

English Meals

In the English category, the meals with the highest fat content per portion and per 100 g were mushroom omelette and chips and fish and chips. To some extent, the high fat content will be due to the chips. The fat content of chips can be affected by a number of factors including chip size, frying medium, and temperature of the oil during cooking (Gertz, 2014). Thick, straight cut chips with a 14 mm cross section absorb less fat than thinner chips (Food Standards Agency, 2020b). In addition, ensuring the deep fat fryer is heated up to the correct temperature before frying foods helps to reduce fat absorption (Food Standards Agency, 2020b). A project carried out in Glasgow, found it was possible to greatly reduce SFA content of fried foods served by fish and chip shops by changing the outlets usual frying oil to rapeseed oil (Paton, 2015). One outlet's fish and chips resulted in a reduction from 42.9 g SFA to 2.1 g when prepared in rapeseed oil (portion size for both samples were between 600-650 g). However, a drawback to exchanging frying mediums was that the business operator observed the chips to be paler, tasteless and had a different texture compared to chips prepared with other oils (Paton, 2015), showing the importance of involving the business operator and chefs when suggesting changes to meal preparation.

Chinese and Indian Meals

For the Chinese meals, sweet and sour chicken with chips was significantly higher (p<0.0001) in fat content than all the other meals in that category apart from chicken satay with fried rice. The next highest meals were special fried rice and beef in black bean sauce with fried rice, the lowest were prawn chow mein and kung po king prawns with boiled rice. For the Indian meals, king prawn rogan josh with pilau rice was significantly lower in fat than the other meals in this category per portion and per 100 g (p<0.0001) with 32.1 g (18.7- 44.2 g) and 4.6 g (2.8-5.7 g) respectively. Whereas lamb bhuna and chips had the highest fat content with 84.5g (76.1-92.9 g) and 11.2 g (10.4-12.1 g) respectively.

In the 'Local Authorities Food Standards Survey 14', 409 samples of chicken tikka masala, pilau rice, sweet and sour chicken and fried rice were analysed (Local Government Group, 2011). The survey found significant variation in the composition of the meals, the average chicken tikka meal provided 60 g of fat (85% of the GDA for a woman) and provided 116% of the GDA for saturated fat (*Ibid*). High levels were also seen in the present study, there were no results for chicken tikka masala with pilau rice for comparison, however chicken tikka masala with keema rice contained 73.3 g (67.0-91.6 g) fat and 22.7 g (18.9-31.5 g) SFA, chicken tikka masala (no rice) contained 43.9 g (26.3-71.4 g) fat and 15.6 g (12.0-31.1 g) SFA. Sweet and sour chicken (no rice) contained 34.3 g (23.2-44.4 g) fat. When served with boiled rice, this increased to 41.6 g (30.8-47.6 g) fat which is comparable with the 45 g of fat provided by an average sweet and sour meal in the food standards survey (*Ibid*).

These results show high fat content in takeaway food, and large variability in fat content for the same meal served by different outlets (Figures 4.7-4.10, Tables 4.9 and 4.10). Variation has also been found for the same meal served by large transnational fast-food outlets in ten countries in the survey carried out by Ziauddeen et al. (2015). Their survey examined total energy, fat and SFA content of fast food using available public information for the same meal items being served in different countries. In terms of total energy and fat content, the least variation was in Burger Kings Whopper Burger (967-1029 kJ, 12.6-14.5 g) and the most variation was in KFC Original Recipe Chicken (536-1301 kJ, 7.5-18.2 g). Large variation was also seen in McDonalds Chicken McNuggets which when served in Germany contained 12 g fat per 100 g in comparison with 21.1 g in New Zealand (Ziauddeen et al., 2015).

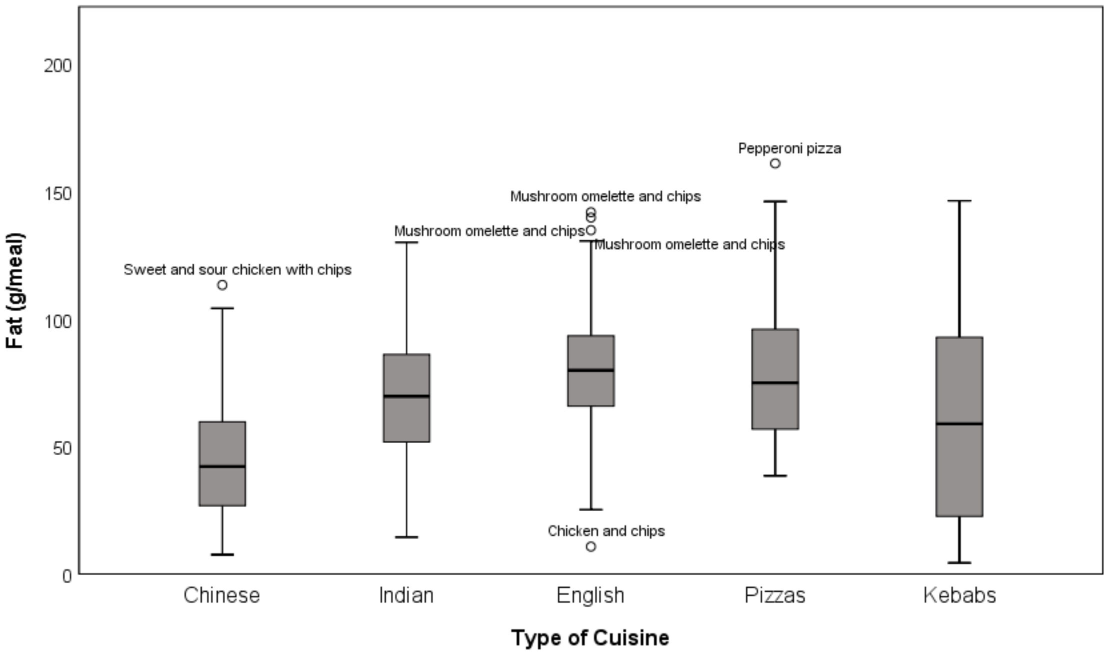


Figure 4.7 Median fat content per portion for each type of cuisine

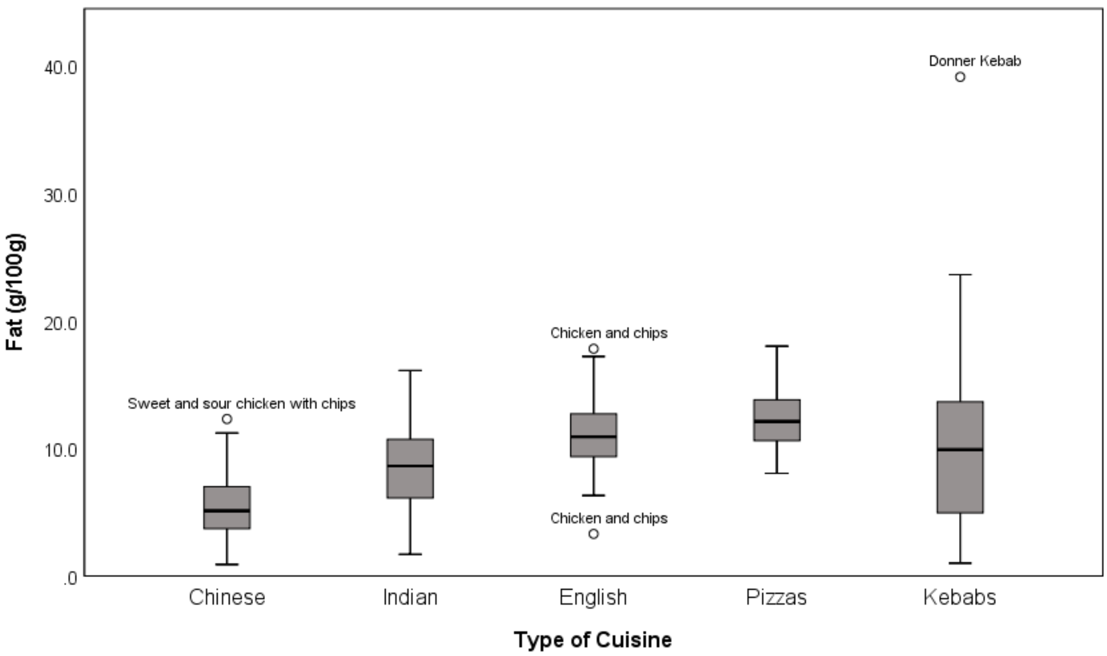


Figure 4.8 Median fat content per 100g for each type of cuisine

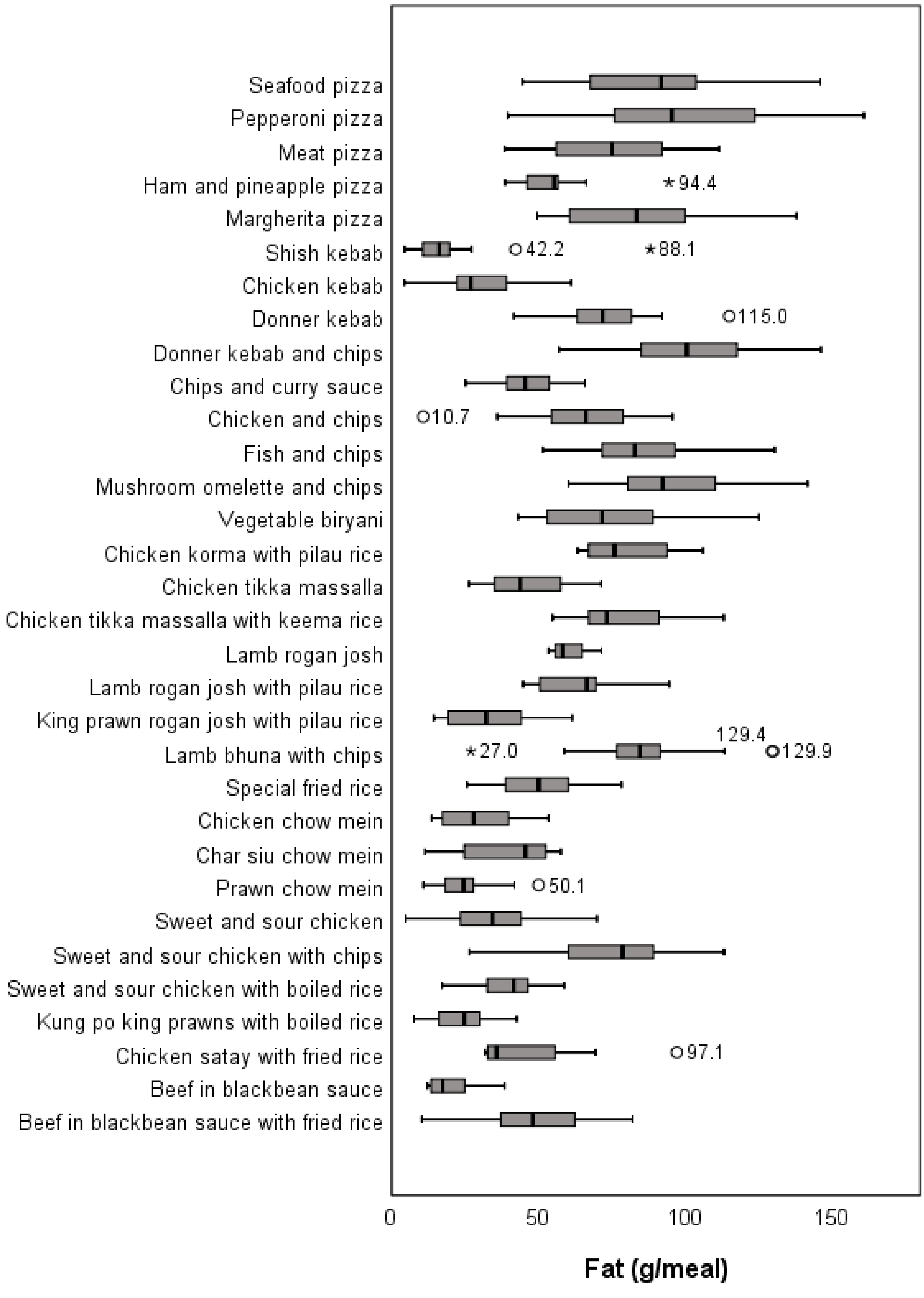


Figure 4.9 Median fat content per portion for each meal type

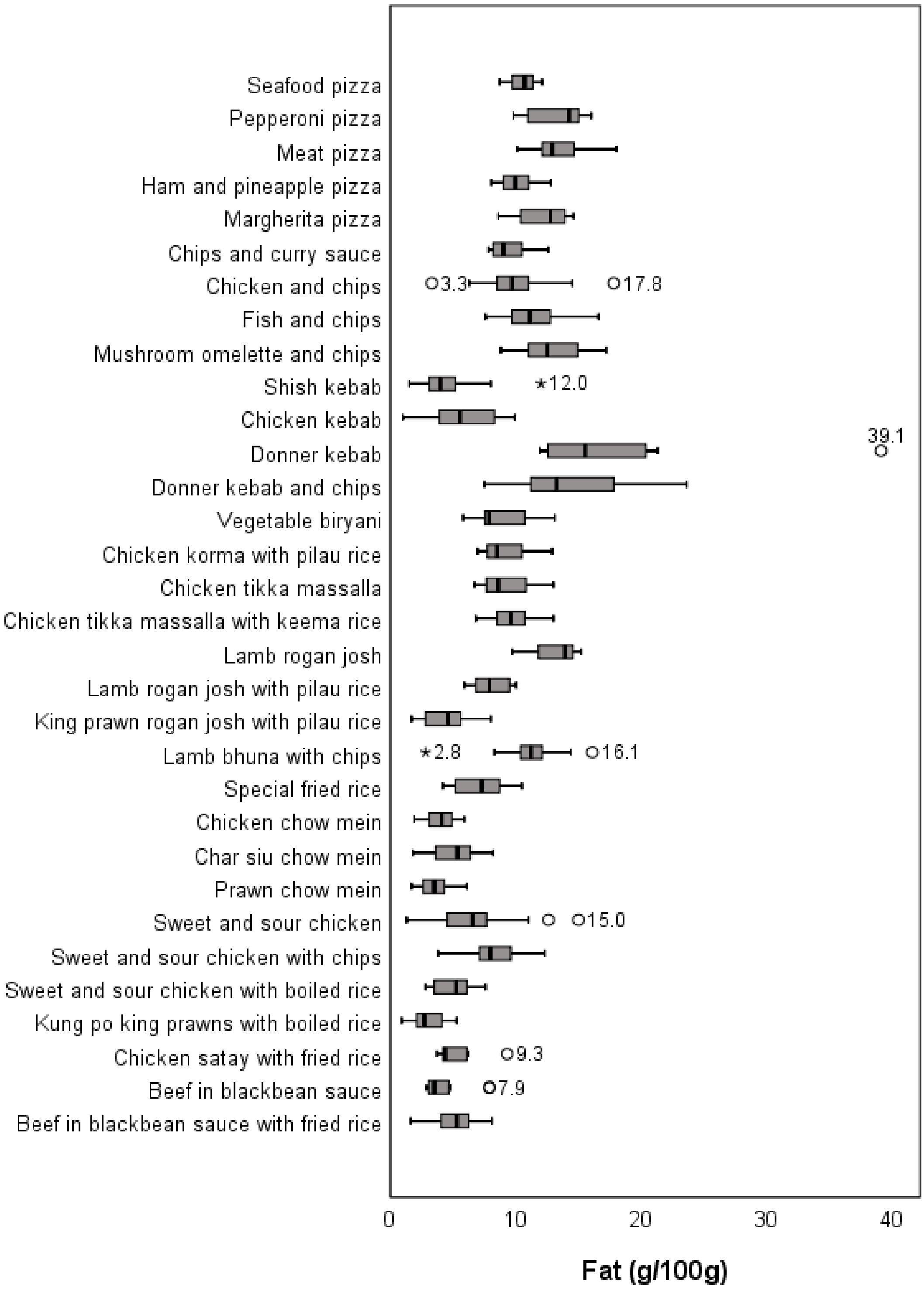


Figure 4.10 Median fat content per 100 g for each meal type

4.4.1.4 Saturated Fatty Acids

Most of the meals in the Pizza and English meal categories contained high levels of SFA resulting in these categories having the highest median SFA content (35.7 g per portion), almost four times higher than the Chinese category (9.1 g per portion). Pizza and English meals also had the highest SFA content per 100 g (Figures 4.11-4.12, Tables 4.6-4.7).

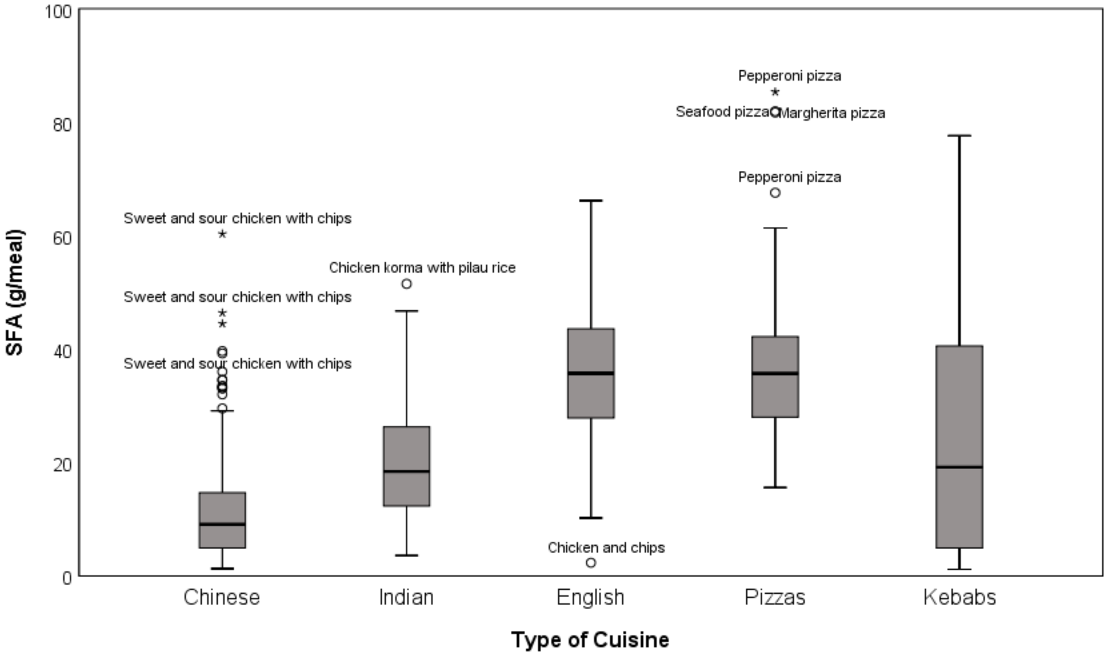


Figure 4.11 Median SFA content per meal for each type of cuisine.
(SFA = saturated fatty acids)

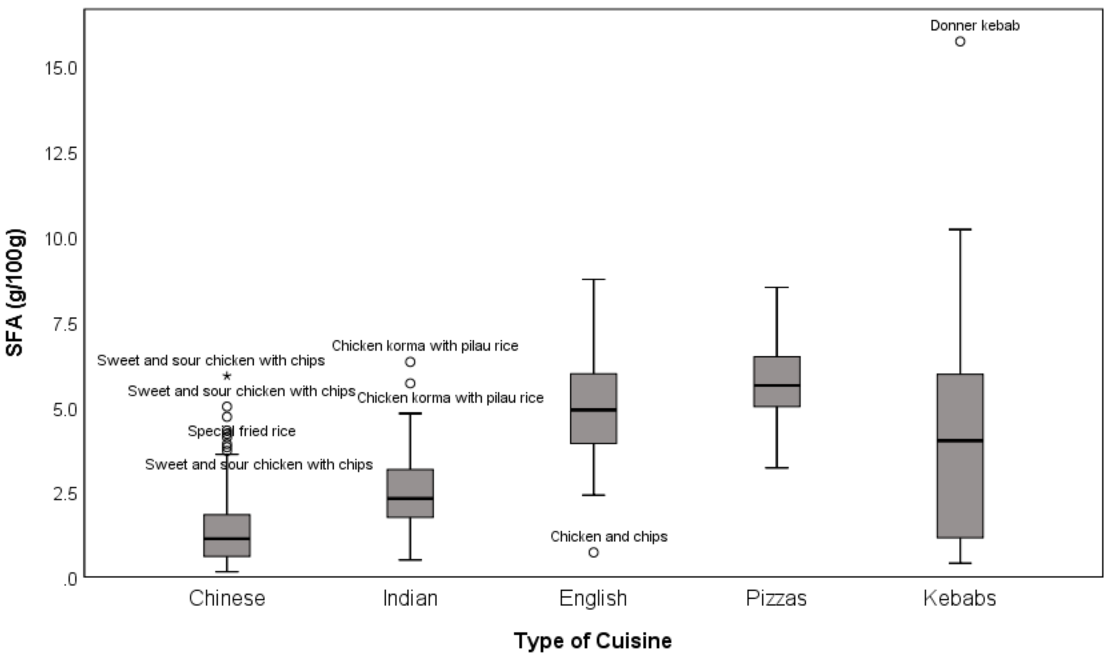


Figure 4.12 Median SFA content per 100g for each type of cuisine.
(SFA = saturated fatty acids)

4.4.1.4.1 Saturated Fatty Acid Content of Individual Takeaway Meals

Some of the meals containing the highest levels of SFA exceeded the UK dietary reference value for SFA from just one meal (31.2 g for men and 23.7 g for women). For example: donner kebab and chips contained 47.6 g, fish and chips 42.0 g, chicken korma and pilau rice 34.5 g and four of the five types of pizzas contained more than 33 g SFA per pizza (Figures 4.13-4.14). These results are comparable with takeaway meals analysed in Sandwell where an average portion of fish and chips contained 34.0 g and an average donner kebab contained 25.7 g (Saunders, Saunders and Middleton, 2015) compared with 42.0 g and 29.9 g respectively in the present study.

Chinese Meals

Apart from sweet and sour chicken and chips which contained 33.1 g of SFA per portion, most of the Chinese meals were low in SFA, which resulted in this category having the lowest SFA per portion and per 100 g. Meals with low SFA content included prawn chow mein with 3.8 g per portion and kung po king prawns with boiled rice with 4.8 g per portion. In the Local Government Group (2011) survey, an average portion of sweet and sour chicken (n = 133) contained 5.4 g SFA (range 0.69-23.2 g). These results are similar to the present study where a median portion of sweet and sour chicken contained 6.6 g (2.5-14.8 g) SFA, the addition of chips increased the SFA content fivefold to 33.1 g (25.1-36.8 g).

Indian Meals

The meals with the highest SFA content per meal and per 100 g were chicken korma with pilau rice (34.5 g/portion and 3.9 g/100 g) and chicken tikka masala with keema rice (22.7 g/portion and 3.0 g/100 g) whilst king prawn rogan josh with pilau rice had the lowest SFA content (9.3 g/portion and 1.2 g/100 g). In the Local Government Group (2011) survey, an average portion of chicken tikka masala (n = 90) contained 19.4 g (7.71-40.9 g) SFA, increasing to 23.2 g with the addition of pilau rice (n = 39) which is comparable with the present study.

Kebabs

In the Kebab category, shish kebab with 4.4 g and chicken kebab with 4.9 g were also low in SFA content in contrast with donner kebab with six times more SFA (29.9 g) per portion. One outlier of note was a donner kebab that contained 15.7 g of SFA per 100 g compared with the median 6.2 g per 100 g for this meal. This donner kebab contained 1358 kcal, 115 g total fat and 46.2 g SFA, equivalent to more than half of a man's daily EAR, 116% DRV for total fat and 145% DRV for SFA.

Pizza and English Meals

Per 100 g, both the Pizza and English categories contained four times more SFA than the Chinese category and twice as much as the Indian category. The high SFA content of pizzas is most likely due to the cheese topping, high in SFA. Per portion, pizzas were not significantly different, but meat pizza was significantly higher in SFA than seafood pizza per 100 g (p <0.005). In the English category, fish and chips were significantly higher in SFA than the other meals both per portion and per 100 g (p <0.008).

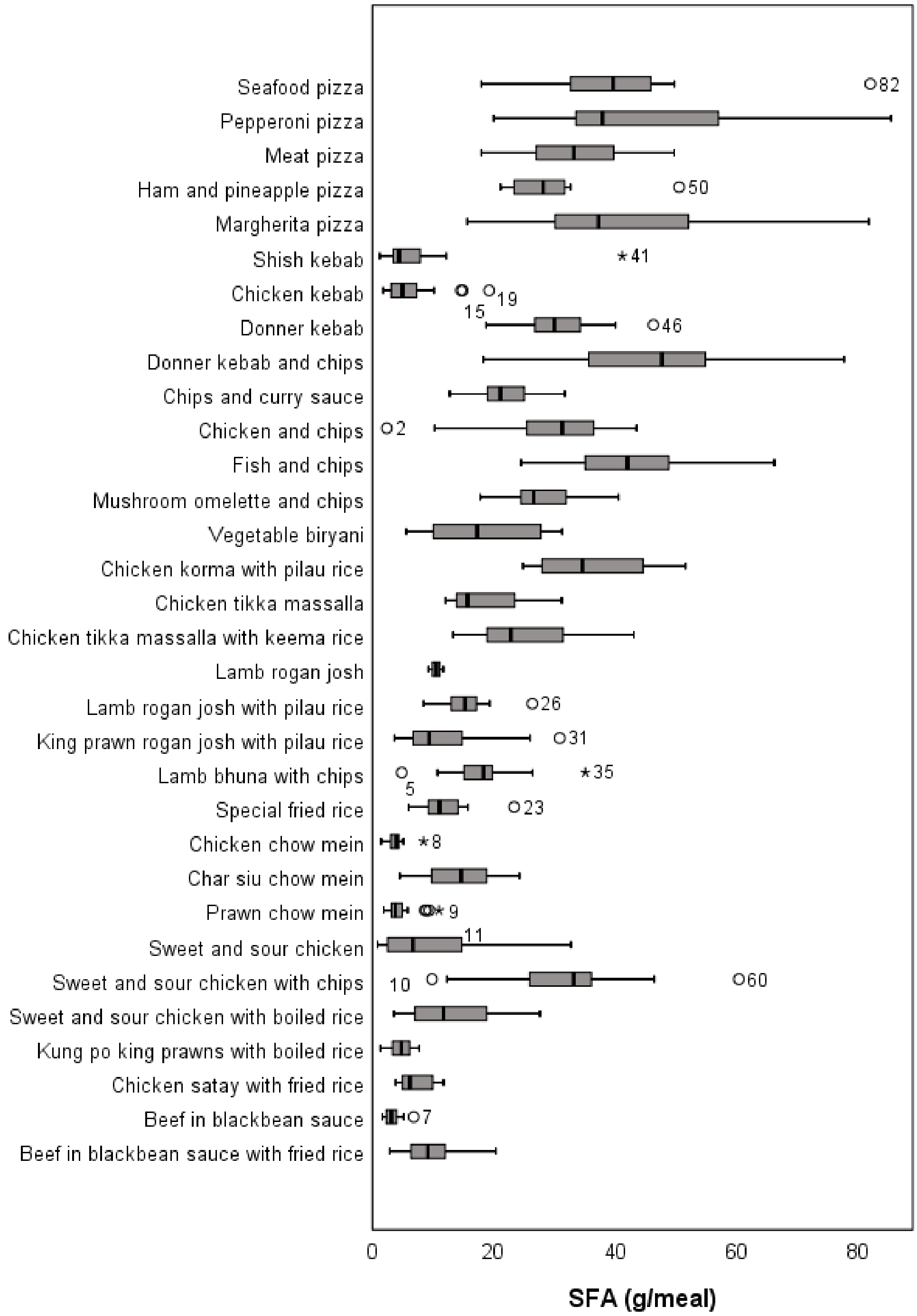


Figure 4.13 Median SFA per meal for each meal type. (SFA = saturated fatty acids)

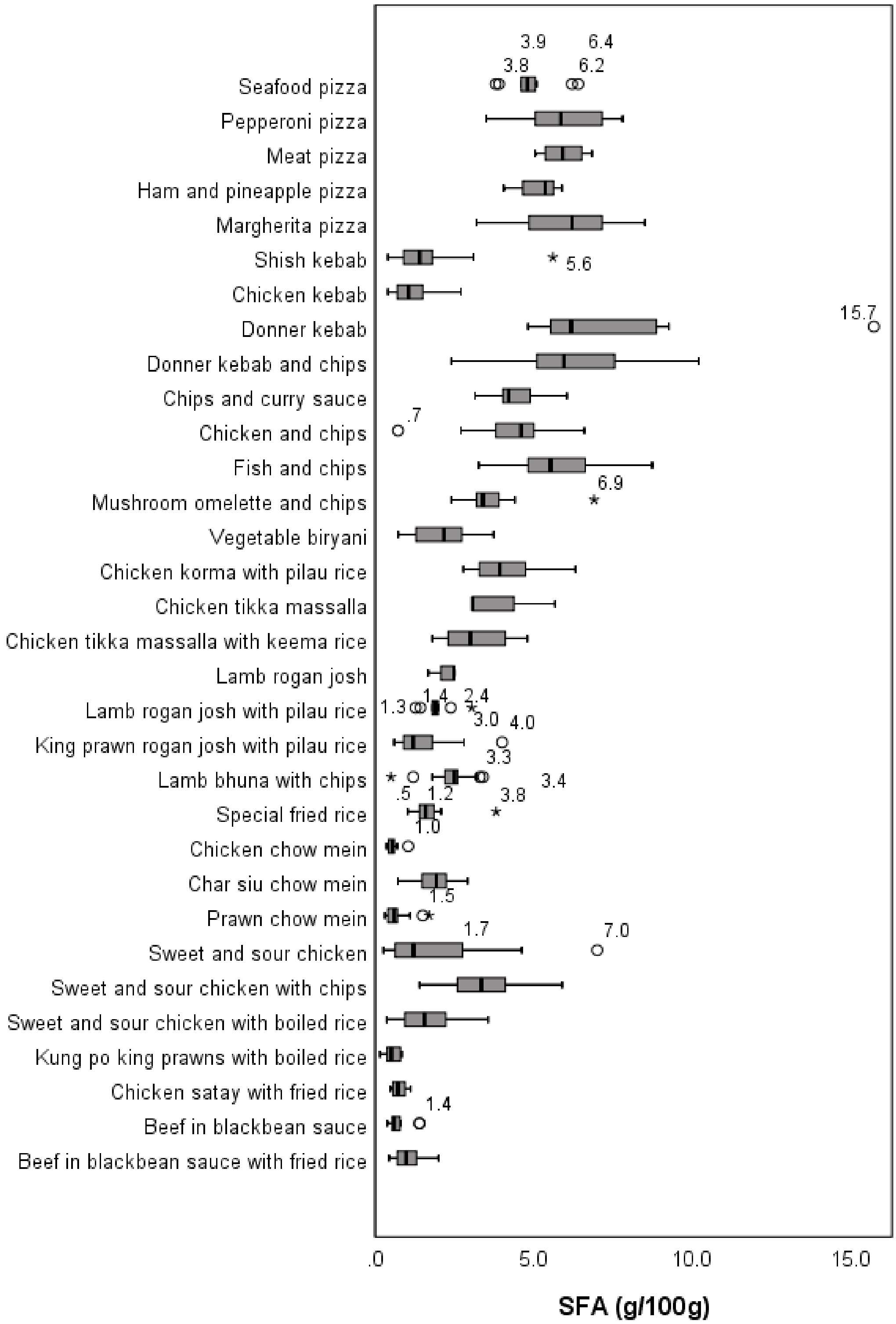


Figure 4.14 Median SFA per 100 g for each meal type. (SFA = saturated fatty acids)

4.4.1.5 Trans Fatty Acids

Dietary TFAs occur naturally in the meat and dairy products of ruminant animals (for example beef, lamb) as a result of microbial action in the digestive tract (Tsuzuki, Matsuoka and Ushida, 2010). TFAs are also industrially produced (iTFAs) when solid fats are created via partial hydrogenation of liquid oils (usually vegetable) (de Souza et al., 2015). Naturally occurring TFAs from ruminants do not usually exceed 6% of total fatty acids in meat and dairy products, whilst partially hydrogenated vegetable oils (PHVOs), the primary source of iTFAs, account for up to 60% of total fatty acids (Firdaus and Mishra, 2021b). iTFAs are used by the food industry to improve shelf-life, stability, and palatability at a lower cost (Food Standards Agency, 2014b; Allen et al., 2015). Major sources of iTFAs include deep fried fast food, chips, and fried potato products, packaged snack foods, baked goods, and spreadable fats (Roe et al., 2013; Hutchinson et al., 2018). In the present study It was not possible to distinguish between industrially produced and naturally occurring TFA from the analysis methodology used by PAL.

The consumption of trans fats has been linked to an increased risk of CHD and CVD due to their adverse impact on serum lipids and lipoproteins (Mensink et al., 2003; Islam et al., 2019). Dietary TFAs have been shown to raise LDL-C and lower HDL-C, contributing to fat deposits in the arteries and assisting in the formation of atherosclerosis (Mozaffarian et al., 2006; Firdaus and Mishra, 2021a). A systematic review by de Souza et al. (2015) found a 2% increase in daily energy intake from TFAs to be associated with a 23% increased risk of CHD and a 31% increase in CHD mortality and this is most likely due to higher intakes of industrially produced rather than ruminant derived trans fats.

To reduce the risk of CHD, current UK guidelines state that TFA consumption should not exceed more than 2% of daily energy requirements for men and women (SACN, 2007) whilst the WHO recommends a reduction to less than 1% of total energy intake and aims to globally eliminate industrially produced TFAs from the food supply by 2023 (WHO, 2020a). Results from the most recent NDNS survey show current mean intakes of consumption are at 0.5 to 0.6% of total energy for the UK adult population (PHE, 2020b). The results in the present study show low TFA levels for the English and Chinese meal categories with 0.3 g per portion, Indian meals and Pizzas were a little higher with 0.8 g and 1.0 g per portion, respectively. The TFA levels were significantly higher in the Kebabs category (p <0.0001), with 2.7 g (1.85-4.45g) per portion. Per 100 g, levels of TFA in the Chinese, Indian and English meal categories were relatively low, and Kebabs were significantly higher than all other categories with 0.85 g (0.53-0.98) per 100 g.

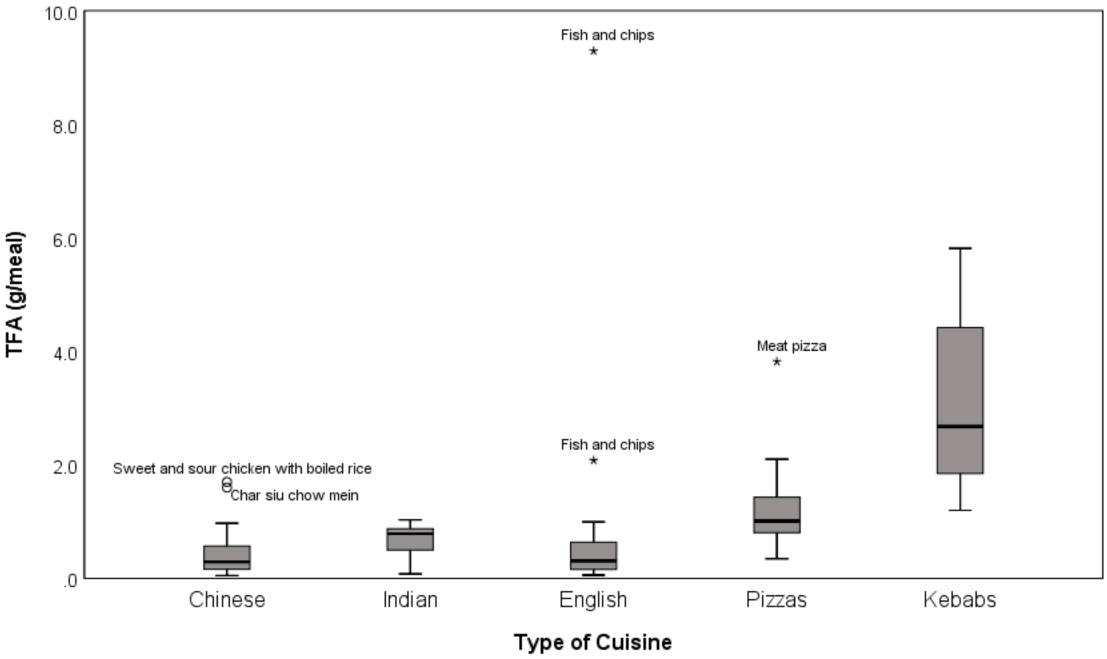


Figure 4.15 Median TFA content per meal for each type of cuisine.
(TFA = trans fatty acids)

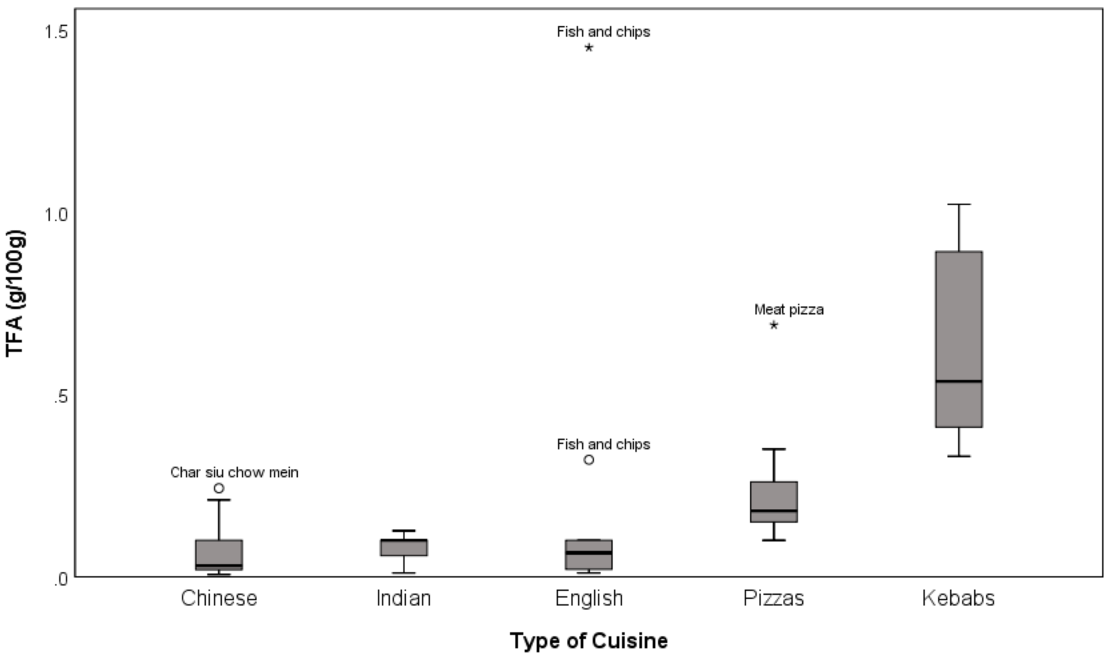


Figure 4.16 Median TFA content per 100 g for each type of cuisine.
(TFA = trans fatty acids)

4.4.1.5.1 Trans Fatty Acid Content of Individual Takeaway Meals

Kebabs

Highest TFA levels were in donner kebabs with 2.0 g per portion. When served with chips this increased twofold to 4.5 g per portion ($p = 0.001$), more than a day's DRV for a woman and 80% of a man's (DRV is 4.3 g for women and 5.7 g for men). Donner kebabs are usually made from lamb meat which contains natural TFAs although the LACORS (2009) study found only a third of sampled kebabs were made purely from sheep meat, 20% were made from sheep and beef meat and 20% were sheep, beef, and chicken. The LACORS study looked at the fat and SFA content of kebabs but unfortunately did not analyse TFA content (*Ibid*). In the FSA Scottish study carried out in Glasgow, portion size of donner kebabs ranged from 192 up to 848 g and contained an average 3.7 g of TFA per portion (Food Standards Agency, 2014b) compared to the present study where the range of portion size was smaller (294 g minimum up to 678 g maximum) and contained 2.0 g TFA per portion. The food composition database shows naturally occurring TFA values for cooked minced lamb and beef is 0.9 g per 100 g and 0.7 g respectively (PHE, 2015a). Allowing for the naturally occurring TFA in the donner meat, the large variation in portion sizes, the pitta bread, salad and any dressings in the present study, 2.0 g (1.83 - 2.79 g) of TFA in a donner kebab sounds credible.

Pizzas, Chinese, Indian and English Meals

At the individual meal level, two different types of pizza (meat / ham and pineapple) contained 1.0 g of TFA per pizza (although there was no data available for the other types of pizza). For the Chinese meals, chicken chow mein (0.69 g/portion) and special fried rice (0.53 g/portion) had the highest TFA levels whilst for the Indian meals, chicken korma with pilau rice contained the most with 0.83 g per portion. Chips and curry sauce contained twice as much TFA (0.49 g (0.46 g – 0.55 g), $p = 0.003$) as fish and chips which had low levels of TFA with 0.25 g (0.15 g – 0.67 g). The low levels of TFA in the Chinese and Indian meals could be due to these types of outlets using vegetable oils when deep-frying. Research carried out by the FSA in the most deprived areas in Scotland found Chinese and Indian style takeaways used vegetable oils for deep-frying whereas most of the fish and chip shops in the study used oil from animal origin such as beef dripping (Food Standards Agency, 2014b).

The FSA's Scottish study also found the highest amounts of TFAs in the foods most commonly fried in beef dripping such as fritters (1.7 g portion), fish and chips (3.0 g portion) and one outlier serving of fish (no chips) which contained 3.6 g TFA (Food Standards Agency, 2014b). Use of beef dripping could be one reason for the increase in

TFA in a portion of donner kebab and chips in the present study. The Healthier Takeaway's Project showed that outlets can reduce TFA content of chips by changing the frying oil to one containing less TFAs (Antrim Borough Council, 2009). Chunkier chips can also reduce overall fat and TFA content, so TFA content may be affected depending on outlets serving French fries rather than chunkier chips. French fries absorb more oil due to their smaller surface area to volume ratio (Asokapandian, Swamy and Hajjul, 2020).

The concentration of TFA in oils has also been found to increase when oils are used repeatedly at high temperatures due to deterioration of unsaturated fatty acids (Chen et al., 2014). Hence TFA content will be affected by how frequently the frying oil is changed, this might be the reason why some meals had a much greater range in TFA content than others, such as donner kebab and chips (Figure 4.17). A fast food chain study carried out by Stender, Dyerberg and Astrup (2007) also showed a large range of TFA content in investigated meals. Their analysis of 74 samples of French fries and fried chicken served by MacDonalds and KFC showed TFA content was variable not only when compared with a different chain but also in different stores in the same chain. A portion of French fries and chicken meat contained between 0.3 and 10.2 g TFA when served from MacDonalds and between 0.3 and 24 g TFA from KFC (Stender, Dyerberg and Astrup, 2007)

Outliers

Outliers of note included two portions of fish and chips with 9.3 g and 2.1 g of TFA, and a meat pizza with 3.8 g. Although TFA levels were relatively low in Chinese meals an outlier portion of sweet and sour chicken with boiled rice contained 1.6 g of TFA and a portion of char siu chow mein contained 1.7 g.

Per 100g, outliers were a portion of fish and chips with 1.45/100 g of TFA, a donner kebab with 1.0 g/100 g of TFA and a meat pizza with 0.69/100 g of TFA. The highest levels of TFA were in donner kebabs with 0.44/100 g and donner kebab with chips where TFA content increased to 0.85/100 g with the addition of chips. These results show how TFA intakes could easily reach and exceed the 5g per day recommendations when combined with the consumption of other TFA containing foods throughout the day.

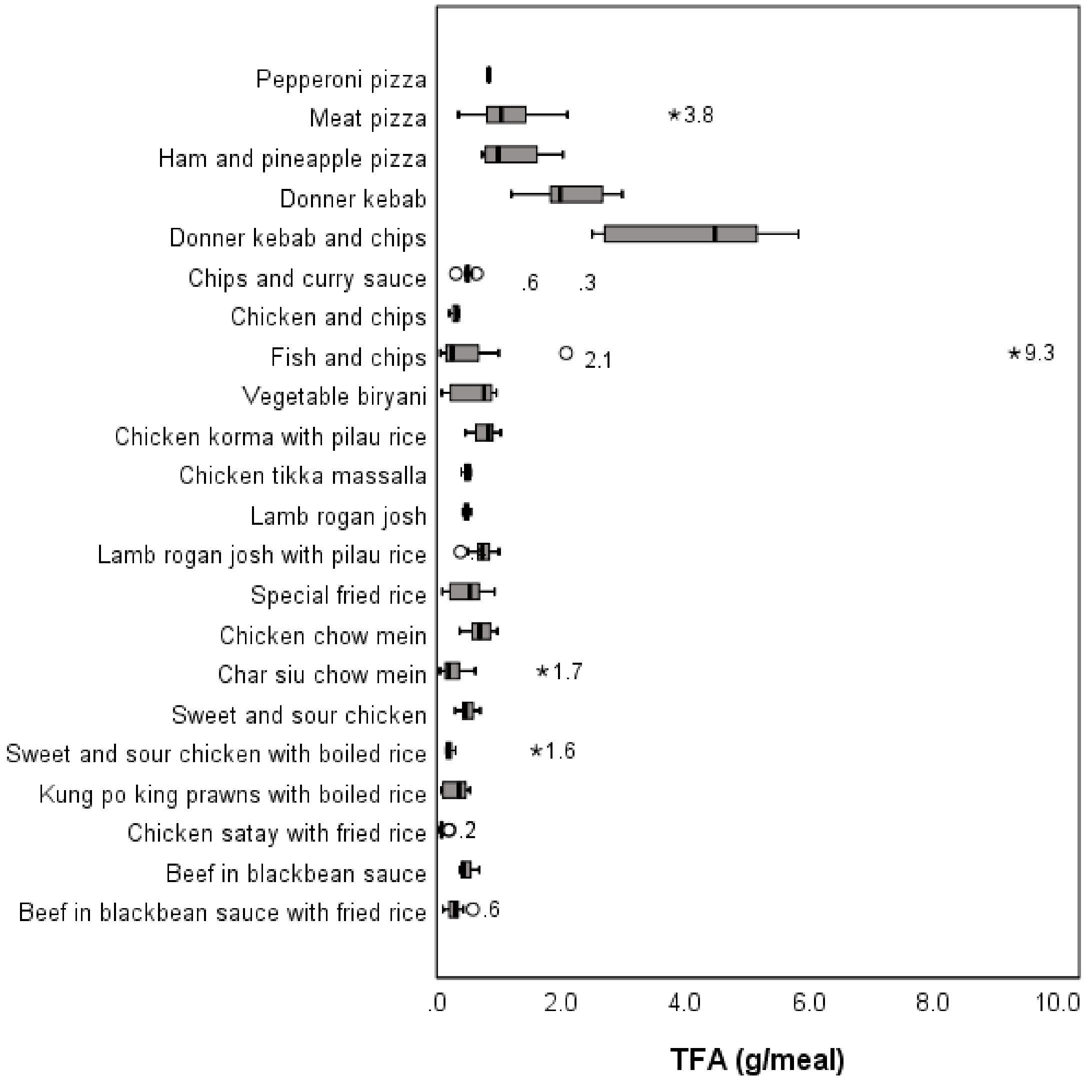


Figure 4.17 Median TFA content per meal for each meal type.
(TFA = trans-fatty acids)

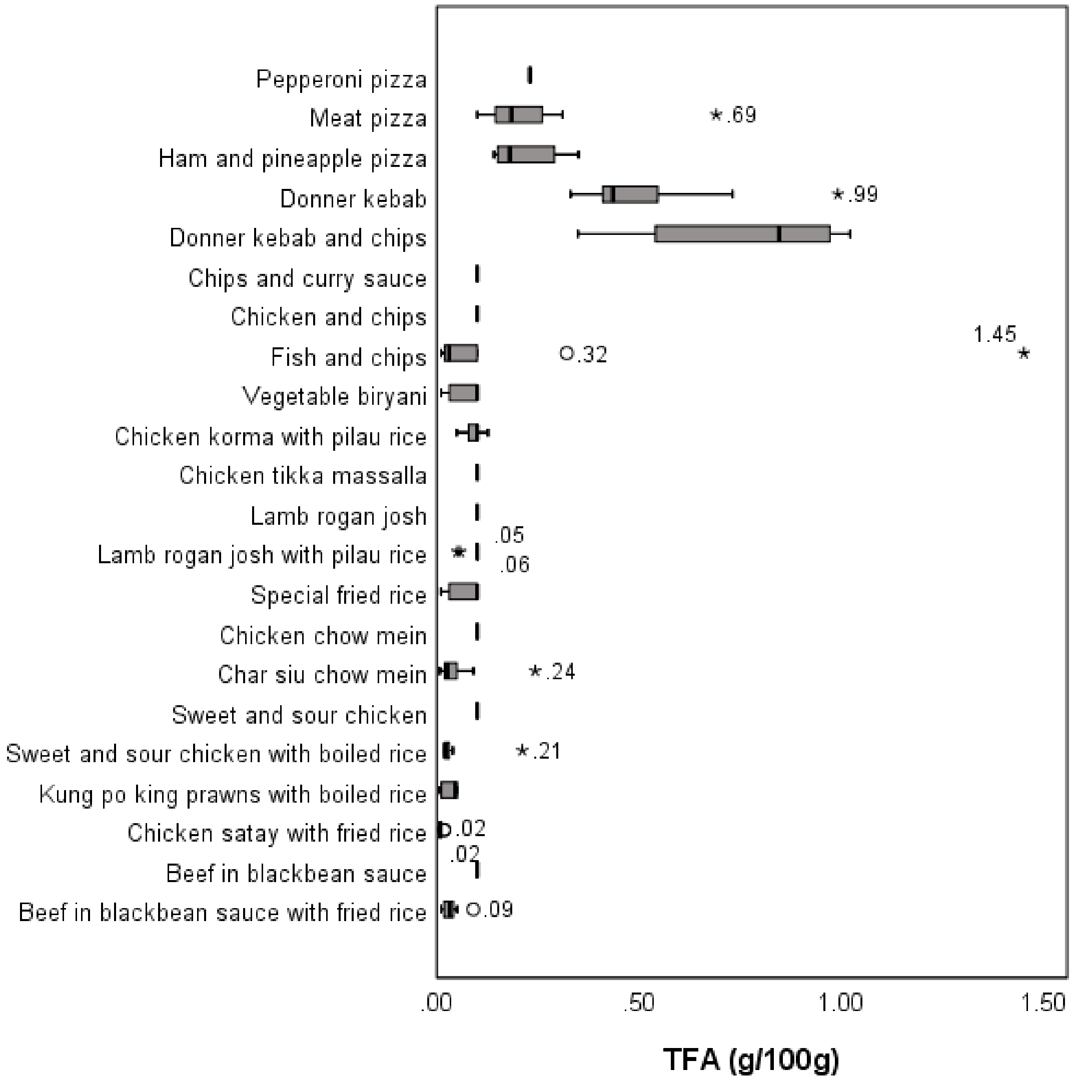


Figure 4.18 Median TFA content per 100 g for each meal type.
(TFA = trans fatty acids)

4.4.1.6 Sugars

Current guidelines are that carbohydrates should account for approximately 50% of total dietary energy. This was comprised of starches, intrinsic sugars, milk sugars and non-milk extrinsic sugars (NMES) until 2015 when NMES was changed to free sugars. Whereas intrinsic sugars are those naturally incorporated into the cellular structure of foods; extrinsic sugars are sugars not contained within the cellular structure of food (except lactose in milk and milk products) but includes all sugars added to foods, for example sucrose, glucose and fructose, and sugars naturally present in fruit juices, for example glucose and fructose (SACN, 2015). The extrinsic sugars in milk and milk products (specifically lactose) were deemed to be exempt from the classification of sugars in relation to the dietary reference value (Department of Health, 1991). Between 1991 and 2015 it was recommended that the population average intake of NMES should be limited to no more than 10% total dietary energy (Department of Health, 1991). The term 'non-milk extrinsic sugars' was exclusively used in the UK and was more challenging to understand when compared to the terms 'free sugars' or 'added sugars'. Hence, SACN (2015) recommended the UK adopt the term free sugars instead of NMES. The definition for free sugars is all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups, and unsweetened fruit juices. Under this definition, lactose naturally present in milk and milk products and sugars contained within the cellular structure of foods would be excluded (SACN, 2015). The sugar declared within the nutritional information panel on food labels refers to 'total sugars' and does not distinguish between free and non-free (intrinsic) sugars. Likewise in the present study, it was not possible to distinguish between free and non-free sugars from the analysis methodology used by PAL.

The quality of carbohydrate in the diet has been associated with increased risk of obesity and metabolic disease. The SACN report on ‘Carbohydrates and Health’ recommends the population average intake of free sugars should not exceed 5% of total dietary energy for all age groups from 2 years upwards. Additionally, both adults and children should minimize the consumption of sugar-sweetened beverages (SSBs) (SACN, 2015). Free sugars in liquid form, such as SSBs, are low in nutritional quality and are associated with low satiety (Malik and Hu, 2019). Furthermore, SSBs may contribute towards weight gain and obesity by increasing overall energy intake and their consumption has been linked with increased risk of metabolic syndrome and type 2 diabetes (Imamura et al., 2015; Malik and Hu, 2019). As SSBs are frequently purchased with out of home food (Taksler et al., 2016) the importance of determining total sugar within takeaway meals served by independent outlets in Liverpool is particularly relevant.

Using UK Biobank data for a large British prospective cohort study of middle-aged adults, Kelly et al. (2021) found intake of free sugars was positively associated with serum triglycerides and inversely associated with HDL-C. There was also an inverse association between intake of non-free sugars and triglycerides suggesting that the quality of carbohydrate and reducing free sugar intake may be important in the prevention of CVD (Kelly et al., 2021). A Swedish population based prospective cohort study of 25,877 individuals in the Malmö Diet and Cancer Study also found different dietary sources of added sugar affected CVD risk (Janzi et al., 2020). Their findings suggested that reducing the consumption of added sugar and SSBs could be helpful in the prevention of stroke and coronary events. The study found an increased risk of incident stroke and coronary events when added sugar intake was more than 20% energy intake, additionally high intakes of SSB (> 8 servings/week) was associated with an increased risk of stroke (Janzi et al., 2020).

The following results for sugar are discussed using 'total sugar' as per methodology. Per 100g and per meal, the highest levels of sugar were observed in the Indian, Chinese and Pizza categories which were all significantly higher in sugar (p <0.001) than the Kebab and English meal categories (Figures 4.19 and 4.20).

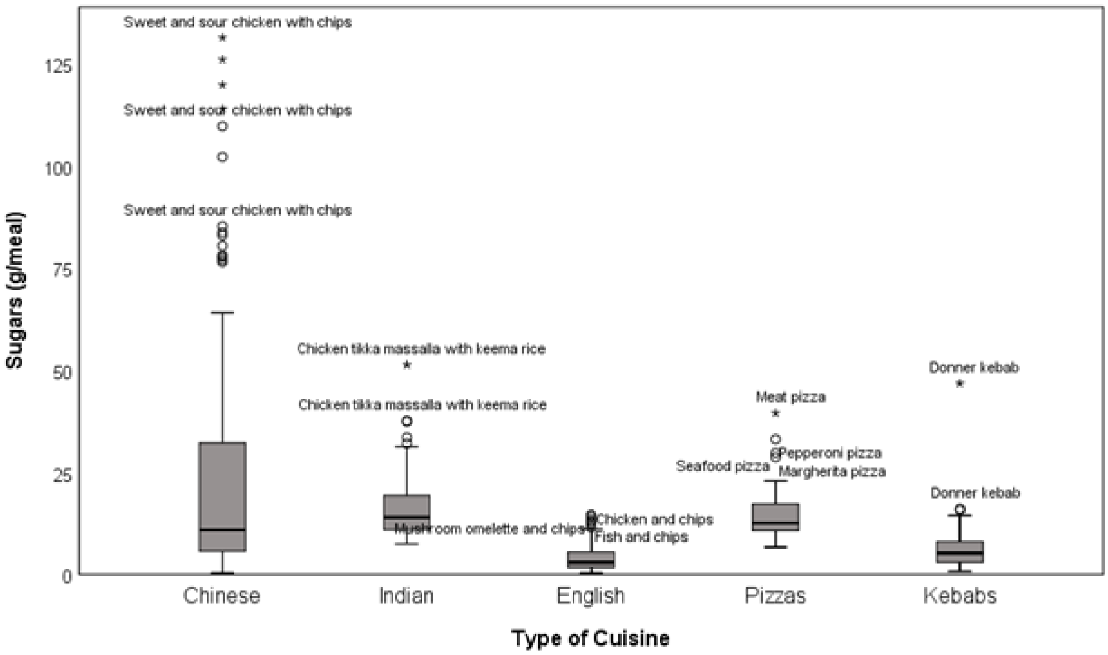


Figure 4.19 Median sugar content per meal for each type of cuisine

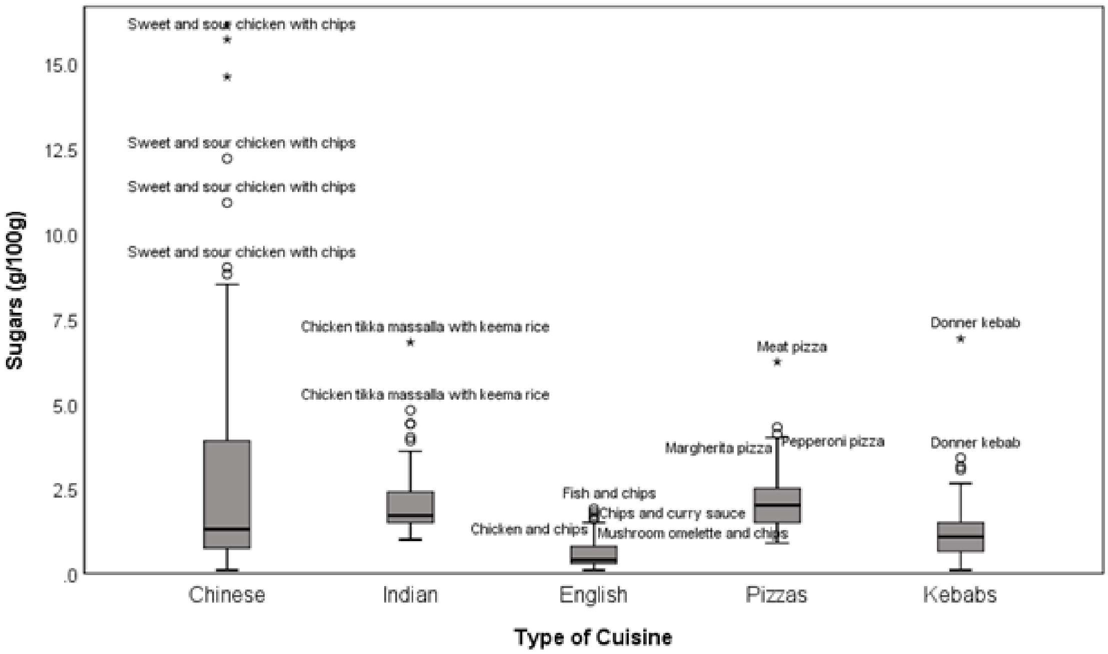


Figure 4.20 Median sugar content per 100 g for each type of cuisine

4.4.1.6.1 Sugar Content of Individual Takeaway Meals

Generally, individual meals were not high in sugar, but high amounts were found in sweet and sour meals and tikka massalla meals. Sweet and sour chicken with chips contained 78.1 g (47.4-106.0 g) of sugar (Figure 4.21) and sweet and sour chicken (no rice) contained 77.2 g (53.8-85.7 g), per 100 g this was equivalent to 7.7 g and 15.1 g respectively (Figure 4.22). High sugar content was also shown in the Local Government Group (2011) survey, where the average sugar content of sweet and sour chicken (no rice, n = 92) was 66.7 g per portion and 13.8 g per 100g. There was no data for sweet and sour chicken with rice, however this would also be expected to be high. These two meals were significantly higher in sugar than all the other Chinese meals where sugar had been analysed: beef in black bean sauce with fried rice, beef in black bean sauce (no rice), prawn chow mein, chicken chow mein, special fried rice (p <0.001). Chicken tikka massalla (no rice) contained the next highest levels of sugar with 52.5 g (49.9 - 64.2 g) per portion and 11.7 g (10.3-12.7 g) per 100g. The sugar content of tikka massalla with boiled rice was not analysed, however analysis with keema rice showed 22.6 g (18.6-31.7) per portion and 2.6 g (2.1-4.0 g) per 100g. In the Local Government Group (2011) survey the average sugar content in chicken tikka masala (no rice, n = 61) was 35.2 g per portion and 7.1 g per 100 g.

These results show that the consumption of a SSB in combination with specific takeaway meals could result in an individual consuming an exceedingly large quantity of sugar, even when not taking side orders into account.

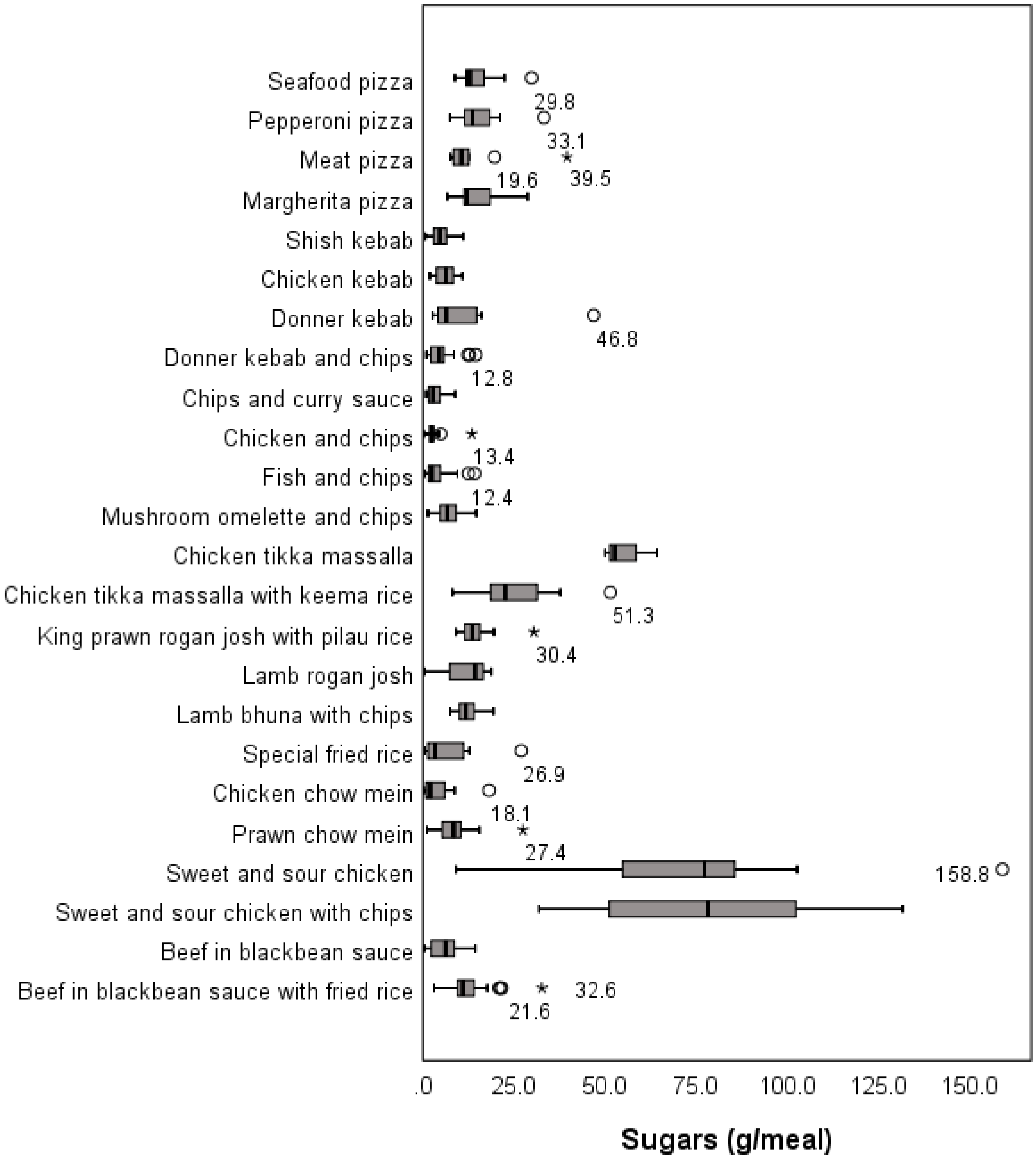


Figure 4.21 Median sugar content per meal for each meal type

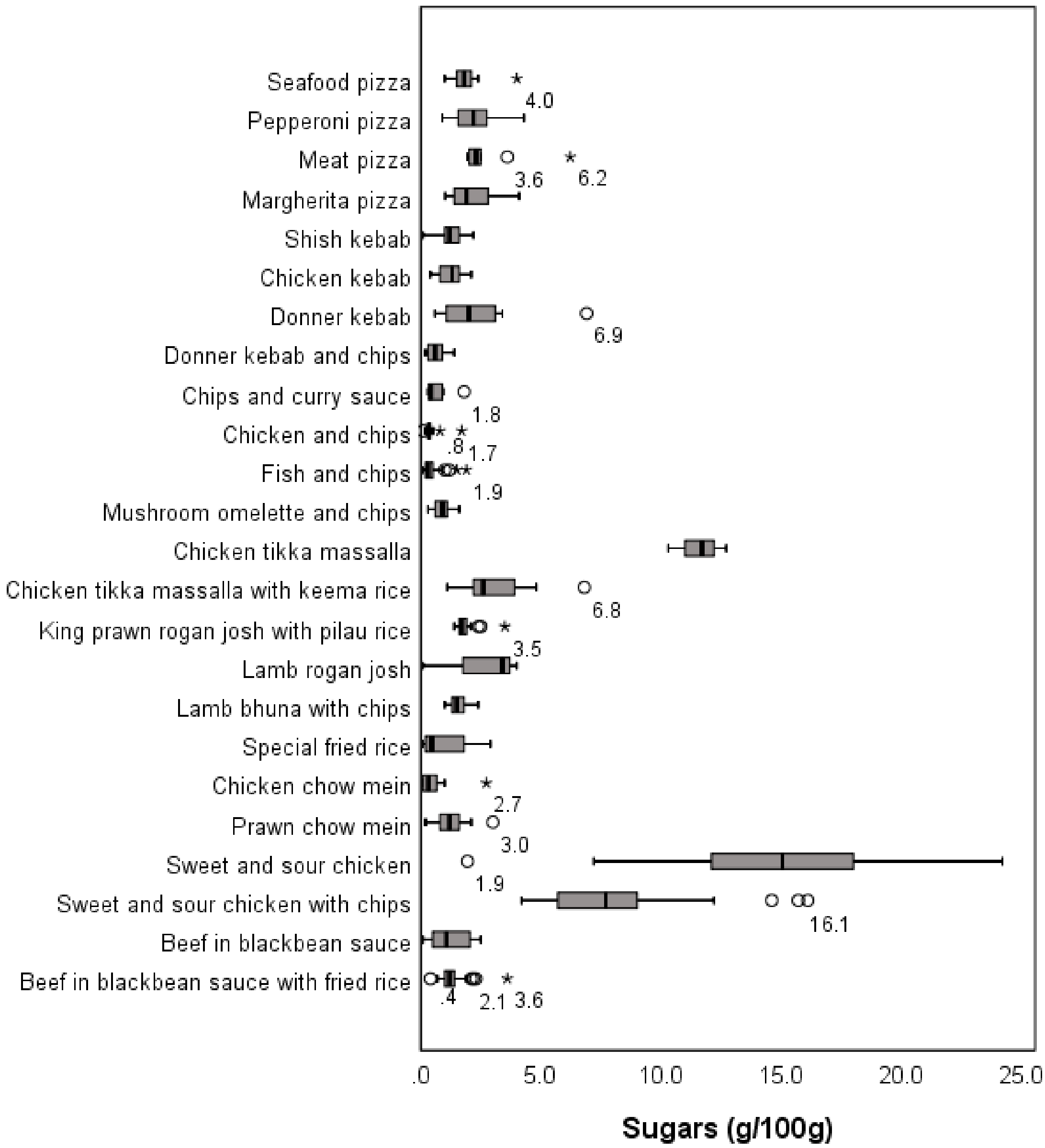


Figure 4.22 Median sugar content per 100 g for each meal type

4.4.1.7 Salt

This study found very high levels of salt in the takeaway meals with many meals containing more than the recommended amount of salt for the whole day. The RNI for salt for adults is 4 g per day and the current UK targets are that adults should aim to eat 6 g of salt a day or less (SACN, 2003). Results from the latest NDNS assessment of salt intake in adults estimates adults salt intake at 7.5 g a day (PHE, 2020a).

In the present study, the results showed pizzas to have the highest median salt content with 9.1 g/meal (6.79-11.96 g) and this meal category was significantly higher (p <0.005) in salt than all other categories. The order of ranking per portion was pizzas > Chinese > kebabs > Indian > English meals (Figure 4.23). For salt density (g/100g), the ranking order was slightly different: pizzas > kebabs > Chinese > Indian > English meals (Figure 4.24). Pizzas had a significantly higher salt density (1.48 g per 100 g (1.26-1.70 g); p<0.005) than all other categories (Chinese, Indian, English, kebabs). Salt content in the English meals was significantly lower per portion (2.98 g (2.10-4.39 g)) and per 100 g (0.41g (0.30-0.59 g)) (p <0.001) compared with all other categories.

With respect to individual meals, the meals with the highest salt content were pepperoni pizza, seafood pizza, beef in black bean sauce with fried rice and chicken satay with fried rice, and these contained 2 to 3 times more salt than the 4 g RNI for salt and twice as much as the recommended 6 g maximum for the day. One reason for the higher levels of salt in the Chinese meals could be due to the significantly higher median portion size, than English, pizza, and kebab meals (p <0.001) (Table 4.1 and Figure 4.1).

Outliers

There were also some outlier meals with exceedingly high salt levels. For example, some Chinese meals contained more than three times the UK salt target of 6 g. A single portion of beef and black bean sauce with fried rice contained 27.6 g of salt and a single portion of prawn chow mein contained 21.8 g of salt per portion (Figure 4.25). Similarly, one of the seafood pizzas contained 21.8 g of salt and a single portion of chicken tikka massalla with keema rice contained double the UK target with 12.5 g of salt.

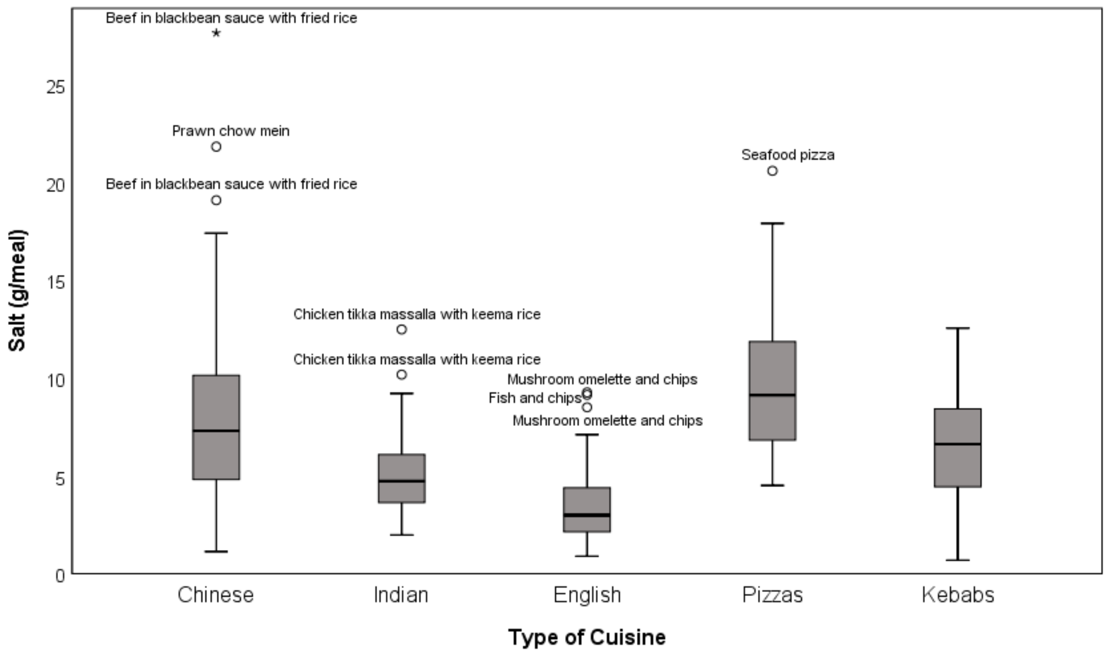


Figure 4.23 Median salt content per meal for each type of cuisine

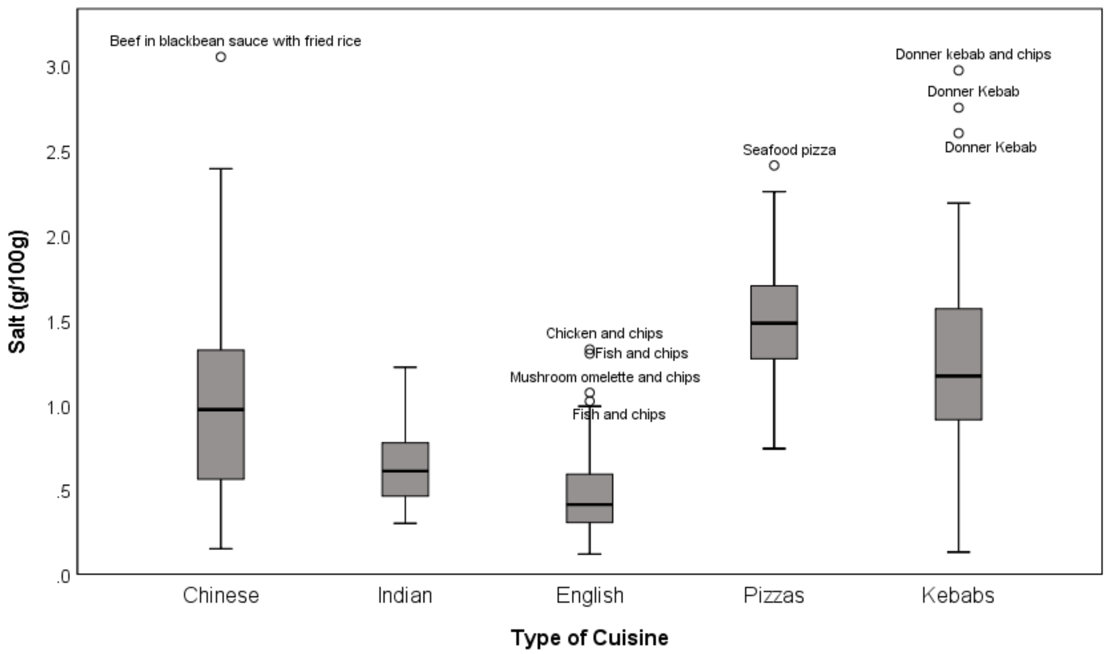


Figure 4.24 Median salt content per 100 g for each type of cuisine

4.4.1.7.1 Salt Content of Individual Meals

Pizzas

The very high salt content in pizzas corresponds with results from the *safe*food pizza survey where the mean salt content in a thin base pizza ranged from 4.6 g in a margherita pizza to 6.84 g in a Hawaiian pizza. When comparing deep base pizzas, salt ranged from 5.8 g to 8.25 g providing 97-138% GDA for salt (*safe*food, 2012a). In the present study, pepperoni pizza contained almost 13 g of salt, seafood pizza contained 11 g and the other three types of pizza contained between 7.7 and 8.8 g of salt. Salt content per 100 g in the present study ranged between 1.32 and 1.63 g per 100 g. These findings correspond with results from the Food Standards Agency (2004) Pizza Survey which analysed a combination of pizzas from takeaways and supermarkets in the UK (n = 98). In the Pizza survey, 32% of pizzas contained more than 3 g of salt in a recommended 200 g portion for an adult and 65% contained more than 1.5 g of salt per 100 g (Food Standards Agency, 2004).

Kebabs

Per 100g, donner kebabs contained the highest salt levels per 100 g with 1.90 g (1.61-2.16 g) and this corresponds with analysis of donner kebabs in the LACORS kebab study. The survey combined results (n = 494) from 76 individual councils and found 43% of kebabs exceeded 6 g of salt, with some as high as 16.6 g per portion (LACORS, 2009). The average salt content per 100 g was 1.97 g and per portion was 5.9 g (98% of adults GDA). In the present study, a portion of donner kebab (no chips) contained 8 g of salt (6.6-9.7 g) and was significantly higher in salt than a portion of chicken kebab ($p = 0.006$) or shish kebab ($p < 0.001$).

Indian and Chinese Meals

Significant differences were found in the salt content between meals in the same cuisine category (Tables 4.7 and 4.8) highlighting the difference between the lowest and highest salt content between meals (see Figure 4.25). For instance, noticeable differences were found in Chinese takeaway meals; sweet and sour chicken with boiled rice and sweet and sour chicken with chips both contained more than three times less salt than a meal of beef, green peppers and black bean sauce with fried rice, prawn chow mein, or chicken satay with fried rice ($p < 0.001$).

Salt levels in the Indian takeaway meals tended to be lower, although a portion of chicken tikka massalla with keema rice contained significantly more salt (6.68 g (5.64-8.18); $p < 0.003$) than chicken korma and pilau rice, king prawn rogan josh, lamb rogan josh and lamb bhuna and chips. Vegetable biryani (5.63 g (4.77-6.47); $p < 0.003$) also contained significantly more salt than chicken korma and pilau rice.

Similarly, high levels of salt were reported in the meals collected and analysed for the 'Local Authorities Food Standards Survey 14' (n = 409) (Local Government Group, 2011). The survey found an average chicken tikka and pilau rice meal provided 92% (5.52 g) of an adults recommended daily intake for salt whilst an average sweet and sour chicken and fried rice meal provided 119% (7.12 g) (Local Government Group, 2011). In the present study, chicken tikka masala with keema rice contained 6.68 g (5.64-8.18 g) of salt and 3.71 g (3.54-4.08 g) of salt in chicken tikka masala (no rice). The present study does not have results for sweet and sour chicken with fried rice, however sweet and sour chicken with boiled rice contained 3.13 g (1.83-3.76 g) of salt and sweet and sour chicken (no rice) contained 3.74 g (2.30-5.12 g).

English Meals

Per portion, mushroom omelette and chips contained the highest amount of salt (3.77 g (2.15-5.55 g)) whilst chicken and chips contained the lowest (2.18 g (1.68-3.23 g)) although there were no significant differences between meals in this category. Per 100 g, only chips with curry sauce (0.63 g (0.47-0.82 g)) was significantly higher in salt (p = 0.005) than chicken and chips (0.36 g (0.24-0.56)). Dunford et al. (2012) studied salt content in fast food served by multinational fast-food chains served across six countries. Using available public information for salt content in fast food, the researchers found great variation in salt content, not only between products in the same categories but also between similar products served by the same company but in different countries (Dunford et al., 2012). For instance, salt content was significantly lower in chicken products served in the UK when compared with the United States (1.1 g salt per 100 g compared with 1.8 g per 100g) and McDonalds Chicken McNuggets contained 0.6 g of salt per 100 g in the UK compared with 1.6 g per 100 g in the United States.

These results show a large proportion of takeaway meals contain high levels of salt and that if takeaway outlets were to reduce salt content in some of the takeaway meals they serve, this could help to improve the health of their takeaway consumers.

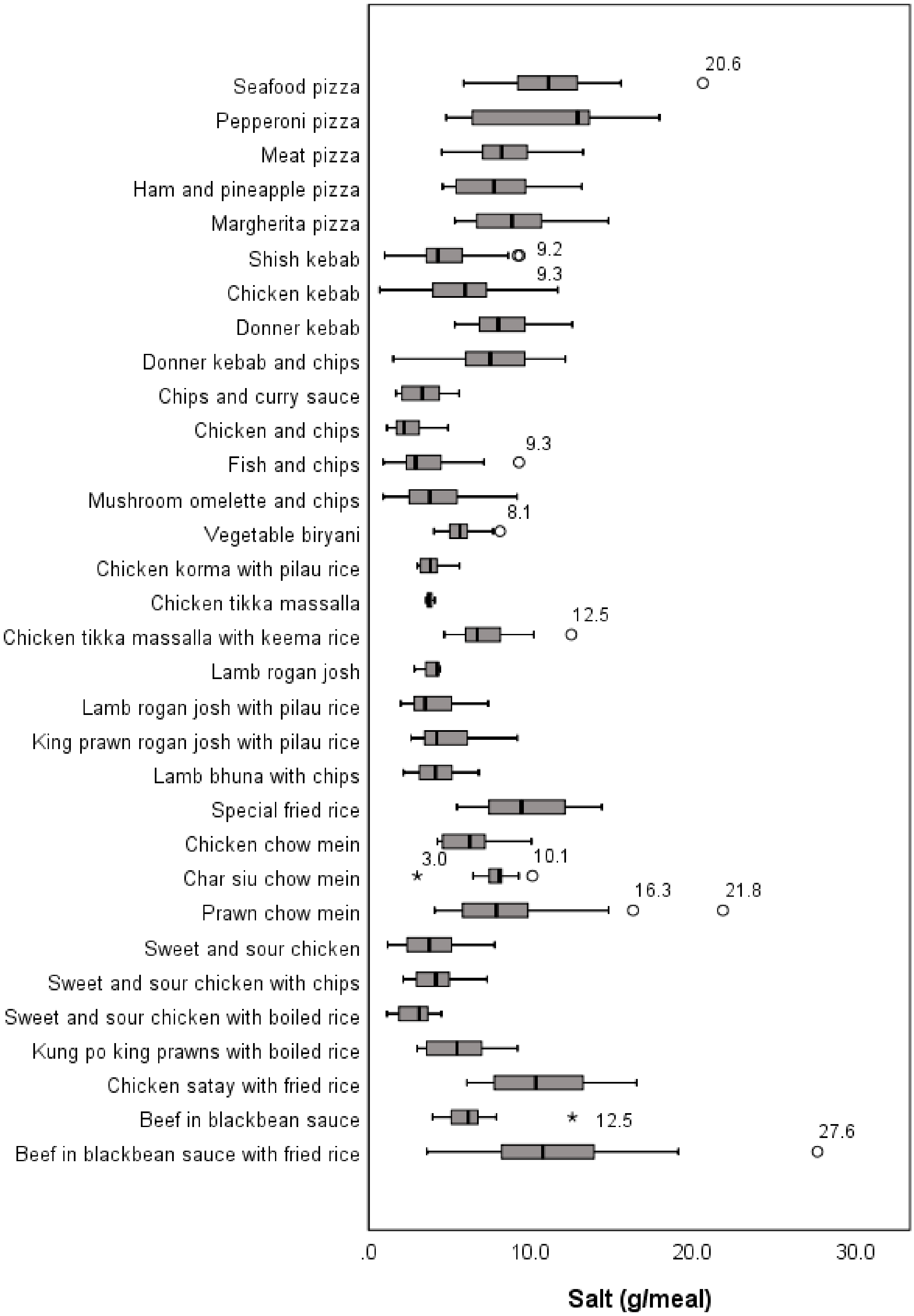


Figure 4.25 Median salt content per meal for each meal type

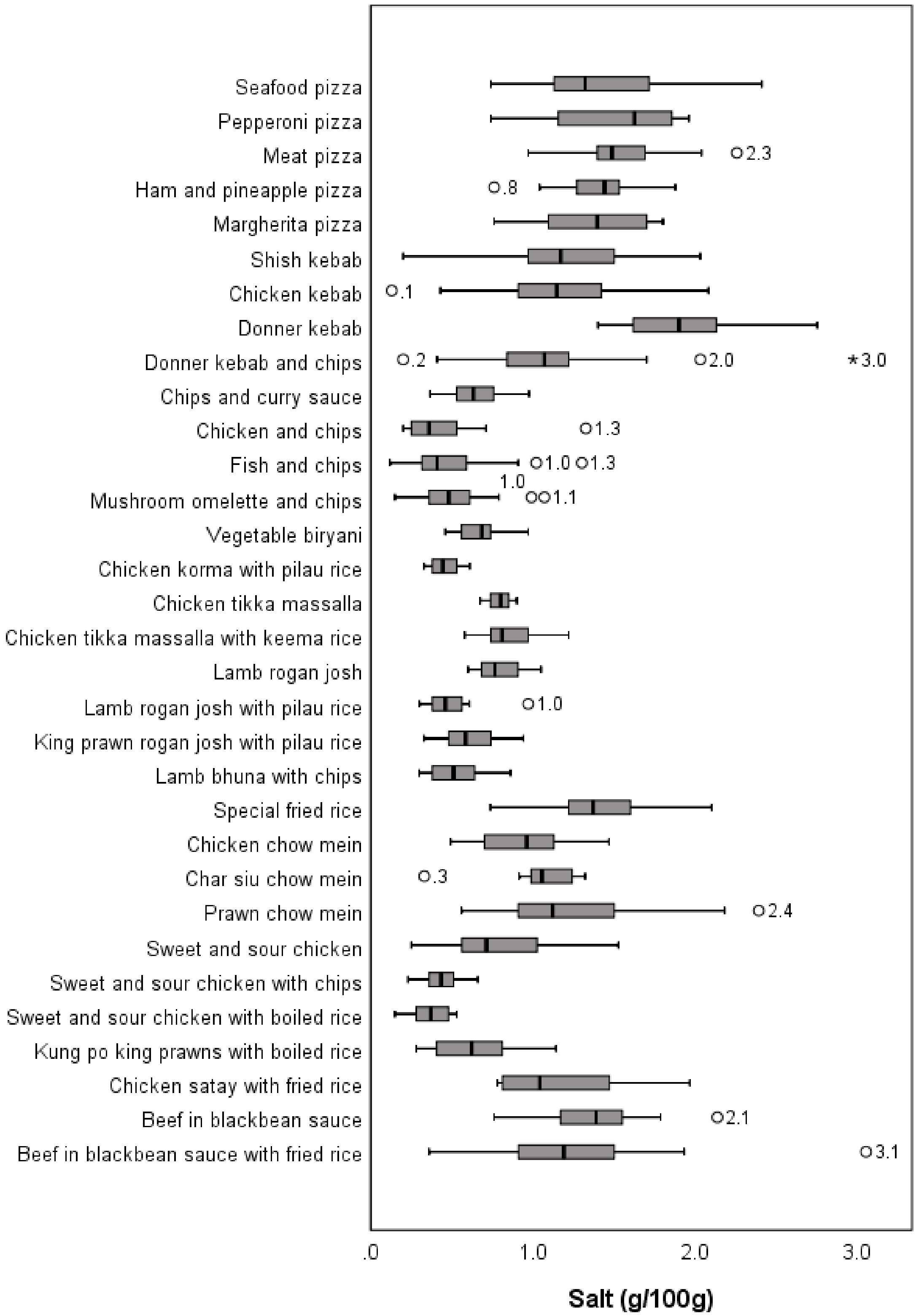


Figure 4.26 Median salt content per 100g for each meal type

4.4.1.8 Salt Targets and Reformulation

The governments Green Paper ‘Advancing our health: prevention in the 2020s’ aims to reduce the population salt intakes to 7 g per day using industry salt reduction targets (Department of Health & Social Care, 2019). Since the publication of the SACN (2003) ‘Salt and Health’ report, there have been five voluntary salt reduction targets published by the government for individual categories of food. The latest targets were published in September 2020 and businesses are expected to work towards achieving these by 2024. The eating out, takeaway and delivery sector is expected to commit to meeting the maximum per serving target specifically designed for this sector. Their targets include a ‘Dish Target’ for individual dishes that can be served on its own or as part of a dish and a ‘Meal Target’ which includes a specific dish, sides and accompaniment (PHE, 2020d).

Indian Meals

The current salt meal target for Indian main meals is 3.8 g and this target includes any side dishes the meal would usually be served with such as rice, naan, prawn crackers. In the present study, of the 6 Indian main meals, only chicken korma and pilau rice (3.8 g median) and lamb rogan josh with pilau rice (3.5 g median) met the 3.8 g target, with median salt content of the four other main meals ranging from 4.1 g up to 6.7 g.

Chinese Meals

As regards the Chinese meals, only one of the nine meals met the 3.2 g sauce-based meal target: sweet and sour chicken with boiled rice (3.1 g median). The median salt content for the eight other main meals ranged from 4.1 g up to 10.7 g with five meals containing more than double the salt target.

It is important to note that these comparisons with the Chinese and Indian meal targets do not include naan bread, prawn crackers or other sides, just the main rice, noodles or chips component and if they were added then the salt content of the meal would be expected to increase meaning less meals would meet the above-mentioned targets. Furthermore, only two Chinese meals and four Indian meals met the earlier 2006 targets (0.6g salt per 100g) for meat based takeaway meals (Food Standards Agency, 2006).

Pizzas

Since 2006, the voluntary salt target for pizzas have reduced from 1.2 g/100 g (by 2010) to 1.0 g/100 g (by 2024). In this study, the median salt content per 100 g for each of the different types of pizzas substantially exceeded both the 2010 and 2024 targets (Food Standards Agency, 2006; PHE, 2020d) with salt content ranging from 1.32 g for seafood pizza up to 1.63 g for pepperoni pizza. Additional 2024 targets for takeaway pizza include

1.13 g salt per slice (for toppings that include cured meat) and 0.88 g salt per slice for all other toppings. Using their guide of eight slices per medium pizza, then in the present study, a median slice of pepperoni pizza would weigh approximately 80 g and contain 1.61 g of salt, well over the target of 1.13 g for cured meat toppings. A medium margherita pizza would weigh in at 84 g a slice and contain 1.1 g of salt, greater than the 0.88 g target.

Kebabs

The targets for kebabs have also reduced considerably since 2006 when the target was set at 1.0 g/100 g, gradually decreasing to 0.75 g/100 g by 2017 and now 0.68 g/100 g by 2024 (PHE, 2020d). None of the kebabs in the study met the earlier 1.0 g target or the later reduced targets, although the median salt content for chicken or shish kebabs was significantly lower than the salt content in donner kebabs (1.1 g/100 g versus 1.9 g/100 g respectively; p <0.008). However, the salt level in donner kebabs was more than double the latest target of 0.68 g/100 g at 1.9 g/100 g (1.61-2.16).

English Meals

In 2006, the FSA target for coated poultry products was set at 1.0 g per 100 g and the latest 2024 criteria for battered or breaded chicken portions and pieces is a dish target dependent on energy content per portion (0.9 g salt <200kcal; 1.8 g salt 200-400 kcal; 3.15 g salt >400 kcal) (PHE, 2020d) so neither are comparable to the results in this study (as the chicken was collected and analysed with chips). However, 88% of the chicken and chips meals met the 2006 criteria for meat based takeaway meals of 0.6 g/100 g. Even so, portion sizes were large in this category with most meals providing an excess amount of salt, for example chicken and chips contained 2.18 g (1.68-3.23); fish and chips 2.89 g (2.31-4.47); chips and curry sauce 3.31 g (1.88-4.55); and mushroom omelette and chips 3.77 g (2.15-5.55).

Two thirds (n = 42) of the sampled fish and chips meals met the 2006 criteria for fish based takeaways which was set at 0.5/100 g (Food Standards Agency, 2006) with a median salt content of 0.41/100 g (0.31-0.59). However large portion sizes 749 g (656-827 g) meant that over half of these meals (n = 34) did not meet the latest voluntary target set at 2.75 g salt per serving (meal target). The median salt content per portion was 2.89 g salt (2.31-4.47 g) and one portion contained more than three times this target with 9.3 g of salt. These results are higher when compared with the fish and chop meals collected by North Yorkshire County Council where the average portion size of fish and chips (n = 5) was 567 g, salt content was 1.46 g per portion and 0.26 g per 100 g, however sample size was very small (Hudson, 2007). Thirty-six portions of chips were purchased in the Sandwell takeaway food survey, without additional salt added at the takeaway counter. Using an average portion size of 355 g for chips, the salt content in the Sandwell survey was calculated to be 0.6 g per portion of fish and chips (Saunders, Saunders and Middleton, 2015), which is higher than the 0.41 g/100g in the present study. More recently, a study carried out in Northern England analysed the sodium content of fish and chips, meals, and component parts, purchased from fish and chip shops (n = 61) (Goffe et al., 2016). The mean salt content in a portion of fish and chips was 2.9 g of salt which is comparable with the 2.89 g in the present study (Goffe et al., 2016). Although in the present study, it was not known whether salt was added at the counter or not when the meal was sampled.

4.4.1.9 Traffic Light System

To help consumers make healthier choices when food shopping, they are often provided with a traffic light signpost labelling system. When examining nutritional labels on foods, the traffic light system shows if the food is high in fat, SFA, sugars and salt per 100 g. When comparing this system with the takeaway meals in this study, the majority of Chinese meals would be considered low in fat and SFA (less than 3 g fat per 100 g and 1.5 g SFA per 100 g) and medium for salt (0.3-1.5 g per 100 g). Some meals would be classed as high (red) in SFA if they contained more than 5 g SFA per 100 g, such as donner kebab and margherita pizza, both with 6.2 g per 100 g and fish and chips with 5.5 g per 100 g. Meals that would be categorised as medium (amber) include chicken korma with pilau rice with 3.92 g SFA per 100 g and sweet and sour chicken with chips with 3.35 g SFA per 100 g (this is most likely due to deep-frying the chicken pieces as well as the chips). At first glance these figures may not seem extreme, but when portion size is considered, the values for the majority of meals are of concern.

PER 100G FOOD	LOW	MEDIUM	HIGH
Fat	3g or less	3-17.5g	17.5g or more
Saturates	1.5 g or less	1.5-5g	5g or more
Sugars	5g or less	5 – 22.5g	22.5g or more
Salt	0.3g or less	0.3-1.5g	1.5g or more

Figure 4.27 Traffic Light Criteria for 100 g of food
(Department of Health, 2013)

Table 4.5 Nutritional Composition of Takeaway Meals per portion (*objective one*)

Takeaway Group	n^1	Portion Size (g)	Energy (kcal/meal)	Fat (g/meal)	SFA (g/meal)	n^2	TFA (g/meal)	n^3	Salt (g/meal)	n^4	Sugars (g/meal)
Chinese (all meals)	145	830 (694-935)[3,4,5]	1247 (968-1569)	42.1 (26.7-59.9)	9.1 (4.9-14.7)	81	0.29 (0.16-0.58)	145	7.30 (4.78-10.15)[2,3]	83	10.9 (5.4-32.6)[3]
Indian (all meals)	95	803 (731-864)[3,4,5]	1391 (1170-1585)[5]	69.6 (50.4-86.3)[1]	18.4 (11.8-26.3)[1]	30	0.79 (0.50-0.88)[1,3]	95	4.73 (3.61-6.10)[3]	63	14.0 (10.9-19.4)[3,5]
English (all meals)	119	716 (638-830)[4,5]	1606 (1431-1881)[1,2,5]	79.8 (65.7-94.0)[1,2,5]	35.7 (27.2-43.7)[1,2,5]	54	0.31 (0.16-0.64)	119	2.98 (2.10-4.39)	87	3.0 (1.7-5.6)
Pizza (all meals)	65	637 (538-768)[5]	1820 (1469-2152)[1,2,3,5]	74.9 (56.5-96.4)[1,5]	35.7 (27.8-43.3)[1,2,5]	31	1.01 (0.81-1.56)[1,2,3]	65	9.12 (6.79-11.96)[1,2,3,5]	45	12.6 (10.7-17.8)[3,5]
Kebabs (all meals)	87	491 (418-636)	1125 (690-1673)	58.9 (22.3-93.3)	19.2 (4.4-41.1)[1]	22	2.68 (1.85-4.45)[1,2,3,4]	87	6.62 (4.27-8.48)[2,3]	75	5.3 (3.0-8.3)[3]

Table 4.6 Nutritional Composition of Takeaway Meals per 100g (*objective one*)

Takeaway Group	n^1	Energy (kcal/100g)	Fat (g/100g)	SFA (g/100g)	n^2	TFA (g/100g)	n^3	Salt (g/100g)	n^4	Sugars (g/100g)
Chinese (all meals)	145	150 (125-189)	5.1 (3.7-7.1)	1.12 (0.60-1.84)	81	0.03 (0.02-0.10)	145	0.97 (0.55-1.34)[2,3]	83	1.3 (0.7-4.2)[3]
Indian (all meals)	95	176 (145-197)[1]	8.6 (6.1-10.7)[1]	2.30 (1.70-3.20)[1]	30	0.10 (0.06-0.10)[1]	95	0.61 (0.46-0.79)[3]	63	1.7 (1.5-2.4)[3,5]
English (all meals)	119	234 (207-240)[1,2]	10.9 (9.3-12.7)[1,2]	4.90 (3.90-5.98)[1,2]	54	0.07 (0.02-0.10)	119	0.41 (0.30-0.59)	87	0.4 (0.3-0.8)
Pizza (all meals)	65	283 (260-304)[1,2,3,5]	12.1 (10.6-14.0)[1,2,5]	5.62 (5.00-6.48)[1,2,3,5]	31	0.18 (0.15-0.26)[1,2,3]	65	1.48 (1.26-1.70)[1,2,3,5]	45	2.0 (1.5-2.5)[3,5]
Kebabs (all meals)	87	206 (155-257)[1,2]	9.9 (4.9-14.0)[1]	4.00 (1.10-6.00)[1]	22	0.54 (0.41-0.89)[1,2,3,4]	87	1.17 (0.91-1.58)[1,2,3]	75	1.1 (0.6-1.5)[3]

Notes: n^1 = number of meals for Portion Size, Energy, Fat, SFA $\quad$ n^2 = number of meals for TFA

n^3 = number of meals for Salt $\quad$ n^4 = number of meals for Total Sugars

Data presented as median (interquartile range: 25th - 75th percentile)

Significant difference of paired comparisons within meal categories

(*p* <0.005; Kruskal–Wallis test; *p* <0.005; Mann–Whitney's test with Bonferroni adjustment: 1 Chinese; 2 Indian; 3 English; 4 pizza; 5 kebabs).

Table 4.7 Nutritional Composition of Takeaway Meals per Portion – Energy, Salt, and Sugars

Meal type	n^1	Portion Size (g)	Energy (kcal/meal)	Salt (g/meal)	n^2	Sugars (g/meal)
Chinese						
Beef in black bean sauce with fried rice	31	915 (871-1013)[d,f,i]	1386 (1170-1559)[d,e]	10.72 (8.13-13.88)[b,c,h]	21	11.0 (8.8-15.8)[e]
Beef in black bean sauce (no rice)	12	424 (396-560)	432 (335-552)	6.13 (5.05-6.79)	12	6.2 (2.1-8.7)
Sweet & sour chicken with boiled rice	10	766 (744-868)	1501 (1415-1619)[d]	3.13 (1.83-3.76)		n/d
Sweet & sour chicken with chips	22	931 (785-1199)[i]	2031 (1680-2230)[a,d,e,f,h,i]	4.14 (2.94-4.98)	21	78.1 (47.4-106.0)[a,cc,d,e,i]
Sweet & sour chicken (no rice)	28	469 (419-586)	914 (698-1067)	3.74 (2.30-5.12)	28	77.2 (53.8-85.7)[a,cc,d,e,i]
Prawn chow mein	21	679 (584-834)	725 (651-884)	7.88 (5.58-9.99)[b,c]	21	8.4 (5.2-10.8)
Chicken chow mein	10	690 (567-873)	839 (697-1024)	6.23 (4.50-7.45)[b]	10	2.1 (0.9-6.6)
Char sui chow mein	10	716 (680-848)	1095 (806-1159)	8.07 (7.18-8.46)[c]		n/d
Chicken satay with fried rice	10	891 (781-1063)	1247 (1095-1727)[d]	10.30 (7.50-13.40)[b,c]		n/d
Kung po king prawns with boiled rice	10	882 (794-931)	1098 (984-1318)[d]	5.45 (3.51-7.37)		n/d
Special fried rice	21	686 (604-742)	1367 (1235-1547)[d,e,f]	9.41 (7.17-12.33)[b,c]	10	3.3 (1.2-11.6)
Indian						
Chicken korma with pilau rice	10	869 (819-923)	1595 (1459-1744)[l]	3.81 (3.18-4.35)		n/d
Chicken tikka massala with keema rice	21	808 (746-872)	1480 (1331-1689)[l]	6.68 (5.64-8.18)[j,l,m,n]	21	22.6 (18.6-31.7)[l,n]
Chicken tikka massala (no rice)	3	510 (393-549)	882 (664-1224)	3.71 (3.54-4.08)	3	52.5 (49.9-64.2)
King prawn rogan josh with pilau rice	22	772 (701-828)	1027 (838-1155)	4.20 (3.44-6.08)	21	13.6 (11.2-16.1)
Lamb rogan josh with pilau rice	10	758 (719-857)	1356 (1246-1479)[l]	3.49 (2.78-5.23)		n/d
Lamb rogan josh (no rice)	3	470 (419-551)	870 (771-992)	4.21 (2.82-4.40)	3	14.2 (0.6-18.8)
Lamb bhuna with chips	22	745 (714-830)	1522 (1379-1765)[l]	4.12 (3.10-5.14)	21	11.7 (10.0-14.2)
Vegetable biryani	10	834 (747-910)	1311 (1102-1519)	5.63 (4.77-6.47)[j]		n/d

Notes: n^1 = number of meals for Portion Size, Energy, Fat, SFA, n^2 = number of meals for Total Sugars; data presented as median (interquartile range);
Significant difference between meal types within the same meal category:
(Bonferroni adjustments: Chinese p <0.001; Indian p <0.003; English p <0.008; pizzas p <0.005; kebabs p <0.008)

Meal type	n^1	Portion Size (g)	Energy (kcal/meal)	Salt (g/meal)	n^2	Sugars (g/meal)
English						
Chicken and chips	25	694 (606-828)[r]	1575 (1320-1858)[r]	2.18 (1.68-3.23)	24	2.6 (1.7-3.0)
Fish and chips	64	749 (656-827)[r]	1658 (1515-1968)[r]	2.89 (2.31-4.47)	33	2.5 (1.5-4.8)
Chips and curry sauce	9	487 (459-548)	1053 (830-1124)	3.31 (1.88-4.55)	9	2.7 (1.5-5.0)
Mushroom omelette and chips	21	783 (662-917)[r]	1568 (1376-1920)[r]	3.77 (2.15-5.55)	21	6.7 (4.7-9.4)[p,q,r]
Pizzas						
Pepperoni Pizza	12	750 (639-855)	2137 (1928-2598)[w,x]	12.87 (5.94-13.70)	12	13.6 (11.3-19.4)
Seafood Pizza	11	765 (690-971)[w,x]	2004 (1697-2515)[w]	11.09 (8.66-13.62)	11	12.8 (11.9-18.4)
Margherita Pizza	12	674 (575-740)	1986 (1712-2270)[w]	8.83 (6.63-10.81)	11	12.1 (11.1-22.1)
Ham and Pineapple Pizza	10	558 (497-605)	1469 (1261-1526)	7.72 (5.37-9.75)		n/d
Meat Pizza	20	550 (462-646)	1563 (1323-2008)	8.20 (6.93-9.82)	10	10.5 (8.3-14.4)
Kebabs						
Donner kebab and chips	32	751 (561-979)[z,aa,bb]	1865 (1577-2221)[z,aa,bb]	7.50 (5.90-9.71)[bb]	21	4.4 (2.1-6.6)
Donner kebab	12	447 (338-503)	1164 (1121-1355)[aa, bb]	7.98 (6.64-9.73)[aa,bb]	12	6.4 (3.9-15.3)
Chicken kebab	22	481 (436-539)[bb]	726 (650-819)[bb]	5.94 (3.95-7.27)	21	6.3 (3.6-8.4)
Shish kebab	21	386 (334-478)	604 (509-709)	4.27 (3.47-5.99)	21	4.6 (2.9-7.0)

Notes: n^1 = number of meals for Portion Size, Energy, Fat, SFA, n^2 = number of meals for Total Sugars; data presented as median (interquartile range); Significant difference between meal types within the same meal category: (Bonferroni adjustments: Chinese p <0.001; Indian p <0.003; English p <0.008; pizzas p <0.005; kebabs p <0.008)

[a]Beef green pepper in black bean sauce with fried rice; [cc]Beef in black bean sauce (no rice); [b]Sweet and sour chicken with boiled rice; [c]Sweet and sour chicken with chips; [d]Prawn chow mein; [e]Chicken chow mein; [f]Char siu chow mein; [g]Chicken satay with fried rice; [h]Kung po king prawns with boiled rice; [i]Special fried rice; [j]Chicken Korma with pilau rice; [k]Chicken tikka Massalla with keema rice; [l]King Prawn Rogan Josh with pilau rice; [m]Lamb Rogan Josh with pilau rice; [n]Lamb Bhuna with chips; [o]Vegetable Biryani; [p]Chicken and chips; [q]Fish and chips; [r]Chips and curry sauce; [s]Mushroom omelette and chips; [t]Pepperoni pizza; [u]Seafood pizza, [v]Margherita pizza; [w]Ham and Pineapple pizza; [x]Meat pizza; [y]Donner kebab with chips; [z]Donner kebab; [aa]Chicken kebab; [bb]Shish kebab.

Table 4.8 Nutritional Composition of Takeaway Meals per Portion – Fat, SFA and TFA

Meal type	n[1]	Portion Size (g)	Fat (g/meal)	SFA (g/meal)	n[3]	TFA (g/meal)
Chinese						
Beef in black bean sauce with fried rice	31	915 (871-1013)[d,f, i]	48.0 (36.9-63.6)[d,h]	9.1 (6.3-12.3)[d,e]	10	0.30 (0.19-0.36)[g]
Beef in black bean sauce (no rice)	12	424 (396-560)	17.4 (13.3-25.4)	3.1 (2.2-4.0)	12	0.42 (0.40-0.56)
Sweet & sour chicken with boiled rice	10	766 (744-868)	41.6 (30.8-47.6)	11.7 (6.4-19.2)	10	0.19 (0.16-0.25)
Sweet & sour chicken with chips	22	931 (785-1199)[i]	78.7 (60.2-90.9)[a,b,d,e,f,h,i]	33.1 (25.1-36.8)[a,b,d,e,f,g,h,i]		n/d
Sweet & sour chicken (no rice)	28	469 (419-586)	34.3 (23.2-44.4)	6.6 (2.5-14.8)	28	0.47 (0.42-0.59)
Prawn chow mein	21	679 (584-834)	24.5 (17.3-31.5)	3.8 (3.1-5.3)		n/d
Chicken chow mein	10	690 (567-873)	27.9 (17.1-41.8)	3.9 (3.0-4.5)	10	0.69 (0.57-0.87)[a,g,h]
Char sui chow mein	10	716 (680-848)	45.5 (22.9-53.7)	14.6 (9.6-18.9)[d,e]	10	0.19 (0.13-0.43)
Chicken satay with fried rice	10	891 (781-1063)	35.8 (32.6-59.2)	6.2 (4.7-10.1)	10	0.08 (0.06-0.12)
Kung po king prawns with boiled rice	10	882 (794-931)	24.8 (12.2-31.6)	4.8 (3.0-6.2)	10	0.36 (0.09-0.47)
Special fried rice	21	686 (604-742)	50.0 (37.7-62.5)[d,h]	11.1 (9.1-14.4)[d,e,h]	21	0.53 (0.21-0.70)[g]
Indian						
Chicken korma with pilau rice	10	869 (819-923)	75.9 (66.2-96.5)[l]	34.5 (27.5-45.1)[l,m,n,o]	10	0.83 (0.59-0.92)
Chicken tikka massala with keema rice	21	808 (746-872)	73.3 (67.0-91.6)[l]	22.7 (18.9-31.5)[l,m]		n/d
Chicken tikka massala (no rice)	3	510 (393-549)	43.9 (26.3-71.4)	15.6 (12.0-31.1)	3	0.51 (0.39-0.55)
King prawn rogan josh with pilau rice	22	772 (701-828)	32.1 (18.7-44.2)	9.3 (6.7-15.2)		n/d
Lamb rogan josh with pilau rice	10	758 (719-857)	66.5 (50.0-70.7)[l]	15.2 (12.4-17.7)	10	0.73 (0.62-0.84)
Lamb rogan josh(no rice)	3	470 (419-551)	58.2 (53.4-71.4)	10.5 (9.2-11.7)	3	0.47 (0.42-0.55)
Lamb bhuna with chips	22	745 (714-830)	84.5 (76.1-92.9)[l,m]	18.3 (15.0-20.3)		n/d
Vegetable biryani	10	834 (747-910)	71.7 (50.8-90.6)[l]	17.2 (9.8-28.5)	10	0.76 (0.22-0.88)

Meal type	n[1]	Portion Size (g)	Fat (g/meal)	SFA (g/meal)	n[3]	TFA (g/meal)
English						
Chicken and chips	25	694 (606-828)[r]	66.2 (53.9-79.4)[r]	31.2 (25.2-36.8)	25	0.33 (0.20-0.36)
Fish and chips	64	749 (656-827)[r]	82.8 (71.6-96.7)[p,r]	42.0 (34.8-48.8)[p,r,s]	64	0.25 (0.15-0.67)
Chips and curry sauce	9	487 (459-548)	45.5 (38.6-60.0)	21.0 (17.0-27.8)	9	0.49 (0.46-0.55)
Mushroom omelette and chips	21	783 (662-917)[r]	92.3 (79.9-114.3)[p,r]	26.5 (23.4-33.2)		n/d
Pizzas						
Pepperoni Pizza	12	750 (639-855)	95.4 (75.3-130.7)[w]	37.8 (32.9-59.1)		n/d
Seafood Pizza	11	765 (690-971)[w,x]	91.8 (66.9-109.5)[w]	39.6 (31.7-49.5)		n/d
Margherita Pizza	12	674 (575-740)	83.4 (59.6-103.6)	37.2 (29.1-52.8)		n/d
Ham and Pineapple Pizza	10	558 (497-605)	55.3 (45.3-59.1)	28.1 (22.9-31.9)	10	0.99 (0.77-1.71)
Meat Pizza	20	550 (462-646)	75.1 (55.9-92.1)	33.1 (26.6-40.6)	20	1.04 (0.81-1.50)
Kebabs						
Donner kebab and chips	32	751 (561-979)[z,aa,bb]	100.5 (83.6-118.3)[z,aa,bb]	47.63 (34.7-55.2)[z,aa,bb]	32	4.48 (2.69-5.22)[z]
Donner kebab	12	447 (338-503)	71.8 (63.1-82.1)[aa,bb]	29.92 (26.08-34.95)[aa,bb]	12	1.99 (1.83-2.79)
Chicken kebab	22	481 (436-539)[bb]	26.9 (20.3-40.4)	4.93 (3.00-7.75)		n/d
Shish kebab	21	386 (334-478)	16.2 (10.2-22.2)	4.41 (3.35-8.15)		n/d

Notes: n[1] = number of meals for Portion Size, Energy, Fat, SFA, n[3] = number of meals for TFA; data presented as median (interquartile range);
Significant difference between meal types within the same meal category:
(Bonferroni adjustments: Chinese p <0.001; Indian p <0.003; English p <0.008; pizzas p <0.005; kebabs p <0.008)

[a]Beef green pepper in black bean sauce with fried rice; [cc]Beef in black bean sauce (no rice); [b]Sweet and sour chicken with boiled rice; [c]Sweet & sour chicken with chips; [d]Prawn chow mein; [e]Chicken chow mein; [f]Char siu chow mein; [g]Chicken satay with fried rice; [h]Kung po king prawns with boiled rice; [i]Special fried rice; [j]Chicken Korma with pilau rice; [k]Chicken tikka Massalla with keema rice; [l]King Prawn Rogan Josh with pilau rice; [m]Lamb Rogan Josh with pilau rice; [n]Lamb Bhuna with chips; [o]Vegetable Biryani; [p]Chicken and chips; [q]Fish and chips; [r]Chips and curry sauce; [s]Mushroom omelette and chips; [t]Pepperoni pizza; [u]Seafood pizza, [v]Margherita pizza; [w]Ham and Pineapple pizza; [x]Meat pizza; [y]Donner kebab with chips; [z]Donner kebab; [aa]Chicken kebab; [bb]Shish kebab.

Table 4.9 Nutritional Composition of Takeaway Meals per 100g – Energy, Salt, Fat, SFA, TFA and Sugars

Meal type	n[1]	Energy kcal/100g	Salt g/100g	Fat g/100g	SFA g/100g	n[2]	TFA g/100g	n[3]	Sugars g/100g
Chinese									
Beef in black bean sauce with fried rice	31	147 (132-153)[d]	1.19 (0.91-1.50)[b,c]	5.3 (4.0-6.5)	0.98 (0.70-1.30)	10	0.03 (0.02-0.04)[g]	21	1.2 (1.0-1.7)
Beef in black bean sauce	12	88 (80-108)	1.39 (1.16-1.58)	3.5 (3.0-4.7)	0.60 (0.52-0.79)	12	0.10 (0.10-0.10)	12	1.1 (0.5-2.1)
Sweet & sour chicken with boiled rice	10	188 (168-196)[a,d]	0.37 (0.27-0.49)	5.2 (3.5-6.1)	1.55 (0.82-2.34)	10	0.02 (0.02-0.03)[g]		n/d
Sweet & sour chicken with chips	22	208 (180-222)[a,d,e,f,g,h]	0.44 (0.36-0.52)	8.0 (7.1-9.6)[a,b,d,e,h]	3.35 (2.58-4.13)[a,d,e,g,h,i]		n/d	21	7.7 (5.6-10.0)
Sweet & sour chicken	28	175 (138-198)	0.71 (0.56-1.03)	6.6 (4.5-7.7)	1.22 (0.61-2.87)	28	0.10 (0.10-0.10)	28	15.1 (12.0-18.3)[a,cc,c,d,e,i]
Prawn chow mein	21	102 (93-124)	1.12 (0.80-1.51)[b,c]	3.5 (2.4-4.4)	0.60 (0.40-0.80)		n/d	21	1.2 (0.8-1.7)
Chicken chow mein	10	129 (108-134)	0.96 (0.68-1.16)[b,c]	4.1 (3.1-5.2)	0.54 (0.41-0.62)[a]	10	0.10 (0.10-0.10)[a,b,f,g,h]	10	0.3 (0.1-0.8)
Char sui chow mein	10	129 (119-143)	1.06 (0.97-1.25)[c]	5.3 (3.3-6.5)	1.93 (1.43-2.34)[d,e,h]	10	0.03 (0.02-0.06)[g]		n/d
Chicken satay with fried rice	10	146 (130-157)[d]	1.04 (0.81-1.51)[b,c]	4.4 (4.1-6.1)	0.72 (0.55-0.98)	10	0.01 (0.01-0.01)		n/d
Kung po king prawns with boiled rice	10	126 (114-152)	0.62 (0.39-0.85)	2.7 (1.8-4.2)	0.52 (0.33-0.80)	10	0.05 (0.01-0.05)		n/d
Special fried rice	21	200 (189-217)[a,d,e,f,g,h]	1.37 (1.15-1.66)[b,c,h]	7.3 (5.2-8.8)[a,d,e,h]	1.59 (1.39-1.90)[a,d,e,g,h]	21	0.10 (0.03-0.10)[g]	10	0.5 (0.2-1.8)
Indian									
Chicken korma with pilau rice	10	179 (168-213)[l]	0.45 (0.37-0.54)	8.5 (7.6-11.1)[l]	3.92 (3.24-4.97)[l,m,n,o]	10	0.10 (0.07-0.10)		n/d
Chicken tikka massala with keema rice	21	187 (175-199)[l,o]	0.81 (0.70-0.97)[j,l,m,n]	9.6 (8.5-10.8)[l]	3.00 (2.25-4.10)[l,m]		n/d	21	2.6 (2.1-4.0)[l,n]
Chicken tikka massala	3	173 (169-223)	0.80 (0.68-0.90)	8.6 (6.7-13.0)	3.07 (3.06-5.67)	3	0.10 (0.10-0.10)	3	11.7 (10.3-12.7)
King prawn rogan josh with pilau rice	22	136 (117-142)	0.59 (0.48-0.74)	4.6 (2.8-5.7)	1.20 (0.88-1.80)		n/d	21	1.7 (1.6-2.0)
Lamb rogan josh with pilau rice	10	174 (155-187)[l]	0.46 (0.37-0.57)	7.9 (6.8-9.5)[l]	1.91 (1.71-2.09)	10	0.10 (0.09-0.10)		n/d
Lamb rogan josh	3	184 (158-211)	0.77 (0.50-1.05)	13.9 (9.7-15.2)	2.48 (1.67-2.51)	3	0.10 (0.10-0.10)	3	3.4 (0.1-4.0)
Lamb bhuna with chips	22	206 (188-215)[l,m,o]	0.51 (0.38-0.65)	11.2 (10.4-12.1)[l,m]	2.50 (2.18-2.63)[l]		n/d	21	1.5 (1.3-1.8)
Vegetable biryani	10	151 (139-171)	0.69 (0.55-0.78)[j]	7.9 (7.2-10.7)[l]	2.17 (1.27-2.91)	10	0.10 (0.03-0.10)		n/d

Meal type	n[1]	Energy kcal/100g	Salt g/100g	Fat g/100g	SFA g/100g	n[2]	TFA g/100g	n[3]	Sugars g/100g
English									
Chicken and chips	25	226 (210-247)[r,s]	0.36 (0.24-0.56)	9.7 (8.5-11.0)	4.60 (3.75-5.00)[s]	3	0.10 (0.10-0.10)	24	0.3 (0.3-0.4)
Fish and chips	64	229 (215-251)[r,s]	0.41 (0.31-0.59)	11.1 (9.6-12.8)[p,r]	5.53 (4.81-6.63)[p,r,s]	42	0.03 (0.02-0.10)	33	0.3 (0.2-0.6)
Chips and curry sauce	9	191 (177-213)	0.63 (0.47-0.82)[p]	9.0 (8.0-10.5)	4.21 (3.96-5.12)	9	0.10 (0.10-0.10)[q]	9	0.4 (0.3-0.9)
Mushroom omelette and chips	21	205 (190-223)	0.48 (0.31-0.66)	12.5 (10.9-15.1)[p,r]	3.40 (3.20-3.90)		n/d	21	0.9 (0.6-1.2)[p,q]
Pizza									
Pepperoni Pizza	12	304 (283-315)[w,u]	1.63 (1.15-1.87)	14.3 (10.9-15.0)	5.85 (5.03-7.18)		n/d	12	2.2 (1.5-2.8)
Seafood Pizza	11	253 (250-262)	1.32 (0.99-1.83)	10.7 (9.7-11.4)	4.80 (4.60-5.10)		n/d	11	1.8 (1.5-2.3)
Margherita Pizza	12	301 (281-312)[w,u]	1.40 (1.06-1.70)	12.8 (10.3-14.0)	6.20 (4.73-7.23)		n/d	12	1.9 (1.4-3.0)
Ham and Pineapple Pizza	10	257 (247-280)	1.44 (1.21-1.57)	9.95 (8.8-11.5)	5.36 (4.62-5.69)	10	0.18 (0.15-0.30)		n/d
Meat Pizza	20	288 (278-312)[w,u]	1.49 (1.39-1.71)	12.9 (12.1-14.7)[u,w]	5.91 (5.36-6.52)[u]	20	0.19 (0.14-0.30)	10	2.3 (2.0-2.8)
Kebabs									
Donner kebab and chips	32	254 (224-306)[aa,bb]	1.07 (0.84-1.22)	13.3 (11.2-18.1)	5.95 (5.10-7.58)[aa,bb]	10	0.85 (0.53-0.98)[z]	21	0.60 (0.25-0.90)
Donner kebab	12	277 (223-325)[aa,bb]	1.90 (1.61-2.16)[y,aa,bb]	15.6 (12.5-20.4)[aa,bb]	6.18 (5.48-8.87)[aa,bb]	12	0.44 (0.41-0.55)	12	2.01 (1.06-3.12)[y]
Chicken kebab	22	147 (135-184)	1.15 (0.91-1.42)	5.6 (3.7-8.4)	1.05 (0.68-1.60)		n/d	21	1.30 (0.80-1.65)[y]
Shish kebab	21	155 (139-164)	1.17 (0.91-1.51)	4.0 (2.8-5.3)	1.40 (0.85-1.90)		n/d	21	1.20 (0.95-1.60)[y]

Notes: n^1 = number of meals for Energy, Salt, Fat, SFA, n^2 = number of meals for TFA, n^3 = number of meals for Sugars; data presented as median (interquartile range);
Significant difference between meal types within the same meal category:
(Bonferroni adjustments: Chinese p <0.001; Indian p <0.003; English p <0.008; pizzas p <0.005; kebabs p <0.008)

[a]Beef green pepper in black bean sauce with fried rice; [cc]Beef in black bean sauce (no rice); [b]Sweet and sour chicken with boiled rice; [c]Sweet & sour chicken with chips; [d]Prawn chow mein; [e]Chicken chow mein; [f]Char siu chow mein; [g]Chicken satay with fried rice; [h]Kung po king prawns with boiled rice; [i]Special fried rice; [j]Chicken Korma with pilau rice; [k]Chicken tikka Massalla with keema rice; [l]King Prawn Rogan Josh with pilau rice; [m]Lamb Rogan Josh with pilau rice; [n]Lamb Bhuna with chips; [o]Vegetable Biryani; [p]Chicken and chips; [q]Fish and chips; [r]Chips and curry sauce; [s]Mushroom omelette and chips; [t]Pepperoni pizza; [u]Seafood pizza, [v]Margherita pizza; [w]Ham and Pineapple pizza; [x]Meat pizza; [y]Donner kebab with chips; [z]Donner kebab; [aa]Chicken kebab; [bb]Shish kebab.

Please Note: Additional tables showing protein, carbohydrate, MUFA and PUFA are in Appendix 4.0 and Appendix 4.1.

4.4.2 Nutritional profile of takeaway meal categories compared to UK DRVs (objective 2)

The nutritional profile for the complete takeaway meals (the four main components only meals with no sides: beef, green peppers and blackbean sauce, sweet and sour chicken, chicken tikka massalla, lamb rogan josh were excluded) were combined in each of the takeaway meal categories (Chinese, Indian, English Pizzas, Kebabs) to enable comparison with UK dietary reference values for men and women aged 19-50 years (Table 4.4). The results are shown in Figures 4.27, 4.28, 4.29 and Tables 4.10 and 4.11.

Energy

EAR for energy ranged between 44% and 71% for men (Figure 4.28) and between 58% and 94% for women (Figure 4.29). Three of the five meal categories provided more than 50% of the EAR for energy, specifically pizzas, English and Indian meals. Chinese meals and kebabs had the lowest.

Protein

All five of the meal categories provided 100% RNI or more for protein for women. Protein content ranged from 87% to 163% RNI for males and from 108% to 201% for females. Pizzas had the highest protein RNI (163% (133-194%) for men and 201% (163-239% for women), kebabs were the next highest with 116% (99-137%) for men and 143% (121-169%) for women.

Carbohydrate

The categories tended to be lower in carbohydrate, ranging from 22 to 72%, although four of the meal categories provided around half of the days DRV for carbohydrate. The kebabs category contained the lowest carbohydrate (22% for men, 29% for women) whereas pizzas contained the highest (55% for men, 72% for women).

Total Sugars

Only total sugar in the takeaway meals were available (PAL analysis did not differentiate between free sugars and intrinsic sugars, see section 4.3.2); thus, total sugars were compared to free sugars (not bound in foods) to provide an estimate of how takeaway meal categories compare to the UK DRV for free sugars. The English meal category had the lowest DRV with 8.8% for men and 11.5% for women. Results were similar for Pizzas, Chinese meals, and Indian meals, ranging from 37% to 41% for men and from 48.6% to 54% for women, thus providing half the DRV in free sugars for a woman.

Fat

Total fat levels ranged from 38% to 106% DRV and SFA from 27% to 151% DRV. PUFA ranged from 35% to 167% and MUFA from 46% to 108%. Pizzas and English meals had the highest %DRV for total fat and SFA. Chinese meals were the lowest in total fat and SFA content and Indian meals had the highest %DRV for PUFA. TFA %RNI levels ranged from 5.4% to 62.1%, kebabs had the highest %RNI of TFA with 47.2% (32.6-78.5%) for men and 62.1% (42.9-103.2%) for women. The lowest %RNI of TFA were found in English meals (5.4% men, 7.2% women) and Chinese meals (7.3% men, 9.6% women). The differences in types of fat content between the different categories will largely be due to the use of different cooking oils and fats during meal preparation as well as the ingredients of the meal.

Salt

Salt content ranged between 74.6% and 228% (Figure 4.27), with four of the five categories exceeding the 4g RNI for salt. Pizzas had the highest %RNI providing more than double the RNI for salt for adults with 228.0% (169.6-299.0%). Kebabs and Chinese meals were also high in salt containing 165% of the RNI. The lowest %RNI for salt was the English meals, however this category still provided three quarters of the %RNI with 74.6% (52.5-109.7%).

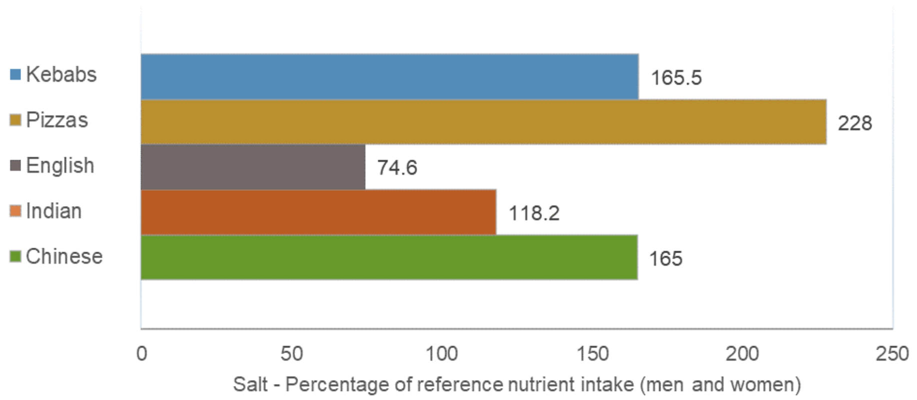


Figure 4.28 Takeaway meal categories compared to %RNI for salt for men and women

4.4.2.1 Summary

These results show that the consumption of one takeaway meal would be enough to provide all of an adult’s daily energy, most of their macronutrient requirements (Jaworowska et al., 2014; Davies et al., 2016) and exceed their RNI for salt (Jaworowska et al., 2012).

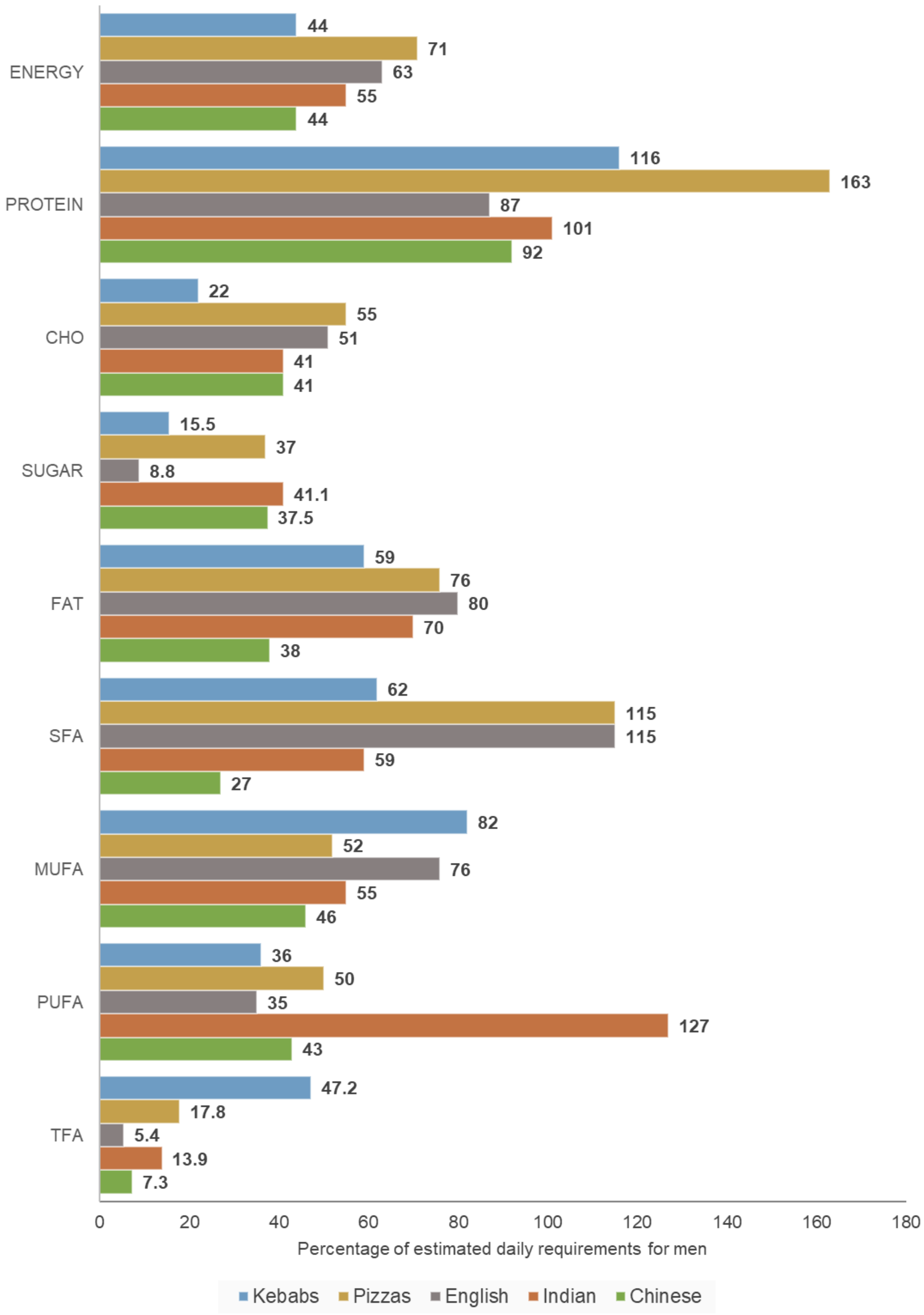


Figure 4.29 Nutritional Profile of takeaway meal categories compared to UK DRVs for men

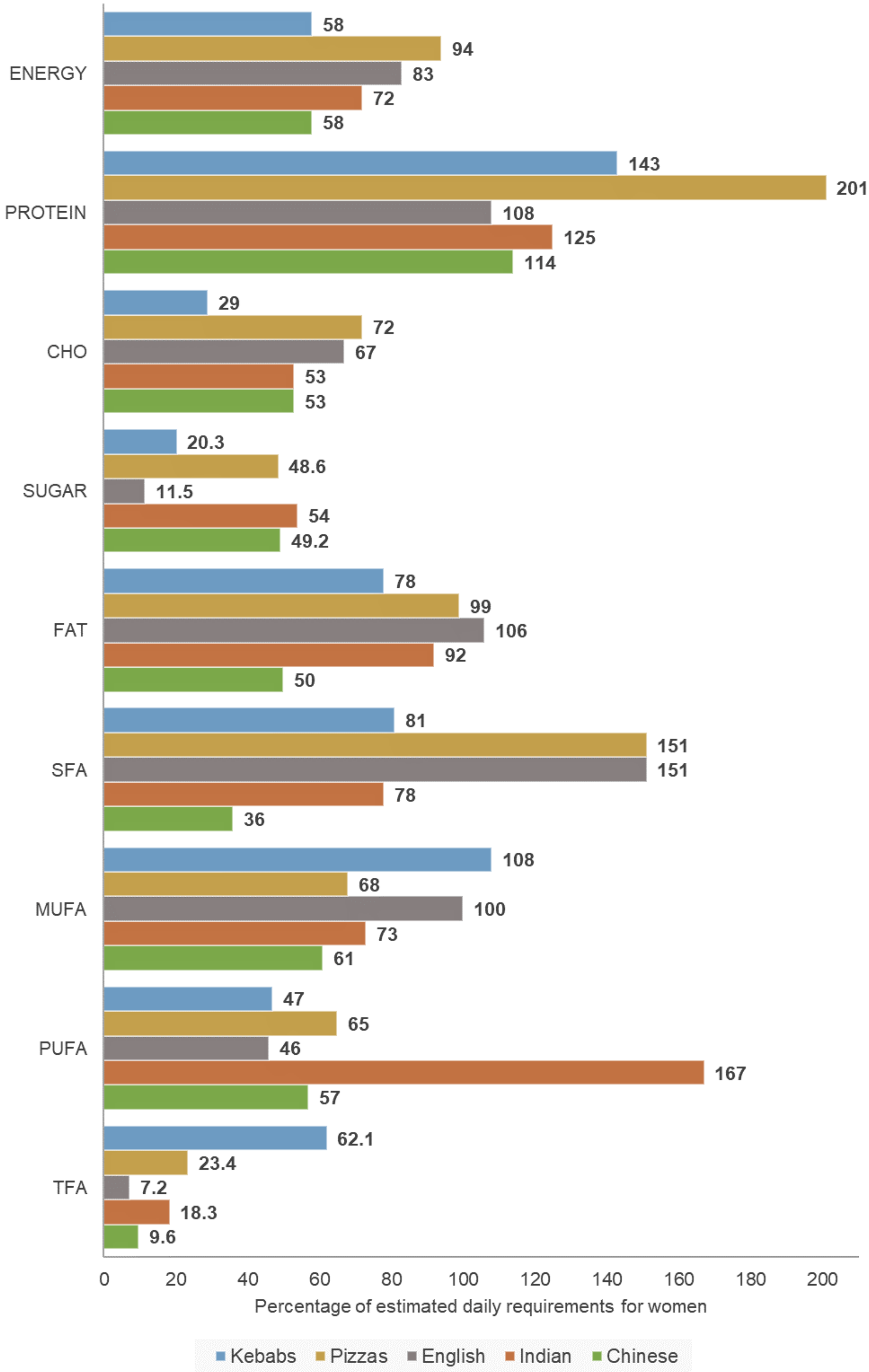


Figure 4.30 Nutritional Profile of takeaway meal categories compared to UK DRVs for women

Table 4.10 Nutritional profile of takeaway meal categories compared to UK dietary reference values (*objective two*)

		Energy (%EAR)		Protein (%RNI)		CHO (%DRV)			Free Sugars (%DRV)*		Salt (%RNI)
Meal Type	n	Men	Women	Men	Women	Men	Women	n[1]	Men	Women	Men & Women
Chinese	185	44 (32-58)	58 (42-76)	92 (77-122)	114 (95-151)	41 (26-56)	53 (34-73)	123	37.5 (19.6-209.0)	49.2 (25.7-274.7)	165.0 (107.0-233.2)
Indian	95	55 (46-62)	72 (60-82)	101 (64-121)	125 (78-150)	41 (35-46)	53 (46-60)	63	41.1 (32.0-57.0)	54.0 (42.1-74.9)	118.2 (90.3-152.5)
English	119	63 (56-74)	83 (74-97)	87 (76-111)	108 (93-137)	51 (40-60)	67 (52-79)	87	8.8 (4.9-16.5)	11.5 (6.5-21.7)	74.6 (52.5-109.7)
Pizzas	65	71 (58-84)	94 (76-111)	163 (133-194)	201 (163-239)	55 (44-66)	72 (58-86)	44	37.0 (31.3-52.4)	48.6 (41.2-68.8)	228.0 (169.6-299.0)
Kebabs	87	44 (27-66)	58 (36-86)	116 (99-137)	143 (121-169)	22 (15-39)	29 (20-52)	75	15.5 (8.7-24.4)	20.3 (11.4-32.0)	165.5 (106.8-212.0)

Meals presented per portion; n = number of meals, n[1] = number of meals for sugars, CHO=carbohydrate; data presented as median (interquartile range)

Table 4.11 Nutritional profile of takeaway meal categories compared to UK dietary reference values (*objective two*)

		Total Fat (%DRV)		Total SFA (%DRV)			Total MUFA (%DRV)		Total PUFA (%DRV)		Total TFA (%DRV)	
Meal Type	n	Men	Women	Men	Women	n[2]	Men	Women	Men	Women	Men	Women
Chinese	185	38 (25-55)	50 (33-73)	27 (13-45)	36 (17-60)	121	46 (26-61)	61 (35-80)	43 (24-64)	57 (32-84)	7.3 (3.4-10.2)	9.6 (4.5-13.4)
Indian	95	70 (51-87)	92 (67-114)	59 (38-84)	78 (50-111)	30	55 (49-71)	73 (64-93)	127 (87-164)	167 (114-215)	13.9 (8.8-15.6)	18.3 (11.5-20.5)
English	119	80 (66-95)	106 (87-125)	115 (87-140)	151 (115-184)	54	76 (59-96)	100 (77-126)	35 (29-46)	46 (38.-61)	5.4 (2.8-11.3)	7.2 (3.7-14.9)
Pizzas	65	76 (57-97)	99 (75-128)	115 (89-139)	151 (117-183)	31	52 (39-79)	68 (52-104)	50 (31-74)	65 (41-97)	17.8 (14.2-27.5)	23.4 (18.7-36.2)
Kebabs	87	59 (23-94)	78 (30-124)	62 (14-132)	81 (19-173)	22	82 (69-101)	108 (90-133)	36 (20-65)	47 (27-85)	47.2 (32.6-78.5)	62.1 (42.9-103.2)

Meals presented per portion; n = number of meals, n[2] = number of meals for MUFA, PUFA and TFA; data presented as median (interquartile range)

Notes: The nutritional profile of all meals within the different categories was compared with UK dietary reference values

UK recommendations for energy are 2,550 and 1,940 kcal per day for males and females aged 19 to 50, respectively.

Total sugars were compared to free sugar not bound in foods, as the UK does not have a DRV for total sugars. * Percentage of UK DRV for free sugars is 5 per cent of total energy.

4.4.3 Effect of consuming takeaway meals on UK diet over a week (objective 3)

An average meal (30% of the UK daily guidelines) was replaced with a corresponding average value for takeaway food, calculated by combining the five takeaway meal categories.

This section explores the dietary impact of consuming takeaway meals on energy and macronutrient intake (Table 4.4). Nutritional analysis was performed by replacing 30% (an average meal) of the UK daily estimated average requirements (EAR) for food energy, dietary reference values (DRV) for fats and sugars and RNI for salt for men and women aged 19–50 years with a corresponding mean takeaway food value. Analysis has been carried out to illustrate:

i. the effect of consuming an additional takeaway meal on top of a normal diet (shown in Tables 4.12 and 4.13)

ii. the effect of replacing 1, 3 or 7 meals with a takeaway meal over a week (shown in Figures 4.31-4.36 and Table 4.12-4.13)

Figures 4.31 shows how energy intake increases as takeaway frequency increases over the week.

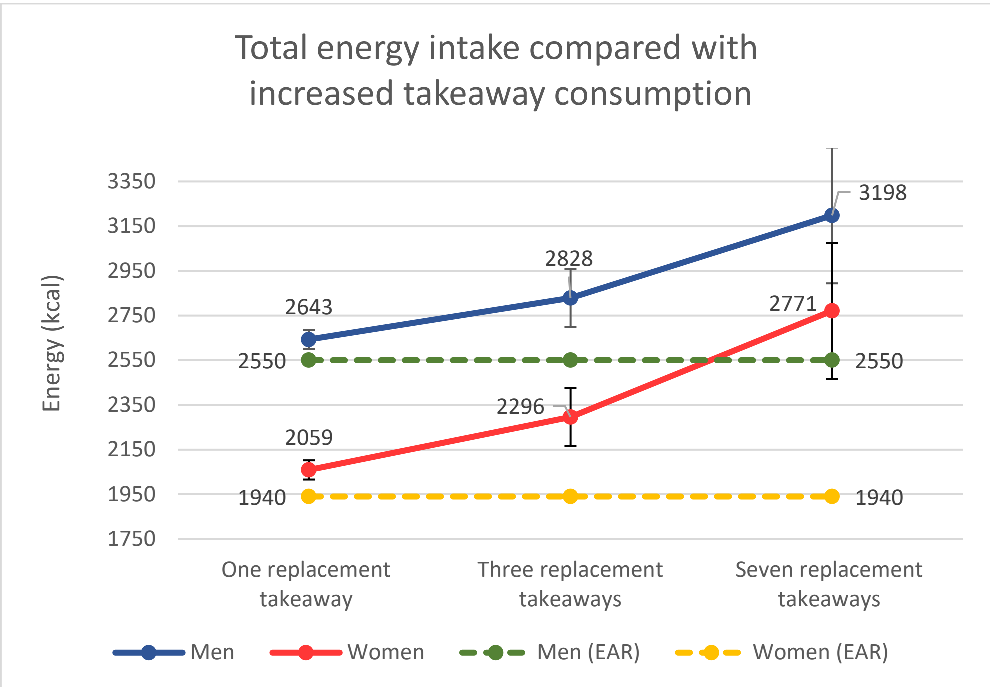


Figure 4.31 Increasing consumption of takeaway food compared with Total Energy Intake

Figures 4.32 and 4.33 show how total fat and SFA intake increase as takeaway frequency increases over the week.

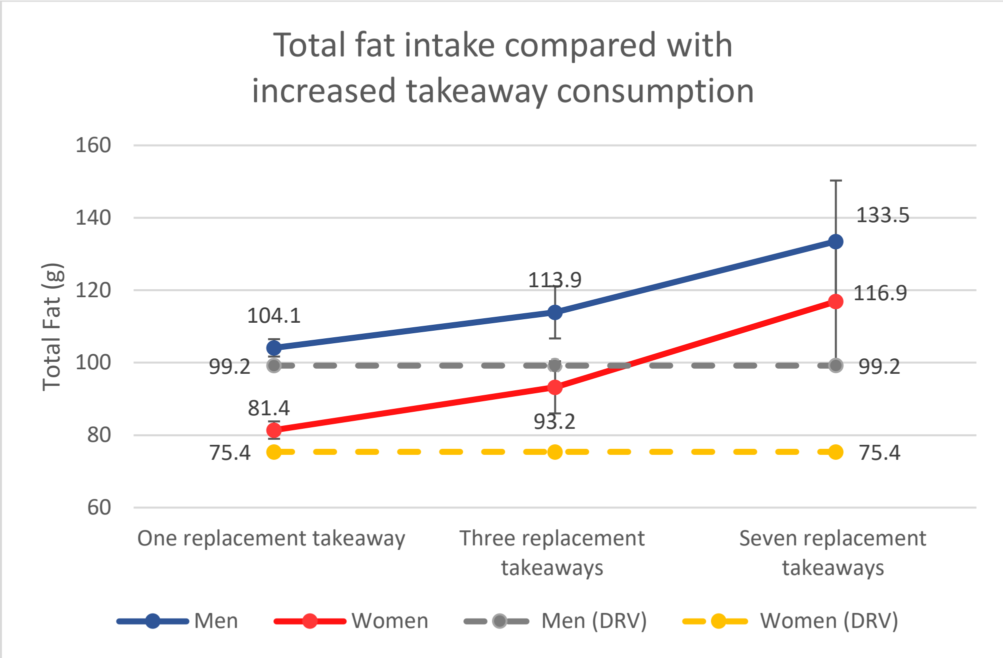


Figure 4.32 Increasing consumption of takeaway food compared with Total Fat Intake

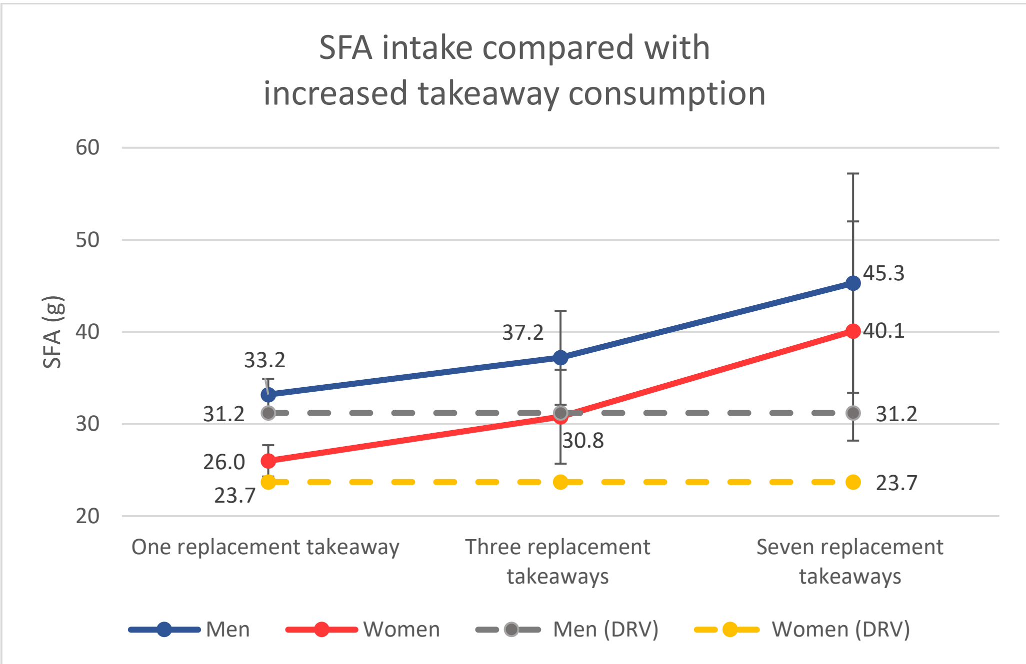


Figure 4.33 Increasing consumption of takeaway food compared with SFA Intake

Figure 4.34 shows how salt intake increases as takeaway frequency increases over the week.

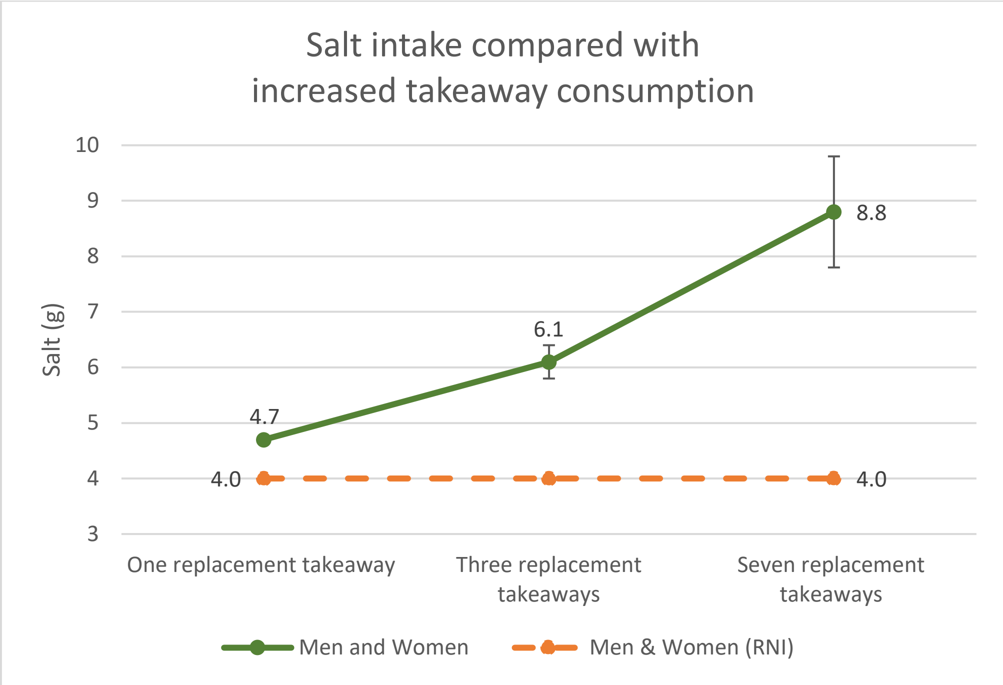


Figure 4.34 Increasing consumption of takeaway food compared with Salt Intake

The results show that for both eating an additional takeaway meal on top of a normal diet and replacing one normal meal with a takeaway meal per week (Tables 4.12 and 4.13), intakes of daily energy, fat, SFA and salt are all increased (Blackham et al., 2015). For individuals consuming more than one takeaway per week the increases are higher. A man consuming one takeaway per week would consume 4% more energy, 5% more fat, 6% more SFA and 18% more salt. If he were to have three takeaways per week instead, this would increase to 11% more energy, 15% more fat, 19% more SFA and 52% more salt. For women, the increases would be even higher due to their lower nutrient requirements.

For men, intakes of both sugar and TFA decreased with increasing consumption of takeaway meals (Table 4.12 and 4.13). For women, TFA decreased, and sugar increased however the differences between each increase in takeaway meals was quite small and the DRVs for women are smaller than for men. Additionally, the smaller differences in sugar and TFA over the week is most likely because all the different takeaway meals were analysed together and only a small number of takeaway meal types were high in sugar or TFA (Tables 4.8 and 4.9), for example sweet and sour meals in the Chinese category and kebabs in the Kebab category. Furthermore, the sample sizes were smaller as less meals were analysed for TFA or sugar content.

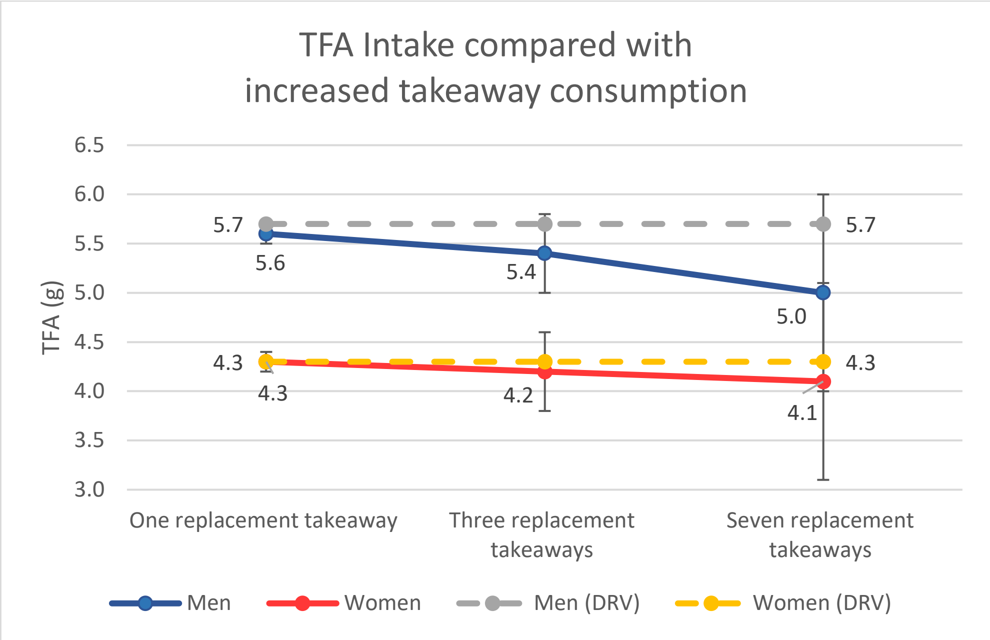


Figure 4.35 Increasing consumption of takeaway food compared with TFA Intake

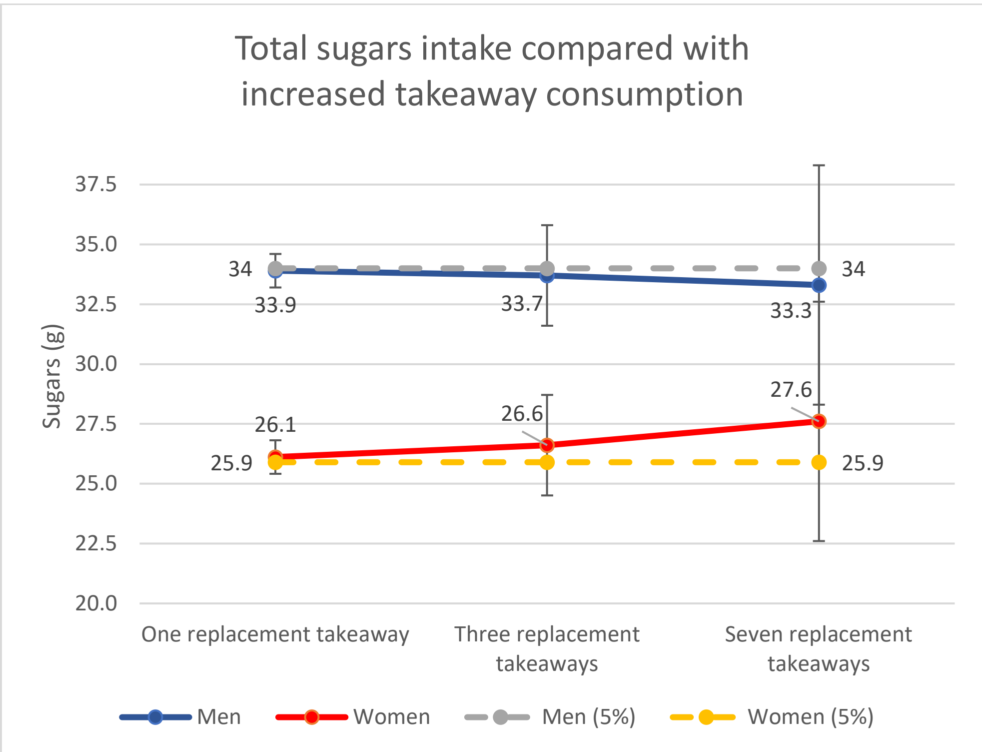


Figure 4.36 Increasing consumption of takeaway food compared with Sugar Intake

4.4.3.1 Summary

These findings show how frequent takeaway food consumption could be associated with weight gain and this has been observed in a number of fast food studies (Paeratakul et al., 2003; Pereira et al., 2005; Smith et al., 2017; Bhutani et al., 2018). Paeratakul et al. (2003) analysed dietary information from a sample of adults and children in the US and found total energy intake was higher in individuals who had reported eating fast food on one or both days in which dietary information was collected. On the day in which the fast food was consumed, the average energy intake was found to be significantly higher in comparison to the day without fast food (Paeratakul et al., 2003). This study also found that individuals who ate fast food had a higher intake of energy, fat, SFA and sodium, and a lower intake of vitamins A and C, milk, fruits and vegetables when compared with those who did not eat fast food (Paeratakul et al., 2003). Similarly on the CARDIA study, individuals who ate fast food three or more times per week were associated with weight gain and reduced insulin resistance (Pereira et al., 2005). Bhutani et al. (2018) showed an increase in BMI of 0.8 kg/m^2 with each one meal/week increase in fast food consumption. In the study by Anderson et al. (2011) obesity prevalence increased with fast food frequency and the odds of being obese were 50% greater when consuming fast food 2 to 3 times a week (compared with less than once a week).

Table 4.12 Effect of takeaway meals on UK diet per week – Energy, Sugars and Salt (*objective three*)

	Energy (kcal)				Sugars (g)				Salt (g)	
	men	%EAR	women	%EAR	men	%DRV	women	%DRV	men & women	%RNI
An additional takeaway on top of a normal diet	2752 (43.43)	108%	2142 (43.43)	110%	35.4 (0.71)	104%	27.2 (0.72)	105%	4.9 (0.34)	122%
One replacement takeaway in the diet	2643 (43.43)	104%	2059 (43.46)	106%	33.9 (0.72)	100%	26.1 (0.72)	101%	4.7 (0.31)	118%
Three replacement takeaways in the diet	2828 (130.35)	111%	2962 (130.32)	118%	33.7 (2.15)	99%	26.6 (2.15)	103%	6.1 (0.98)	152%
Seven replacement takeaways in the diet	3198 (304.16)	125%	2771 (304.16)	143%	33.3 (5.01)	98%	27.6 (5.01)	107%	8.8 (2.29)	220%

Notes: Values shown are mean (SD) for combined takeaway meal categories: Chinese, Indian, English, Pizzas, Kebabs. n = 551 for Energy, Salt; n = 392 for Sugars.

Table 4.13 Effect of takeaway meals on UK diet per week – Total Fat, SFA and TFA (*objective three*)

	Total Fat (g)				Total SFA (g)				Total TFA (g)			
	men	%DRV	women	%DRV	men	%DRV	women	%DRV	men	%DRV	women	%DRV
An additional takeaway on top of a normal diet	108 (2.42)	109%	85 (2.38)	112%	34.5 (1.71)	111%	27.1 (1.70)	114%	5.8 (0.14)	103%	4.5 (0.13)	103%
One replacement takeaway in the diet	104 (2.39)	105%	81 (2.39)	108%	33.2 (1.69)	106%	26.0 (1.71)	110%	5.6 (0.14)	98%	4.3 (0.14)	99%
Three replacement takeaways in the diet	114 (7.19)	115%	93 (7.19)	124%	37.2 (5.13)	119%	30.8 (5.12)	130%	5.4 (0.41)	95%	4.2 (0.41)	97%
Seven replacement takeaways in the diet	134 (16.79)	135%	117 (16.79)	155%	45.3 (11.91)	145%	40.1 (11.91)	169%	5.0 (0.96)	88%	4.1 (0.96)	94%

Notes: Values shown are mean (SD) for combined takeaway meal categories: Chinese, Indian, English, Pizzas, Kebabs. n = 551 for Total fat, Total SFA, n = 258 for Total TFA.

30% (an average meal) of UK daily EAR for food energy, DRV for fats and RNI for salt for men and women aged 19–50 years was replaced with a corresponding mean takeaway food value, calculated by combining takeaway meal categories. Total sugars were compared to free sugar not bound in foods, as the UK does not have a DRV for total sugars. * Percentage of UK DRV for free sugars is 5 per cent of total energy.

4.5 Strengths and Limitations

Objective 1

A strength of this research is that this is the one of the largest UK studies to analyse the nutritional composition of takeaway meals (n = 511) served by independent takeaway outlets and includes popular cuisines (Indian, Chinese, pizza, kebabs, fish and chips). Furthermore, accredited public analyst laboratories were used to determine the nutritional composition of these takeaway meals. The results therefore provide an accurate measurement of energy, macronutrients, and salt (micronutrient). In addition, twenty-eight different types of takeaway meals were purchased from independent takeaway outlets in three different local authorities in Merseyside. The results for each meal type were collated and analysed for portion size, energy, fat, SFA, TFA, salt or sugar content. The results help to fill the gap in quantitative data for takeaway food served by independent takeaway outlets. The wide variation in nutritional composition for specific takeaway meal types suggests there is an opportunity to use recipe reformulation to reduce total fat, SFA, salt or sugar. The evidence from this study could be used to influence policy at a local and national level, and publications from this study data (Jaworowska et al., 2012; Jaworowska et al., 2014) have been referenced in Public Health England's "Using the planning system to promote healthy weight environments" (PHE, 2020f) and the World Health Organizations "Slide to order: a food systems approach to meals delivery apps" (World Health Organization, 2021).

A limitation of the analysis of the nutritional composition of the takeaway meals is that only one sample of each meal was purchased from each outlet and sent to PAL. The nutritional composition of food could be affected at busy times, for instance a chef may need to prepare meals with more haste. It is also conceivable that outlets may employ several chefs who work at different times or days of the week, all of whom may have different cooking practices and techniques. This could mean that meals are prepared with a different nutritional profile depending on the chef working that day and time. To ascertain if meals were prepared at the outlet the same way each time, repeat purchases at different times and days would need to be made and sent for PAL analysis.

Objectives 1, 2 and 3

The current UK recommendations for total sugars consist of intrinsic sugars and free sugars (SACN, 2015). One limitation of the nutritional composition provided by PAL is that only total sugars were analysed, thus the PAL results do not differentiate between free sugars and intrinsic sugars. This means the values used for sugars are based on sugars derived from any source. In future studies it would be interesting to include analysis of free sugars.

Objective 3

A limitation of the analysis which studied the effect of consuming one or more takeaway meals per week, is that all the different types of meals in each cuisine category were analysed together. It is plausible that a takeaway consumer might have fish and chips one night, a Chinese meal another night and an Indian meal or kebab on another night; rather than the same cuisine type each time they have a takeaway. This would need further investigation to determine the types of meals regularly eaten over a week by consumers.

4.6 Conclusions

As detailed earlier, the frequent consumption of takeaway and fast foods has been shown to increase the risk of poor health and the present study provides evidence that the nutritional profile of takeaway foods from independent takeaway establishments is largely nutritionally inadequate. The results show that many of these takeaway meals are high in energy, total fat, SFA and salt and that some of the meals are high in TFA or sugar. The results also show a wide variation in portion sizes for the same meal being served by different takeaway outlets. Large variability was also revealed regarding total energy, total fat, SFA, TFA, salt and sugar when examining by portion size and per 100 g. This has also been observed in other fast food studies, for example Ziauddeen et al. (2015) who surveyed total energy, fat and SFA in fast food served by large transnational FFOs in ten countries and Dunford et al. (2012) in their study of salt levels in fast food carried out over six countries. Due to the large variability between the same meal type served by different fast food chains, the authors concluded there was scope to reformulate products at the higher end of the range towards the lower range (Dunford et al., 2010; Dunford et al., 2012; Ziauddeen et al., 2015). Dunford et al. (2012) also reported the mean salt content in fast foods to be lower in the UK than the other investigated countries which could be the result of the industry already participating in salt reduction efforts. It is important to note that both of these studies examined data published by chains in the fast-food industry and not small independent outlets, nonetheless the similarities in excessive levels of salt, fat and SFA and the large variabilities shown in the current study illustrates that there is opportunity to make similar reductions in takeaway food served by independent outlets.

The large variability shown in the results of the present study for the same meal cooked at different outlets shows that there is room for improvement to the nutritional quality of some of these meals. It may be possible to make reductions in fat, SFA, salt and/or sugar in takeaway food which would go unnoticed by the consumer, especially if these reductions were made gradually over time. Hence projects which involve the training of chefs in small independent takeaway outlets to reformulate the meals they prepare should be encouraged as well as assistance provided to improve cooking techniques, suggest healthier frying practices, and promote a reduction in portion sizes. Just a small improvement in nutritional content has the potential to improve takeaway consumer's health by reducing NCDs such as obesity, T2D and CVD as well as a wider impact by reducing the overall health costs to society.

Chapter 5

Recipe Reformulation

5 Recipe Reformulation

5.1 Introduction

Globally, the food industry is under pressure to reformulate processed foods to reduce high levels of fat, sugar and salt (PHE, 2018a; WHO, 2020b). There is also a focus on the eating out of home sector (PHE, 2017a) and Chapter 4 has shown takeaway food served by small independent takeaway outlets is frequently high in fat, sugar or salt. Findings from the "Overcoming Obesity" discussion paper suggests that changing the default environment via reformulation can have a greater impact than targeted interventions such as education, weight management programmes or surgery (Dobbs et al., 2014). They also suggest that reducing portion sizes can be more profitable for businesses as it saves on ingredients and that nutritional labelling encourages businesses to make their products healthier or reduce portion sizes (Dobbs et al., 2014). To achieve significant impact and shift cultural norms around eating, many interventions would be required over a range of sectors. However, at the time the Overcoming Obesity report was written, Dobbs et al. (2014) calculated that reducing the size of portions in packaged foods, fast food restaurants and canteens was the area of intervention that would have the highest impact, hypothetically saving more than 2 million DALYS over the lifetime of the 2014 UK population. The report also suggested that reformulation would have the second highest impact, saving over 1.7 million DALYS (Dobbs et al., 2014). One benefit of reformulating takeaway food is that it does not rely on targeting an individual's behaviour, thereby relying on them to choose a healthier option (Adams et al., 2016; Van Gestel, Kroese and De Ridder, 2018).

If reformulation is caried out gradually, it can be undetectable and have the benefit of reaching all regular takeaway food consumers (Dobbs et al., 2014). However, the reformulation process can be challenging for the food industry, as nutrients (such as fat and salt) in foods can affect sensory properties such as texture, taste, smell and also shelf life (Velisek, 2013). Despite voluntary targets in the UK food industry to reduce calories, sugar, and salt in foods since 2011, little progress has been made. In their assessment of products manufactured by the top 10 food and beverage companies, Bandy et al. (2021) only found a very small increase in the number of products which could be classified as healthy (46% in 2015% compared with 48% in 2018, p = 0.023) suggesting a slight improvement in the nutritional quality of foods being purchased. Huang et al. (2021) examined trends and changes in energy, SFA, salt and sugar of menu items served by 29 large UK chain restaurants between 2018 and 2020. They found energy, SFA and salt content remained constant overall although sugar content had declined which could be in response to the sugar reduction programme, the governments strategy to tackle childhood obesity (Department of Health and Social Care, 2018).

In the UK, there is also no legal obligation for small independent out of home food businesses to provide nutritional information, although some of the larger businesses do via websites and menus (PHE, 2018d). However, nutritional information is unlikely to be provided by small independent businesses where costs are prohibitive. Fast food chains have more resources and access to expertise than smaller independent outlets, which face the competitive nature of the marketplace and have difficulties in obtaining healthier products through the supply chain (Bagwell et al., 2014). They may also have limited staff resources, lack of training, knowledge or skills and may lack equipment or space for equipment. All of which can make it difficult to adopt healthier catering practices and make it more challenging for independent outlets to achieve these targets (Bagwell et al., 2014).

5.1.1 Public Health Responsibility Deals in the UK

In 2011, the coalition government launched Public Health Responsibility Deal (RD) for England with the aim of helping the public sector meet public health goals (Department of Health, 2011). The Responsibility Deal included a variety of voluntary food related pledges including reduce calories, salt, fat (particularly saturated fat), and industrial trans-fat (Department of Health, 2011). In general, these pledges were aimed at the food industry, supermarkets, and fast-food chains rather than small independent takeaways. Work on the Public Responsibility Deals ended in 2015 when the Conservative government came into session. In 2016, the responsibility for salt reduction was transferred from the Department of Health to Public Health England as part of its ‘sugar reduction and wider reformulation programme’, a main commitment in ‘Childhood Obesity: a plan for action’ (HM Government, 2016; PHE, 2017c). However, food businesses were expected to continue to work towards the 2014 salt reduction targets, which were to be achieved by 2017(PHE, 2017c). New targets to reduce levels of salt were published by PHE in 2020, and food businesses including the eating out, takeaway and delivery sector are expected to work towards achieving these by 2024 as well as reduce levels of sugar and calories (Department of Health and Social Care, 2019; PHE, 2020d). On the 1st October 2021, the health improvement responsibilities of PHE were formally moved to the Office for Health Improvement and Disparities (OHID) which now leads the sugar, salt and calorie reduction and reformulation programme (OHID, 2022b).

5.1.1.1 Saturated Fatty Acids

Evidence suggests that reducing SFA consumption can reduce the risk of CVD and CHD events. Current UK guidelines for the consumption of SFA is no more than about 10% of dietary energy intake and this applies to adults and children (SACN, 2019). At present, the UK reformulation programme does not specifically include SFA, however NICE recommends supportive legislation to enable manufacturers, caterers and producers to reduce SFA in food products (National Institute for Health and Care Excellence, 2021). To reduce their consumption, SACN recommends SFAs are substituted with unsaturated fats and suggests there is more evidence to support substitution with PUFA rather than MUFA (SACN, 2019). Nonetheless, reformulation strategies should be consistent with wider dietary recommendations and take available evidence into account in relation to replacing SFAs with other types of unsaturated fats (National Institute for Health and Care Excellence, 2021).

5.1.1.2 Trans Fatty Acids

Excessive consumption of industrial TFAs is associated with an increased risk of cardiovascular events (Islam et al., 2019). Regulatory approaches to reduce industrial TFAs in the food supply have been found to be more effective than voluntary approaches (Knai et al., 2017). In 2003, Denmark introduced legislation to limit industrial TFAs to 2% of a products composition and this has since been associated with a slowdown in obesity trends and CVD mortality in Denmark (Spruk and Kovac, 2020). Other countries such as Switzerland, Austria, Iceland, Norway and some cities and states in the USA have introduced similar legislations, although some have exemptions (Spruk and Kovac, 2020). However, the removal of industrial TFAs in Germany, France and the UK is still voluntary (Knai et al., 2017). Allen et al. (2015) advise that introducing policies to eliminate TFAs from restaurants and takeaway food (a TFA fast food ban) in England, could improve incidence and mortality from CHD. Furthermore, the reduction in TFA intake would be greater in the disadvantaged socioeconomic groups due to their higher mortality from CHD (Allen et al., 2015). The Public Health Responsibility Deal introduced in 2011 included two pledges regarding the use of TFAs. The first pledge was for food businesses to confirm they do not use artificial TFAs, and the second pledge was to remove industrial TFA from produced food. Between 2011 and 2016, these pledges are thought to have had little effect as they were both voluntary (Knai et al., 2017). For pledge one, 82 of the 90 businesses who signed up, were already removing TFAs from their foods. Food businesses which signed up to the second pledge failed to remove TFAs from products because they were not food manufacturers, hence their actions were limited to adapting catering-related purchases and practices (Knai et al., 2017). None of the food manufacturers and businesses producing fast foods and takeaways signed up to the second pledge. This is disappointing as it is where the majority of the remaining use of industrial TFAs are located in the UK; particularly PHVOs used during frying (Knai et al., 2017). Denmark's success in reducing industrial TFAs to almost zero was because the regulations they introduced were at the ingredient level rather than the final product (Allen et al., 2015).

5.1.1.3 Salt

A 40% reduction in daily salt intake is still needed in the UK to reduce current mean adult salt intakes from 8.4 g per day to its 6 g maximum daily salt recommendation (PHE, 2020a). The government's Green Paper 'Advancing our health: prevention in the 2020s' aims to reduce the population salt intakes to 7 g per day using industry salt reduction targets (Department of Health & Social Care, 2019).

In 2003, the FSA developed salt reduction targets for the food industry in order to reduce population salt intake from 9.5 g to 6 g/day by 2010. Between 2001 and 2011, salt intake reduced from 11 g to 9.3 g/day for men and from 8.1 g to 6.8 g/day for women (Reeve and Magnusson, 2015). This led to revised targets being published in 2009 to be met by 2012. However, nutrition policy was transferred from the FSA to the Department of Health in 2011 when the coalition government came into power (Action on Salt, 2020). The salt reduction program became part of the Public Health Responsibility Deal and salt commitments were based on the 2012 targets (Action on Salt, 2020). Two of the 2011 Public Health Responsibility Deal pledges were specific to the out of home food sector, hence some fast-food chains were encouraged to address the nutritional quality of food served (Department of Health, 2011). However, due to the deals being voluntary, there was no remit for signatories to sign up to all additional relevant pledges (Panjwani and Caraher, 2014). Three new salt pledges were introduced for the out of home food sector in July 2012: 1.Training and Kitchen Practice; 2. Reformulation of products as purchased by the customer and 3. Procurement (Department of Health and Social Care, 2012). The salt reduction pledge expected food businesses to commit to the FSA's 2012 salt reduction targets (Reeve and Magnusson, 2015) and these targets were revised in 2014, 2017 and 2020 (PHE, 2020d).

The targets were set to assist consumers to lower their salt intake from "popular meals" when eating meals prepared out of the home. The targets are based on the ten most popular food groups purchased from the out of home sector with an additional target for children's meals. The targets cover a reproducible product (standardised item) that is offered for at least 30 days in a year (PHE, 2017c). This salt reduction programme guides the industry of levels of salt they should aim for and has resulted in gradual stepwise reductions. The targets also provide a basis for monitoring progress, although the 2017 progress report for the out of home sector shows that reductions are based on chains rather than independent outlets and that the analysis is not representative of all businesses and products on the market (PHE, 2018d). Although the sector was keen for targets which considered the higher levels of salt in these types of products, many businesses within the sector have not worked towards achieving these voluntary targets (PHE, 2018d). The latest targets were published in September 2020 and businesses are expected to work towards achieving these by 2024 (PHE, 2020d). The eating out, takeaway and delivery sector is expected to commit to meeting the maximum per serving target specifically designed for this sector. Their targets include a ‘Dish Target’ for individual dishes that can be served on its own or as part of a dish and a ‘Meal Target’ which includes a specific dish, sides and accompaniment (PHE, 2020d) and have been previously discussed in Chapter 4, section 4.4.1.8.

5.1.1.3.1 Worldwide

The WHO has set a global target to reduce salt/sodium intake by 30% by 2025 (WHO, 2016b), and suggests that if the consumption of salt were reduced globally to less than 5 g per day, 2.5 million deaths could be prevented (WHO, 2014b; WHO, 2019). The WHO also recommends the food industry carry out the following actions to successfully achieve a reduction in salt and meet targets:

1. “Committing to and incrementally reducing salt in products over time so that consumers adapt to the taste and don’t switch to alternative products”
2. “Promoting the benefits of eating reduced salt foods through consumer awareness and education activities”
3. “Reducing salt in foods and meals served at restaurants and catering outlets and labelling sodium content of foods and meals.”

(WHO, 2014b)

In a systematic review of salt reduction initiatives around the world, Santos et al. (2021) found 75% of countries/regions in Europe had existing national salt reduction initiatives with the most used approaches being interventions in settings and food reformulation. The review also found Europe had the highest number of countries (n = 12) implementing mandatory salt level targets compared with the other regions and this does not include the UK where targets are voluntary (Santos et al., 2021). In 2021, the WHO also published global benchmarks for sodium levels in foods across different food categories and these were developed using the experiences of different countries where sodium reduction targets were already implemented (WHO, 2021b).

5.1.1.4 Sugar

Other reformulation strategies include the governments “Childhood Obesity – brave and bold action plan”, “Childhood Obesity: A plan for action” and the more recent “Childhood Obesity, A plan for action, Chapter 2”. These plans highlight several areas to tackle childhood obesity including a sugar tax on high sugar soft drinks and a reformulation programme to reduce sugar by 20% in foods commonly consumed by children up to the age of 18 by 2020 (House of Commons Health Committee, 2015; HM Government, 2016; Department of Health and Social Care, 2018). The “sugar tax” or soft drinks industry levy (SDIL) excludes drinks with a sugar content below 5g/100ml, fruit juices with high levels of natural sugar and drinks containing 75% milk. For drinks containing 5-8 g of sugar per 100 ml, the levy rate is 18 p a litre and 24 p a litre on drinks containing more than 8 g sugar per 100 ml (Thornton, 2018). The SDIL appears to be making positive steps with the sugar reduction progress report showing a 38.5% reduction in calories from the simple average total sugar content of drinks consumed in the eating out of home sector between 2015 and 2019 (PHE, 2020e). One year after implementation of the SDIL, analysis of household purchases (average weekly number of participants n = 22,183) showed that although the purchased volume of soft drinks had not changed, there was a 10% or 30 g reduction in the amount of sugar purchased per household per week (Pell et al., 2021). This is equivalent to the replacement of a 250 ml serving of a drink containing between 5 and 8 g of sugar per 100 ml per person per week with a sugar free alternative (Pell et al., 2021). There has also been a 13% reduction of sugar in breakfast cereals, yogurts and fromage frais (Foley, Balogun and Powell, 2022). These plans also provide local authorities with greater powers to tackle the environment leading to obesity (House of Commons Health Committee, 2015).

5.1.1.5 Calories (Energy) and Portion Size

Public Health England estimates that overweight and obese children in the UK are consuming between 140 and 500 excess calories per day, whilst adults consume between 200 and 300 excess calories per day (PHE, 2018a). In 2017, the calorie reduction programme was launched as part of the governments childhood obesity strategy. The programme sets voluntary guidelines for different sectors of the food industry to reduce portion sizes and/or calories by 20% in product categories that contribute significantly to children’s calorie intakes by 2024 (PHE, 2018a). This includes products such as ready meals, pizzas and savoury snacks but does not cover foods which are included in the sugar reduction programme (PHE, 2018a). Sectors expected to carry out this work includes retailers and manufacturers as well as the eating out sector such as restaurants, pubs, cafes, takeaway and delivery services (PHE, 2018a).

Findings from an observational study carried out by Huang et al. (2021) suggest the voluntary policies between 2018 and 2020 have resulted in very little progress so far in the eating out sector. Evaluation of menu items served by 29 UK large chain restaurants from 2018 to 2020 showed no reduction in energy, salt and SFA content and a small reduction in sugar. This study did not include independent retailers or other smaller chains which are even less likely to have implemented changes (Huang et al., 2021).

5.1.1.6 Nutritional Labelling

The governments Childhood Obesity strategy also proposed mandatory calorie labelling legislation for the out of home sector (Department of Health and Social Care, 2018). This policy came into effect in April 2022 and food businesses can be penalised up to £2,500 for non-compliance (Department of Health and Social Care, 2021). Out of home food businesses including restaurants, cafes, and takeaways with more than 250 employees are required to display calorie labels for the food they sell, and the information needs to be displayed at the point a customer is making their food and drink choices (menus, online menus, third party apps, food delivery platforms and food labels) (Department of Health and Social Care, 2021). Furthermore, to make it easier for the customer to understand what a standard portion is, the labels for the food or drink item need to show calorie content per portion and not per 100 g as shown on pre-packaged food (Department of Health and Social Care, 2021). Small businesses with less than 250 employees are encouraged to provide calorie information voluntarily (Department of Health and Social Care, 2020).

5.1.1.7 Media watershed for products high in fat, salt and/or sugar

To limit children’s exposure to the advertising of foods high in fat, salt and/or sugar (HFSS) and to encourage further reformulation the governments Childhood Obesity plan has proposed introducing restrictions before 9pm on TV and online (Department of Health and Social Care, 2018). These restrictions have been legislated by the Health and Care Act 2022 and were due to come into effect on 1 January 2023 (Sustain, 2022), however this has been delayed until January 2024 (Department of Health and Social Care, 2022).

5.1.2 Reformulation of meals served by independent takeaway outlets

As previously discussed, the takeaway sector is encouraged to improve the nutritional composition of meals served due to the significant contribution takeaway and fast foods have on the population’s diet. The Turning the Tables report recommends a supportive approach to businesses in the FAFH sector, recommending they are assisted in adapting or reformulating their menus to provide healthier foods without accruing extra costs or losing customers (Lasko-Skinner, 2020). This could be achieved using local working groups alongside local consumer representatives, local experts and industry experts (Lasko-Skinner, 2020).

The London Food Board, Mayor of London, and the Chartered Institute of Environmental Health (CIEH) developed a “Takeaways Toolkit” to support takeaway businesses to implement these changes (London Food Board, CIEH and Mayor of London, 2012). As mentioned earlier (in Chapter 1, Section 1.12), the toolkit identifies areas where local authorities can target interventions to assist with tackling the proliferation of takeaways and their impact on health (London Food Board, CIEH and Mayor of London, 2012). The toolkit recommends a multifaceted approach due to the complexity of this area; however, one of its main recommendations is that local authorities should work with takeaway businesses and the food industry to make food healthier. It particularly recommends the use of environmental health teams as they visit food premises regularly to carry out food safety inspections, providing them with means to provide information, training, and advice. Changes to cooking practices and reformulation of recipes could help improve the healthiness of food served by takeaway businesses (London Food Board, CIEH and Mayor of London, 2012). In turn, these changes could contribute to a reduction in chronic diseases and improvements in the health of takeaway consumers. Liverpool is an ideal area to carry out this research due to its high density of fast food and takeaway outlets and high incidence of NCD (PHE, 2020c).

5.2 *Eatright* Liverpool

The use of recipe reformulation provides an opportunity to improve takeaway food, where public health nutritionists, research chefs, food scientists and other stakeholders can work together collaboratively. The following research is a small part of the collaborative work that was carried out on the *Eatright* Liverpool project with the help of local independent takeaway outlets in Liverpool and other project stakeholders. The principal aim of *Eatright* Liverpool was to assist Chinese and Indian takeaway businesses to improve the nutritional content of the takeaway food they served (Davies, 2013).

5.3 Aim and Objectives of the Present Study

5.3.1 Aim

To explore the use of recipe reformulation to improve the nutritional composition of selected Chinese takeaway meals served by local independent takeaway outlets taking part in the *Eatright* Liverpool project. The main aim of this study was to reduce salt content in takeaway meals, thereby increasing the availability of lower sodium takeaway foods if chefs were to make the recommended changes to their recipes.

5.3.2 Objectives

- The primary objective is to reduce the salt content of a takeaway meal via reformulation using recipe information provided by an outlet participating in *Eatright* Liverpool
    - The secondary objective is to reduce the fat and energy content
- The final objective is to access the acceptability of the reformulated takeaway meal

5.3.3 Ethics

Ethical approval was obtained from LJMU's ethical committee (11/ECL/015, Appendix 1.0). All studies obtained informed participant consent.

5.4 Method

5.4.1 Meal Selection

The takeaway meals investigated as part of *Eatright* Liverpool included Chinese meals and Indian meals. These types of takeaway meals were chosen as at the time they were Britain's most favourite type of takeaway (Mintel, 2006b; The Telegraph, 2009; Daily Mail, 2010; Mintel, 2010b; Na, 2010). For the purposes of *Eatright* Liverpool, the chosen meals were based on their popularity with consumers and discussion with Liverpool City Council Trading Standards team and community representatives who were directly involved with takeaway food businesses. It was also decided that the protein part of the meals would be chicken to enable comparison between meal types.

Table 5.1 Meals selected for Recipe Reformulation on *Eatright* Liverpool

Number	Chinese Meals	Indian Meals
1	Black Bean	Rogan Josh
2	Chow Mein	Tikka Masala
3	Satay	Korma
4	Sweet and Sour	Biryani
5	Kung Po	Madras
6	Curry	Jalfrezi
Accompaniment	Egg fried rice	Pilau rice

5.4.2 Recruitment Challenges / Language Barriers

To participate in the *Eatright* Liverpool project, the takeaway outlet had to have a food hygiene rating of 3 or more, assessed as part of England's Good Hygiene Rating scheme. A rating of 3 indicates hygiene standards are generally satisfactory, 4 indicates good and 5 indicates very good (Food Standards Agency, 2022).

Language barriers were expected as many chefs in the ethnic catering sector do not speak English as their first language (Chan, Cole and Bowpitt, 2016). For this reason, community representatives were enlisted from local businesses who worked with individuals and organisations from Black, Asian, and Minority Ethnic (BAME) backgrounds. With their input, a convenience sample of local independent Chinese and Indian takeaways were recruited to take part in the study. In the local restaurant initiative in El Paso, Redelfs et al. (2021) recommended a cultural bridge via a team member who spoke the same language and understood the restaurant culture. For the present study, the Liverpool Chinese Business Association (LCBA) was chosen as they were knowledgeable about local Chinese culture and spoke Cantonese and Mandarin. Similarly, the Muslim Enterprise Development Service (MEDS) was employed to communicate with Asian chefs working in the Indian outlets (for example Indian, Pakistani, Bangladeshi). These community representatives made initial contact with the outlets and arranged visits to the premises with Liverpool Trading Standards. This built on existing relationships Trading Standards had with the takeaway outlets due to carrying out food hygiene inspections. Initial meetings with the facilitators helped overcome language barriers between the takeaway owners and the Trading Standards team. Once introductions had been made, additional visits were organised. In total, seven Chinese takeaways and six Indian takeaways were recruited to the project.

5.4.3 Recipe Collection

Once a commitment to the project had been obtained from the takeaway proprietor, LJMU were provided with the takeaway's details. Their menu was then checked to ensure that some or all the meals selected for the study were available for purchase. A recipe collection form was designed for the Trading Standards team to record recipe information (ingredients and quantities), meal preparation techniques (details of any marinades or home-made sauces) and cooking practices (for example stir fry, deep fry, grill). Additional collected information included the date and time, establishment name and a description of the preparation process.

Recipe information was collected by Trading Standards and a local chef employed by LCC, who worked together with the community representative and the chefs at the outlets. During each visit, the chef prepared the meal being studied while the community representative explained to the team what was happening and gave information about the ingredients. Using a tared scale, ingredients were placed on the scales and the quantity was recorded on the recipe collection form as they were added during the cooking process. Where possible, information was collected about the brand and name of the ingredient. The completed recipe collection form was then emailed to LJMU for consideration and to identify where changes could be made (Recipe Collection form is shown in Appendix 5.1).

5.4.4 PAL Analysis

5.4.4.1 Baseline PAL Analysis

To provide a baseline for each meal being studied at each outlet, nutritional analysis of the meals was carried out by PAL (see Nutritional Composition Chapter 4, section 4.3.2: for details on how PAL analyses meals). It was important to do this as previous results show a large variability in nutritional composition for the same meals when cooked at a different outlet. Furthermore, due to the limitation of only one sample of each meal being purchased from each outlet on the previous study (Chapter 4, Section 4.3.1), the *Eatright* Liverpool team proposed that each of the chosen meals would be purchased and analysed in triplicate from each outlet. This would show the variability in nutritional composition of the same meal prepared at the same outlet on different occasions. However, due to the high cost of using PAL for nutritional analysis, only one signature meal from each participating outlet was purchased in triplicate and the other meals were purchased singularly.

Takeaway menus for each outlet were checked to ensure that the takeaway sold some of the meals being investigated. The researcher then compiled a list of meals which needed to be purchased from each venue. During March 2010, meals were purchased on a weeknight (Tuesday to Thursday) from 5 pm onwards. When the researcher ordered the meals, they presented themselves as an ordinary takeaway consumer. The meals were purchased by the researcher rather than Trading Standards to ensure the chefs did not make changes when cooking the meals (in case the staff members were aware they were participating in a study) and to guarantee that salt or soy sauce (where applicable) were not added at the counter. As the meals were purchased in the evenings, the meals were labelled by the researcher and stored in their fridge until being transferred to a freezer at -18◦C at LJMU the next day. Samples were stored at LJMU until Trading

Standards arranged for them to be collected by a courier and sent to an accredited PAL for nutritional analysis. For each meal, the following information was determined (per 100 g and total weight): energy content (kJ and kcal), total fat, SFA, sodium and salt.

5.4.4.2 PAL Analysis – Reformulated Recipe prepared at Outlet by Chef

After the recipe had been reformulated, an additional sample of the meal was sent to PAL. This enabled the comparison of baseline PAL results with PAL results for reformulated meals to evaluate whether there were any reductions in energy, fat, and salt at each outlet.

5.4.4.3 Post Project PAL Analysis

After the project had ended and recommendations had been provided to the chefs at each outlet, Trading Standards took further meal samples from outlets still participating in the project and sent them for analysis. The PAL results for these are per 100 g only and do not include portion size. These samples were taken during December 2013 and January 2015 by a member of the Trading Standards team.

5.4.5 Recipe Analysis

Nutrient analysis of the recipes (energy, fat and salt content) was analysed at LJMU using dietary analysis software called 'Microdiet^{TM}' (Downlee Systems Limited, Derbyshire, UK), which was based on the food composition tables in the sixth edition of McCance and Widdowson's Composition of Foods (McCance and Widdowson, 2002). These tables consist of detailed micronutrient and macronutrient information for common foods eaten in the UK. This analysis was necessary to check for inconsistencies in the collected information and substantiate whether the collected recipe information supported the laboratory results from PAL. As brand names of ingredients were seldom available and most ingredient labels used in Chinese cooking did not provide nutritional information, supermarket websites were consulted to calculate nutritional information for basic ingredients. For ingredients where no nutritional information was available, flame photometry was carried out at LJMU to calculate the sodium content (such as preserved fermented black beans, before and after rinsing). Food samples were homogenised, weighed, and measured and desiccated in quadruplicate. Flame photometry using BWB XP flame photometer (BWB Technologies, Newbury, Berks., UK) was carried out to determine sodium content (Chen et al., 2005; Chu and Taylor, 2015). When a similar ingredient was not available in the food composition tables on Microdiet^{TM}, then nutritional information for the missing ingredient was added to its database, compiled from nutritional labels, supermarket websites or flame photometry. Microdiet^{TM} was also used to determine the effects of changing cooking methods, reducing/increasing ingredient quantities and exchanging ingredients for others.

5.4.6 Recipe Reformulation

After inspection of the collected recipe information and analysis on Microdiet^{TM}, preliminary recommendations were made to reduce quantities of ingredients (where appropriate) with the intention of reducing the energy, fat, SFA, salt and/or sugar content of meals where applicable. The collected recipe information for each meal type showed that each outlet prepared them differently to some extent, so a black bean meal at one outlet would have different ingredients and quantities than a black bean meal prepared at a different outlet, but with some similarities.

The rest of this chapter focuses on the research carried out for Chinese meals only and shows the process of recipe reformulation and sensory acceptance of a "chicken, green peppers and black bean sauce" meal from one individual outlet participating on the *Eatright* Liverpool project. This meal has been selected as it was one of the meals where most of the recipe information was obtained.

Chicken with green peppers in black bean sauce

A typical chicken with green peppers in black bean sauce meal contains a number of ingredients that are high in sodium, such as fermented/preserved black beans or black bean paste, soy sauce, chicken stock and added salt and/or monosodium glutamate (MSG). Fat usually comes from the oil used to stir fry the meal, the chicken pieces and the sesame oil added towards the end for flavour.

5.4.6.1 Fat reduction

To reduce overall calories and produce a lower fat version, attention was made to the high fat ingredients such as the oil added to the wok during the cooking process.

5.4.6.2 Salt Reduction

Ingredients that were focussed upon to produce a lower salt version of a black bean meal included reducing soy sauce, chicken powder (stock) and reducing the amount of added salt and/or MSG. A typical ingredient in black bean meals is fermented black beans or a ready-made store-bought black bean paste. Outlets which use fermented black beans when preparing meals, often use them to make a homemade black bean paste. As with many Chinese ingredients, the salt content of fermented black beans is not provided on the packaging. Fermented black beans have a very high concentration of salt, and it is important that they are rinsed before use. To calculate their salt content, flame photometry was carried out on samples of un-rinsed and rinsed black beans to determine sodium content. The sodium content was then multiplied by 2.5 to calculate the amount of salt, as 1g of sodium is equivalent to 2.5g salt (SACN, 2003). The flame photometry laboratory work was carried out as part of the *Eatright* Liverpool project (Recipe Analysis, section 5.4.6).

5.4.6.3 Sensory Evaluation

To provide evidence to the takeaway outlets that the suggested changes were acceptable to consumers, some pilot sensory evaluation sessions were carried out at LJMUs research kitchens. These sessions were used to ensure that any changes suggested via recipe reformulation were not detrimental to taste and acceptability. Each meal was prepared and cooked using the original recipe information (provided by the chefs and collected by LCC Trading Standards) and the reformulated recipe. Participants for the pilot sessions were recruited using e-mail and flyer advertisements at LJMU and selected based on the following recruitment criteria: they had eaten fast food or takeaway food in the past and were available at the required testing times. Since consumption of fast food and takeaway food is widespread and commonplace in the UK (see Chapter 2), it was anticipated that many of the recruited participants would have eaten takeaway food previously. All the participants were students or members of staff based at the IM Marsh campus and they did not receive any monetary incentive for taking part in the research.

As this study involved using participants that were untrained in sensory evaluation (naïve assessors), the research team decided upon sensory acceptance testing, a hedonic (affective) sensory method. Sensory acceptance testing captures the sensory response of naïve assessors by asking them to score their preference of things relating to the product being tested such as acceptance, flavour, aroma, and overall acceptability (O'Sullivan, 2017). Sensory acceptance testing is usually carried out with a minimum of 25 individuals (O'Sullivan, 2017), however as this was a pilot study, a smaller number of individuals was used (between 10 and 12 depending on availability of participants).

5.4.7 Sensory Acceptance Testing

Samples of the original and modified meals were evaluated in individual sensory booths under white fluorescent lights at a purpose-built sensory laboratory in the research kitchen at LJMU’s IM Marsh campus. Each participant received two meal samples depending on which versions were being evaluated. The samples were randomly coded with a three-digit number and a cup of water was provided to for participants to cleanse their palates between samples. Sampling order was also alternated between participants to avoid positional bias.

Before evaluation commenced, the participants were instructed to complete a sensory form for each of the samples, and to rinse their mouth after evaluating the first sample before progressing to the second sample. Participants were asked to evaluate the samples based on appearance, aroma, flavour, mouthfeel, aftertaste, and overall acceptability using a standard nine-point hedonic scale ranging from “dislike extremely” to “like extremely” (Table 5.2). This is a reliable scale which untrained assessors find easy to use (O'Sullivan, 2017). The participants were also asked to comment on what they liked or disliked about the samples, the level of saltiness and their overall opinion (see full proforma in Appendix 5.2).

Table 5.2 Sensory Acceptance with a 9-Point Hedonic Scale

Rating	Sensory Attribute					
	Appearance	**Aroma**	**Flavour**	**Mouthfeel**	**Aftertaste**	**Overall Acceptability**
Like extremely	9	9	9	9	9	9
Like very much	8	8	8	8	8	8
Like moderately	7	7	7	7	7	7
Like slightly	6	6	6	6	6	6
Neither like nor dislike	5	5	5	5	5	5
Dislike slightly	4	4	4	4	4	4
Dislike moderately	3	3	3	3	3	3
Dislike very much	2	2	2	2	2	2
Dislike extremely	1	1	1	1	1	1

5.4.8 Statistical Analysis

All quantitative data from the session was entered into Microsoft Excel to determine basic mean averages and plotted onto a radar graph to enable comparisons to be made between the different attributes for each version of the meal. Once the results were collated and analysed it was sometimes necessary to make additional changes to the reformulated recipe, which would then require further testing. Recipe reformulation continued until results from the sensory acceptance testing sessions determined the changes were acceptable. Analysis of sensory acceptance testing sessions was carried out using IBM SPSS (version 27, IBM Corp, Armonk, NY, USA). Normal distribution of the sensory results was assessed with histograms, Kolmogorov–Smirnov and Shapiro–Wilk tests. Paired samples t-tests were carried out for normally distributed comparisons and expressed as means with 95% confidence intervals. Wilcoxon signed rank test was carried out on comparisons with non-normal distributions and expressed as medians with interquartile range (25^{th} and 75^{th} percentiles). Final approval of the reformulated recipe was made by the Trading Standards team during their own informal sensory acceptance session at LJMU before returning to the outlets to discuss the recommendations with the chefs. It was important that the owners and chefs approved the modifications as they were concerned about losing customers and potentially profits.

The following shows the method that was used at LJMU to reformulate a chicken, green peppers and black bean sauce meal served by an outlet on the *Eatright* Liverpool project. This is just one small part of the project.

5.4.8.1 Sensory Acceptance Session 1

For the first session, the amount of oil used during the cooking process and the amount of added salt/MSG and soy sauce were reduced to reduce the total salt and fat content. The outlet's original (baseline) recipe was cooked twice, but with the following changes:

Version 1

1. Vegetable oil reduced from 2 tablespoons (30 ml) to 1 tablespoon (15 ml)
2. Salt/Sugar/MSG solution removed
3. Dark soy sauce maintained at 20 ml (4 teaspoons)

Version 2

1. Vegetable oil reduced from 2 tablespoons (30 ml) to 1 tablespoon (15 ml)
2. Salt/Sugar/MSG solution removed
3. Dark soy sauce reduced from 20 ml to 15 ml (3 teaspoons)

The reasons for the suggested changes in versions 1 and 2 were that recipe information collected from other outlets on the project showed that chefs were preparing this meal using half the amount of vegetable oil and soy sauce. In terms of health, one tablespoon of vegetable oil (roughly 15 ml) provides around 135 kcal, and one teaspoon of soy sauce (roughly 5 ml) provides about 0.9 g salt. The chefs salt/sugar/MSG solution was also omitted from the recipe, as there was no quantifiable way of knowing how much sodium this was providing. This was a solution made by the chef and consisted of an unknown quantity of water which had salt, sugar and MSG added to it.

5.4.8.2 Sensory Acceptance Session 2

In the second sensory session, versions 1 and 2 were recooked but with the addition of a small amount of MSG and sugar (versions 3 and 4). This was to account for the salt/sugar/MSG solution the chef usually added when preparing this meal at the outlet. For the reformulation of the recipe, it was recommended this be removed. The outlets original (baseline) recipe was prepared, but with the following changes:

Versions 3 and 4

1. Vegetable oil reduced from 2 tablespoons (30 ml) to 1 tablespoon (15 ml)
2. Salt/Sugar/MSG solution removed
3. 150ml of water added in place of ½ ladle
4. ½ teaspoon of sugar added
5. ¼ teaspoon of MSG added

Version 3

6. Soy sauce maintained at 20 ml (4 teaspoons)

Version 4

7. Soy sauce reduced from 20 ml to 15 ml (3 teaspoons)

5.4.8.3 Sensory Acceptance Session 3

In the third sensory session, soy sauce was maintained at 15 ml in version 4 and reduced to 10 ml in version 5 to determine whether this ingredient could be reduced further. A portion of egg fried rice was also cooked and a small sample of this was provided to the participants with the meal samples. The reason behind this was to provide a sample of the complete dish which would potentially be ordered from a takeaway.

The outlets original (baseline) recipe was prepared, but with the following changes:

Versions 4 and 5

1. Vegetable oil reduced from 2 tablespoons (30 ml) to 1 tablespoon (15 ml)
2. Salt/Sugar/MSG solution removed
3. 150 ml of water added in place of 1/2 ladle
4. ½ teaspoon of sugar added
5. ¼ teaspoon of MSG added

Version 4

6. Soy sauce maintained at 15 ml (3 teaspoons)

Version 5

7. Soy sauce reduced to 10ml (2 teaspoons)

5.4.8.4 Sensory Acceptance Session 4

Since further modifications in version 5 produced lower levels of acceptability (see Results, Section 5.5.1.3 Sensory Acceptance Session 3), version 4 was trialled against the takeaway outlets original recipe (baseline). The differences between the two meals were as follows:

Original Version (Unmodified)

- 30 ml vegetable oil
- 20 ml soy sauce
- 1 tablespoon water/salt/MSG solution (provided by outlet)

Modified Version 4

- 15 ml vegetable oil
- 15 ml soy sauce
- solution replaced with ½ teaspoon caster sugar and ¼ teaspoon MSG

5.5 Results

5.5.1 Sensory Evaluation

5.5.1.1 Sensory Acceptance Session 1

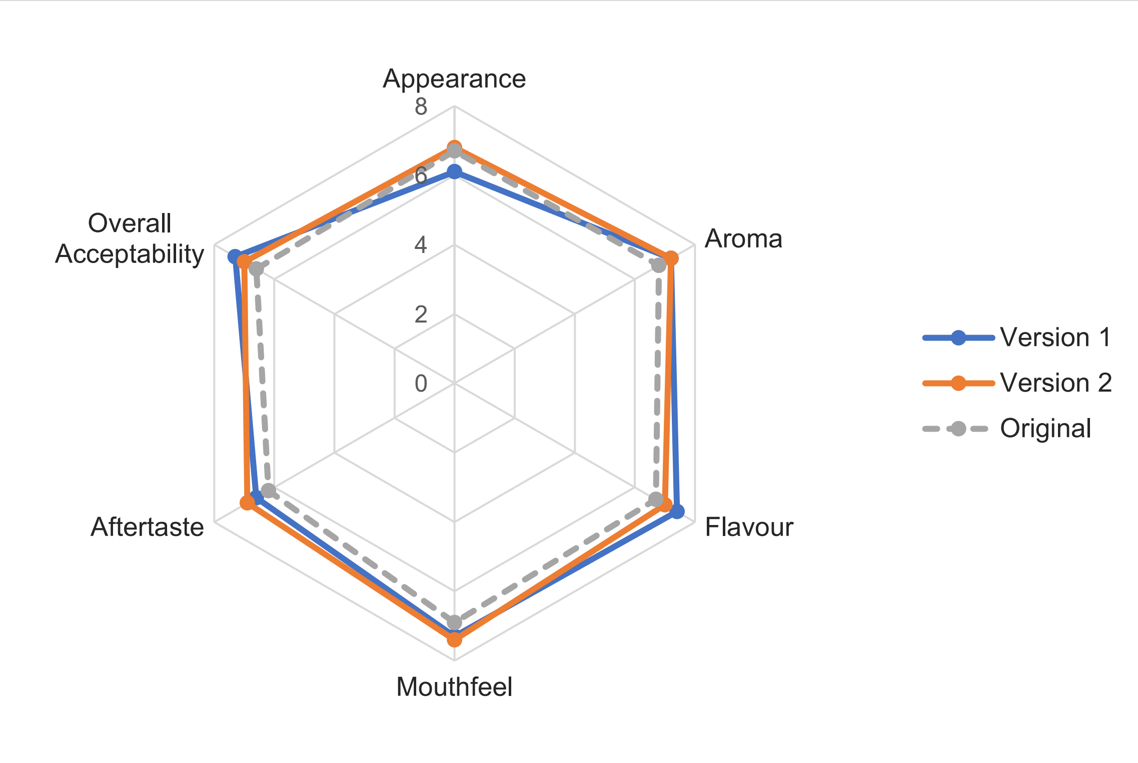
The results from the sensory session are shown in Table 5.3. Attributes were scored from 9 = like extremely down to 1 = dislike extremely. Paired sample t-tests and Wilcoxon Signed Rank test showed no significant differences between the attributes. The scores for both modified versions ranged from “like slightly” up to “like moderately”. Version 2 was prepared with less soy sauce than version 1 (15 ml instead of 20 ml) which may account for its more favourable ‘like moderately’ appearance score (as it was lighter in colour) compared to ‘like slightly’ for version 1. The reduction did not create any perceivable differences in ‘aroma’, and only minimal differences for ‘mouthfeel’. Version 1 had a higher ‘flavour’ score and ‘overall acceptability’, which was addressed in the next session.

Most participants felt both versions contained the ‘right level of salt’, three participants found version 1 ‘too salty’ and only one participant found version 2 ‘too salty’. Additionally, six participants advised they would be satisfied if they had purchased version 2 from a takeaway compared to four participants for version 1.

Table 5.3 Results from Sensory Acceptance Session 1

Sensory Attribute	Mean Score		
	Version 1	Version 2	*p*-value
Appearance	6.1	6.8	0.19
Aroma[w]	7.2	7.2	1.00
Flavour	7.4	7.0	0.27
Mouthfeel[w]	7.3	7.4	0.74
Aftertaste	6.6	6.9	0.54
Acceptability	7.3	7.0	0.34
Overall Score	7.0	7.1	0.82
	Number of participants (n=10)		
Satisfied if purchased from a takeaway?	4	6	
Right level of salt?			
Too salty	3	1	
Right level of salt	7	8	
Not salty enough	0	1	

Overall score = mean (appearance, aroma, flavour, mouthfeel, aftertaste, acceptability)
Paired sample t-tests (normally distributed data), [w]Wilcoxon signed rank tests (non-normally distributed data); statistically significant p <0.05.



Note: The original meal was prepared on a different occasion and is shown as a dashed line to show how it compares with the reformulated recipes.

Figure 5.1 Sensory Acceptance Test for Versions 1 and 2

5.5.1.2 Sensory Acceptance Session 2

In the next session, versions 1 and 2 were recooked but with the addition of extra water (150 ml), a small amount of sugar to offset any bitterness and some MSG, to account for the sodium usually added via the chef in the salt/sugar/MSG solution. Table 5.4 shows the mean scores of versions 3 and 4 were very similar to each other except for ‘aroma’ and ‘mouthfeel’ which were higher for version 4 (with the reduced amount of soy sauce). A Wilcoxon Signed Rank test showed ‘acceptability’ was significantly higher for version 4 (p = 0.046). The median acceptability score was 8 (7.5, 8.5) for version 4 compared with 8 (7, 8) for version 3, the other attributes were not significantly different.

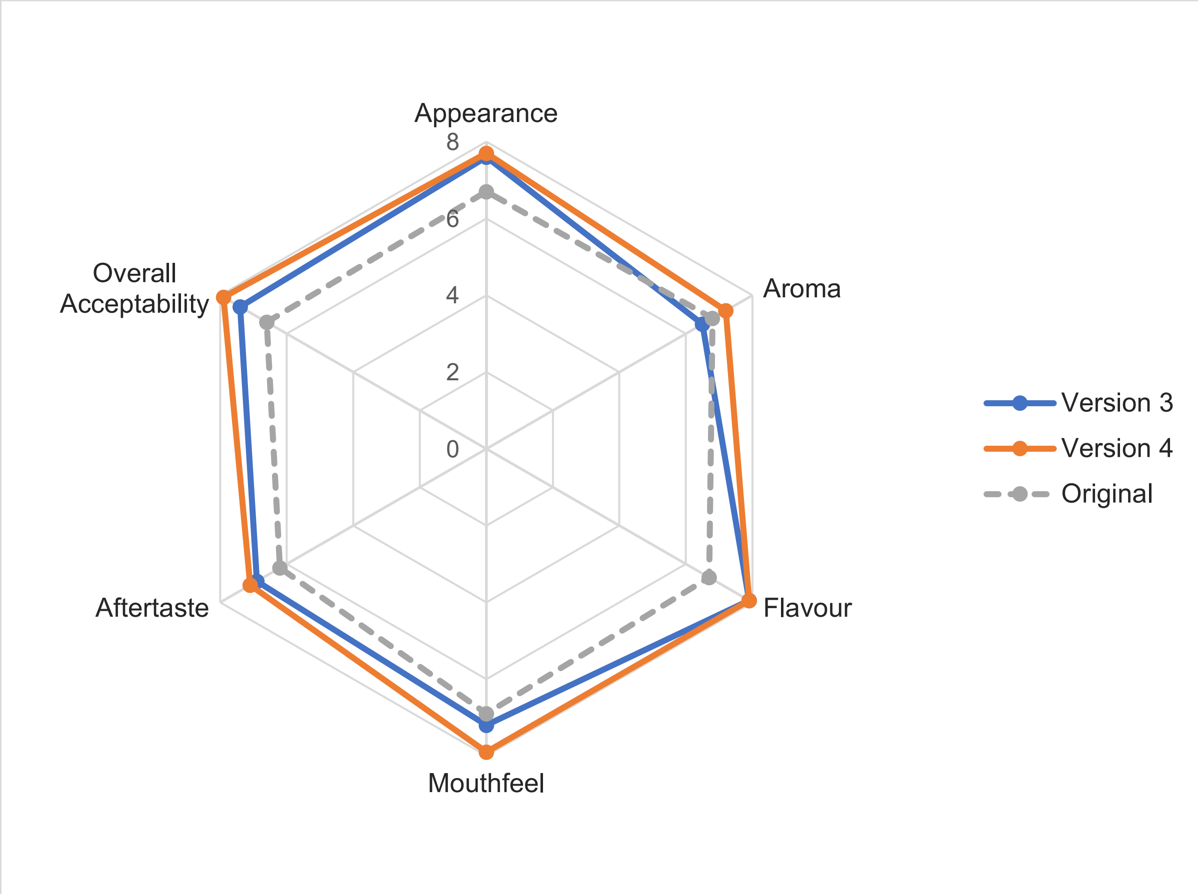
Table 5.4 Results from Sensory Acceptance Session 2

Sensory Attribute	**Mean Score**		
	Version 3	**Version 4**	***p*-value**
Appearance[w]	7.6	7.7	0.32
Aroma[w]	6.5	7.2	0.11
Flavour[w]	7.9	7.9	1.00
Mouthfeel	7.2	7.9	0.89
Aftertaste	6.9	7.1	0.62
Acceptability[w]	7.4	7.9	*0.046
Overall Score	7.3	7.6	0.10
	Number of participants (n = 10)		
Satisfied if purchased from a takeaway?	7	8	
Right level of salt?			
Too salty	3	2	
Right level of salt	7	7	
Not salty enough	-	1	

Overall score = mean (appearance, aroma, flavour, mouthfeel, aftertaste, acceptability)
Paired sample t-tests (normally distributed data), [w]Wilcoxon signed rank tests (non-normally distributed data); *statistically significant p <0.05.

Some of the positive comments regarding versions 3 and 4 included ‘like the flavour’, ‘love the flavour’, ‘rich sauce’ and ‘overall very nice’. Acceptability was significantly higher for version 4, suggesting the addition of MSG and sugar helped improve its acceptability.

As can be seen in Figure 5.2, version 4 was the preferred version. Although seven participants advised both versions contained the ‘right level of salt’, only two participants felt version 4 was ‘too salty’ compared with three participants for version 3.



Note: The original meal was prepared on a different occasion and is shown as a dashed line to show how it compares with the reformulated recipes.

Figure 5.2 Sensory Acceptance Test for Versions 3 and 4

Comparison of the scores for the two sensory sessions showed variations in how much participants liked the meals. The mean scores for version 4 were higher or equal to all the sensory attributes when compared to versions 1, 2 and 3 (Table 5.5).

Table 5.5 Comparison of Sensory Acceptance Sessions 1 and 2

Sensory Attribute	**Mean Score**			
	Version 1	**Version 2**	**Version 3**	**Version 4**
Appearance	6.1	6.8	7.6	7.7
Aroma	7.2	7.2	6.5	7.2
Flavour	7.4	7.0	7.9	7.9
Mouthfeel	7.3	7.4	7.2	7.9
Aftertaste	6.6	6.9	6.9	7.1
Acceptability	7.3	7.0	7.4	7.9
Overall Score	7.0	7.1	7.3	7.6
	Number of participants (n = 10)			
Satisfied if purchased from a takeaway?	4	6	7	8

5.5.1.3 Sensory Acceptance Session 3

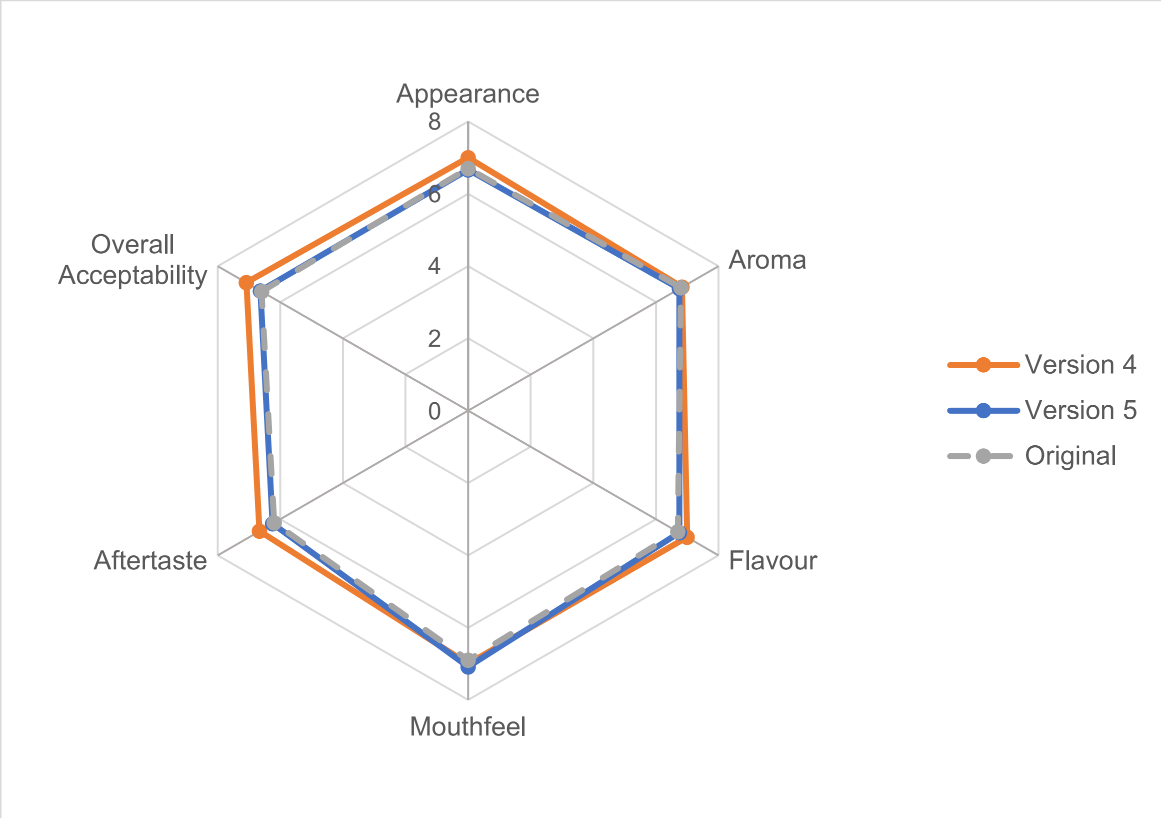
In this session, versions 4 and 5 were recooked with the previous modifications from session 2, except soy sauce was maintained in version 4 and reduced from 15ml to 10ml in version 5. A small sample of egg fried rice was provided along with the samples of the chicken and black bean meal. The sensory panel consisted of 12 participants. Overall, the mean scores for version 4 were lower in this session when compared with results from session 2, this could be due to several factors including use of different participants, the inclusion of egg fried rice, or perhaps there were inconsistencies in the repeat cooking of the meal, despite efforts to minimise this. Figure 5.3 and Table 5.6 show that compared with version 5; version 4 had higher scores for each sensory attribute apart from the minimal difference in 'mouthfeel' (no significant differences).

Seven participants advised they would be satisfied if they had purchased version 4 from a takeaway compared to only four participants for version 5 (Table 5.6). Additionally, ten participants felt version 4 contained the 'right level of salt' compared to only seven for version 5.

Table 5.6 Results from Sensory Acceptance Session 3

Sensory Attribute	Mean Score	
	Version 4	Version 5
Appearance	7.0	6.7
Aroma	6.8	6.8
Flavour	7.0	6.8
Mouthfeel	7.0	7.1
Aftertaste	6.7	6.3
Acceptability	7.1	6.6
Overall Score	6.9	6.7
	Number of participants (n = 12)	
Satisfied if purchased from a takeaway?	7	4
Right level of salt? **Too salty**	1	0
Right level of salt	10	7
Not salty enough	1	2

Even though statistical analysis revealed no significant differences between any of the attributes for versions 4 and 5, reducing the soy sauce in version 5 resulted in comments such as "tasted a bit ordinary" and "quite bland", whilst more positive comments were received for version 4, for example "richer sauce", "tasty" and "good combination of flavours". These comments helped to confirm that version 4 was the preferred version and that reducing the soy sauce to 10 ml in version 5 was too excessive.



Note: The original meal was prepared on a different occasion and is shown as a dashed line to show how it compares with the reformulated recipes.

Figure 5.3 Sensory Acceptance Test for Versions 4 and 5

5.5.1.4 Sensory Acceptance Session 4

In this session, version 4 of the reformulated recipe was trialled against the takeaway outlet's original recipe, a small sample of egg fried rice was also provided as in the previous session. The sensory panel consisted of twelve participants (including two members from the Trading Standards team). Compared with the original recipe, the reformulated version contained reduced amounts of vegetable oil, soy sauce, MSG, and salt.

The results from the session were more favourable for the reformulated meal apart from 'aroma' which was the same for both versions. The greatest differences between the scores were for 'flavour', 'aftertaste' and 'acceptability', with version 4 rated overall as "like moderately" and the original version rated as "like slightly".

Mouthfeel, aftertaste, and overall score were found to be statistically significant with version 4 having higher median scores than the original recipe for each of these attributes. 'Mouthfeel' for version 4 had a significantly higher median score, 8.0 (7.0, 8.0) compared to the original with 7.5 (6.3, 8.0) (p = 0.014). 'Overall score' had a median score of 7.6 (6.9, 8.0) compared to the original with 7.3 (6.4, 7,7) (p = 0.011). 'Aftertaste' for version 4 had a median score of 8.0 (7.0, 8.0) compared with 6.5 (5.3, 8.0) for the original (p = 0.046).

Table 5.7 Sensory Acceptance Test for Version 4 and Original (Unmodified) Version

Sensory Attribute	**Mean Score**		
	Original	**Version 4**	***p*-value**
Appearance	6.7	7	0.220
Aroma^{w}	6.8	6.8	1.00
Flavour	6.7	7.4	0.056
Mouthfeel^{w}	6.9	7.4	0.014*
Aftertaste^{w}	6.2	7.2	0.046*
Acceptability^{w}	6.6	7.4	0.055
Overall Score^{w}	6.7	7.2	0.011*
	Number of participants (n = 12)		
Satisfied if purchased from a takeaway?	9	11	
Right level of salt?			
Too salty	8	1	
Right level of salt	4	10	
Not salty enough	0	1	

Overall score = mean (appearance, aroma, flavour, mouthfeel, aftertaste, acceptability)
Paired sample t-tests (normally distributed data), ^{w}Wilcoxon signed rank tests (non-normally distributed data); *statistically significant p <0.05.

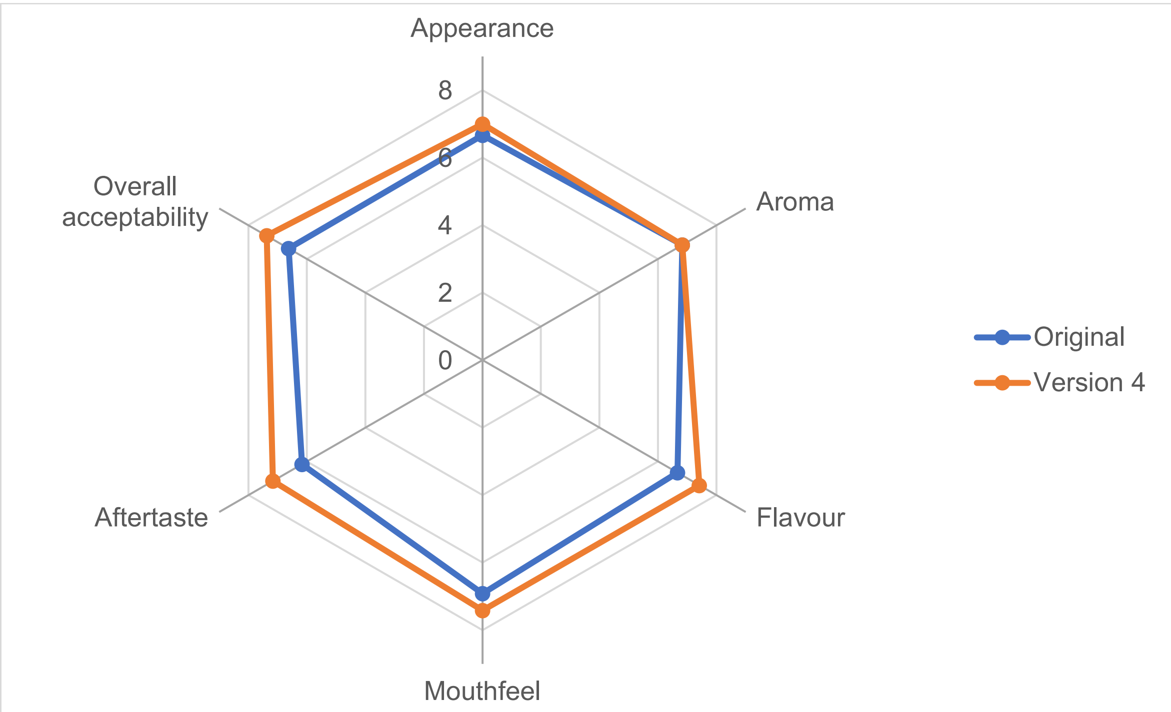


Figure 5.4 Sensory Acceptance Test for Versions 4 and Original (Unmodified) Version

Eight participants also found the original version ‘too salty’ compared with only one for the reformulated version.

Results from this session indicated that the reduction in salt content (via the removal of sodium usually added in the salt/water/MSG solution and reduced amount of soy sauce) produced a meal with a more favourable sensory profile when compared to the original.

Table 5.8 Summary of Sensory Acceptance Results

Sensory Attribute	**Mean Score**							
	Session 1		**Session 2**		**Session 3**		**Session 4**	
	Version 1	Version 2	Version 3	Version 4	Version 4	Version 5	Version 4	Original
Appearance	6.1	6.8	7.6	7.7	7.0	6.7	7.0	6.7
Aroma	7.2	7.2	6.5	7.2	6.8	6.8	6.8	6.8
Flavour	7.4	7	7.9	7.9	7.0	6.8	7.4	6.7
Mouthfeel	7.3	7.4	7.2	7.9	7.0	7.1	7.4	6.9
Aftertaste	6.6	6.9	6.9	7.1	6.7	6.3	7.2	6.2
Overall Acceptability	7.3	7.0	7.4	7.9	7.1	6.6	7.4	6.6
	Satisfied if purchased from a takeaway?							
Yes (n)	4	6	7	8	7	4	11	9
	Right level of salt?							
Too salty (n)	3	1	3	2	1	0	1	8
Right level of salt (n)	7	8	7	7	10	7	10	4
Not salty enough (n)	0	1	0	1	1	2	1	0

(n) = number of participants

Based on the results from the sensory acceptance sessions, the recommended changes from version 4 of the reformulated recipe were proposed to the chef at the outlet by the Trading Standards team.

(Additional generic recipe recommendations for a chicken and black bean meal and for egg fried rice can be found in Appendix 5.3 and 5.4. Recipe recommendations were provided to the outlets participating in *Eatright* Liverpool once recipe reformulation for each of the meals had been completed).

5.5.2 Recipe Reformulation

The following table provides an estimation of the salt and fat content of the ingredients in the meal which contain sodium and fat (Table 5.9). This was carried out before and after recipe reformulation to calculate the reduction in salt and fat content, after favourable results from the pilot sensory acceptance testing sessions.

Table 5.9 Recipe Reformulation of a Chicken and Black Bean Meal at LJMU

Recipe modifications at LJMU after sensory evaluation	**Before**	**After**
1. Reduced Vegetable Oil from 30 ml to 1 tablespoon (approximately 15 ml)	30 ml	15 ml
2. Maintained chicken 230g (1.7 g fat per 100 g raw weight)	3.9 g	3.9 g
3. Maintained Sesame Oil at ½ teaspoon (2.5 ml)	2.5 ml	2.5 ml
Total Fat	36.4 g	21.4 g
Fat Reduction	**41%**	
4. Reduced Dark Soy sauce from 20 ml to 3 teaspoons (approximately 15 ml) (16 g salt per 100 ml)	3.2 g	2.4 g
5. Removed Water, Salt, MSG solution (approximately 1 tablespoon) (16 g per 100g from laboratory results)[1] 6. Replaced with: • MSG 1/4 teaspoon (approximately 1.3 g, one third of MSG is salt) • Sugar 1/8 teaspoon	2.4 g	0.4 g
7. Maintained rinsed Black Beans at 1 tablespoon / 15 g (6 g salt per 100 g)[2]	0.9 g	0.9 g
Total Salt	6.5 g	3.7 g
Salt Reduction	**43%**	
(15 g fat x 9 kcal/g) **Energy Reduction**	**135 kcal**	

[1] LJMU flame photometry results showed salt content of 'Water, Salt, MSG solution' to be 16 g per 100g.

[2] LJMU flame photometry results showed rinsing fermented/preserved black beans reduced the salt content from 13 g per 100 g to 6 g per 100 g, emphasising the importance of rinsing.

5.5.2.1 Acceptance of Suggested Changes by Chef at Outlet

The proposed changes were discussed with the chef at the outlet via LCC Trading Standards team. The chef prepared and cooked the meal with the recommended changes, then tasted it along with the Trading Standards team. The chef then adjusted the recipe until they were happy with the recommendations, in this case a small amount of salt and sesame oil were added to the reformulated recipe (Table 5.10). When the chef was comfortable with the changes to the recipe, the changes were communicated back to LJMU.

Table 5.10 Acceptance of Recipe Reformulation by Chef at Outlet

Recipe modifications when reformulated recipe was prepared by chef at outlet	**LJMU recommendations**	**After chef prepared meal**
Increased Sesame Oil from ½ teaspoon (2.5 ml) to 1 teaspoon (5 ml)	2.5 ml	5.0 ml
Added Salt (1/8 teaspoon)	-	0.75 g

Table 5.11 shows the reductions in salt and fat based on recommendations from the recipe reformulation and sensory acceptance testing as well as the final reductions after the changes were proposed to and prepared by the chef.

Table 5.11 Summary of Reductions after Recipe Reformulation

	LJMU Recommendations	Accepted by Outlet
Salt Reduction	43%	31%
Fat Reduction	41%	34%

5.5.3 PAL Analysis Results

5.5.3.1 PAL Results for Reformulated Meal

The baseline PAL results for the chicken and black bean meals show variability in the nutritional composition of the same meal prepared at the same outlet on different occasions. Portion size ranged from 541 up to 621 g, fat content between 28 and 38 g and salt content between 2.7 and 7.0 g.

Table 5.12 PAL Analysis of meal at different stages of *Eatright* Liverpool project

Chicken & Black bean	n	Weight (g)	Energy (kcal / 100g)	Energy (kcal / portion)	Fat (g / 100g)	Fat (g / portion)	Salt (g / 100g)	Salt (g / portion)
Baseline samples from Outlet (BB005)	1	540.9	119	644	7.0	38	1.3	7.0
	2	637.5	85	542	4.7	30	0.43	2.7
	3	621.1	91	565	4.5	28	1.09	6.8
Average		600.0	98	584	5.4	32	0.94	5.5
Reformulated at LJMU	1	381.9	102	390	2.8	10.7	1.4	5.0
Reformulation implemented at Outlet	1	607.5	72	437	2.7	16.4	1.13	6.9
Post-Project sample from Outlet	1	-	85		3.4		0.85	

n = sample number

5.5.3.2 PAL Result for reformulated meal prepared at LJMU

The PAL results for the reformulated meal which was prepared at LJMU show lower amounts of energy, fat and salt when compared to the average of the three baseline PAL results. One thing to note is that when the meal was prepared at LJMU, it was prepared with a smaller amount of water than would usually be added at the outlet (this was due to the difficulties of collecting accurate recipe information (see 5.6.1 Limitations). This had the effect of concentrating the salt content to 1.4 g per 100 g. The addition of 100-200 ml water would have increased the portion size from 382 g to a more expected size as well as diluted the salt content per 100 g. Per portion, the salt content of the meal was 5.0 g which is closer to the 3.7 g of salt per portion estimated from the reformulation of the recipe, as shown in Table 5.9.

5.5.3.3 PAL Result for meal prepared at Outlet using recipe recommendations

Once the chef had discussed the recommendations and adjusted the recipe so they were happy with the changes, a sample of the meal was taken for PAL analysis. The results show the fat content has reduced to 16 g per portion which is an improvement on all three baseline results (38 g, 30 g, and 28 g fat per portion). However, the salt content was 6.9 g per portion, which is not far removed from two of the three baseline results (7.0 g and 6.8 g salt per portion). Per 100 g, energy and fat were both reduced when compared with the baseline PAL results.

5.5.3.4 PAL Result for meal prepared at Outlet one-year post-project

Approximately one year after the recommendations were discussed with the chef at the outlet, a meal sample was sent to PAL for analysis. The PAL results show a reduction in salt from 1.13 g per 100 g (the previous PAL result) to 0.85 g per 100 g. Fat content shows a small increase from 2.7 g per 100 g to 3.4 g per 100 g, however this is still lower than the 4.5 to 7.0 g per 100 g taken at baseline.

As the sample numbers for these results are very low, it is difficult to conclude whether the changes in PAL results reflect a change in chef practices and the way the meal is prepared at the outlet or whether the improvements are due to pure chance. Combining PAL results for three other chicken and black bean meals that had their recipes reformulated at other outlets (where results were available) it is possible to build a bigger picture.

5.5.4 Comparison of Baseline, Reformulated and Post-Project Meals at 4 Outlets

Table 5.13 shows a breakdown of the salt content for three meals per 100g for baseline PAL results (baseline), PAL results for meals reformulated at LJMU (cooked at LJMU), PAL results for reformulated meals prepared at outlet (cooked at outlet - results available for two outlets only) and PAL results of meals collected at the end of the project (post-project) from the four remaining participating outlets (Table 5.13). These results are based on very low sample numbers, nevertheless they do suggest a reduction in salt content, when comparing post-project results with baseline results (see Figures 5.5 – Figure 5.7).

Table 5.13 Breakdown of PAL results for Reformulated Meals by Outlet and meal type

Outlet	PAL	Black bean		Chow Mein		Satay	
		n	Salt/100g	n	Salt/100g	n	Salt/100g
Outlet 1	Baseline	3	0.94	1	1.27	1	1.47
	Cooked at LJMU	1	1.40	1	0.79	1	0.69
	Cooked at Outlet	1	1.13	1	0.92	1	0.89
	Post Project	1	0.85	1	0.92	1	0.67
% Difference (Post-Project & Baseline)			-9.6%		-27.6%		-54.4%
Outlet 2	Baseline	3	1.28	-		-	
	Cooked at LJMU	1	0.92	-		-	
	Cooked at Outlet	1	1.04	-		-	
	Post Project	1	0.87	-		-	
% Difference (Post-Project & Baseline)			-32.0%	-		-	
Outlet 3	Baseline	1	1.27	3	1.03	1	1.65
	Cooked at LJMU	1	0.89	1	0.81	1	1.25
	Cooked at Outlet	-	-	-	-	-	-
	Post Project	1	1.98	1	0.80	1	1.30
% Difference (Post-Project & Baseline)			+55.9%		-22.3%		-21.2%
Outlet 4	Baseline	1	1.45	1	1.45	3	1.19
	Cooked at LJMU	1	0.53	1	0.84	-	
	Cooked at Outlet	-	-	-	-	-	
	Post Project	1	1.26	1	0.89	1	1.17
% Difference (Post-Project & Baseline)			-13.1%		-38.6%		-1.7%

n = sample number

The combined results shown in Table 5.13 are presented in Figure 5.5. The graph shows that the average salt content in the chicken chow mein meals and chicken satay meals have reduced between baseline and post-project (albeit based on small sample sizes as shown in Table 5.13). However, the salt content in chicken and black bean has increased since baseline (Figure 5.5).

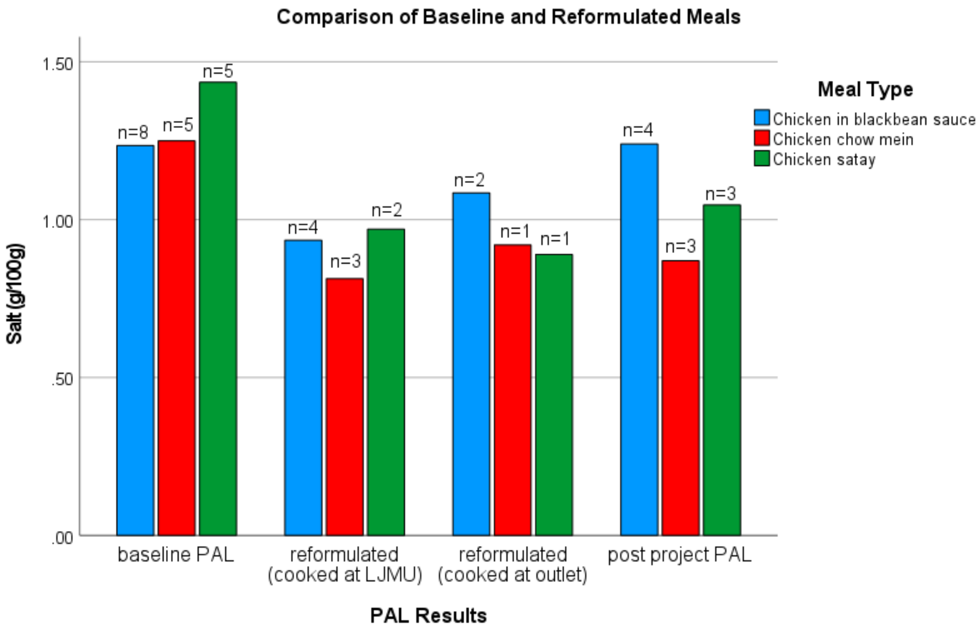


Figure 5.5 Comparison of PAL Results for Outlets 1,2,3 and 4 on *Eatright* Liverpool

PAL results for outlet 3 shows salt content in their chicken and black bean meal increased from 1.3 g per 100 g at baseline to 2 g per 100 g post-project (Figure 5.6). Results for the other two meals at this outlet are more positive.

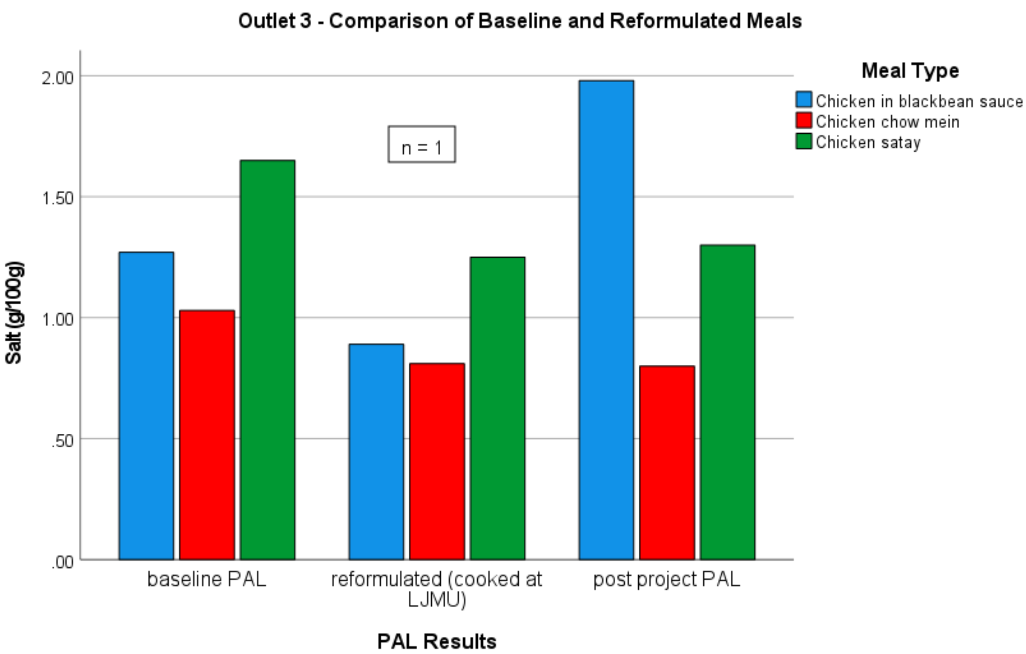


Figure 5.6 Comparison of PAL Results for Outlet 3

By omitting outlet 3 from the analysis, the reduction in salt for the black bean meal at the other three outlets is more evident (Figure 5.7).

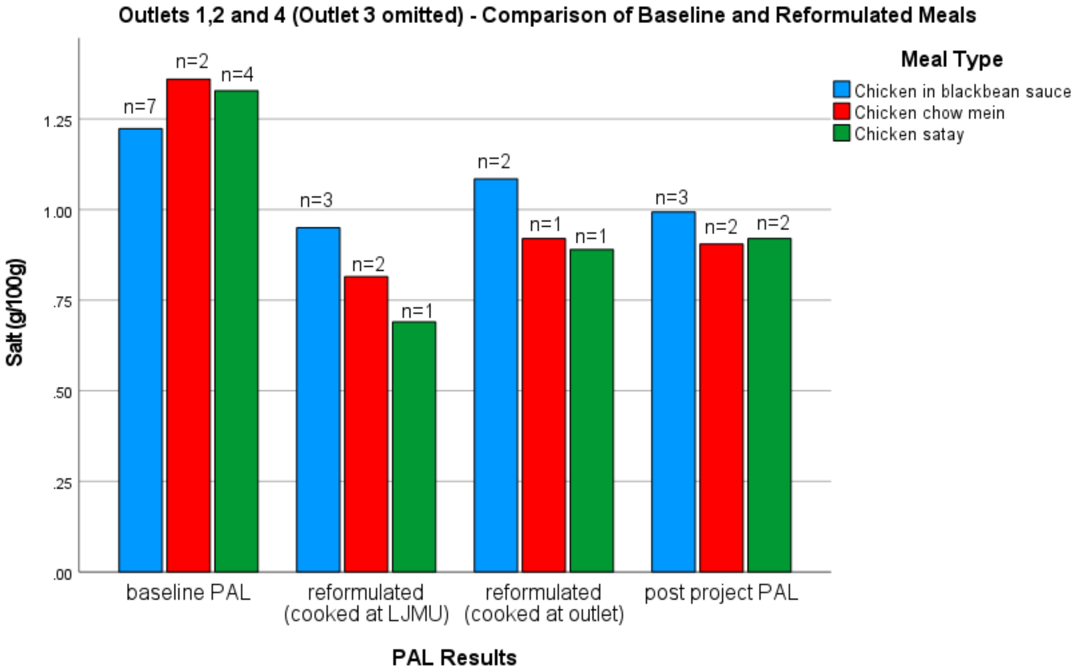


Figure 5.7 Comparison of PAL Results for Outlets 1, 2 and 4

5.5.5 Baseline PAL Results for Chinese Meals (All Outlets)

The baseline PAL results taken for each type of takeaway meal show large amounts of variance for the same meal prepared at different outlets (Tables 5.14 to 5.20). Portion sizes (weights) were extremely variable, for example the portion size of chicken chow mein ranged from 432.5g up to 974.8g (more than double the smallest portion). The energy content for sweet and sour chicken ranged from 641.6 kcal to 1224 kcal and fat content between 14.5g and 54.7g. The highest salt content was found in chicken chow mein (5.4-12.2g) and chicken and black bean (2.7-11.7g). This suggests one of the outlets was serving a chicken and black bean meal with 4 times as much salt as another outlet. Similarly, for egg fried rice, the smallest amount of salt served in a portion was 0.7g whilst the highest was 9.7g, 13 times larger. Some of the differences in nutritional composition will be due to the large range of portion sizes, different cooking practices and use of ingredients, particularly the quantities used of salt containing ingredients and the non-use of measuring spoons. Figure 5.7 shows when the recommendations were carried out at the outlets, the reductions are not quite as big as achieved at LJMU, however they are still lower than the baseline values and suggest reformulation can be carried out successfully.

Table 5.14 Nutritional Composition (per meal) of Chicken and Black Bean Sauce

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
BB001	461.90	1995.41	475.76	17.55	1.85	5.87
BB003	**441.30**	**1791.68**	**428.06**	**23.39**	**3.09**	**6.17**
BB003	**527.60**	**1609.18**	**385.15**	**15.83**	**2.11**	**5.22**
BB003	**442.60**	**1575.66**	**376.21**	**13.72**	**2.21**	**6.42**
BB004	430.40	1609.70	383.06	18.94	2.58	6.24
BB005	**540.90**	**2688.27**	**643.67**	**37.86**	**3.79**	**7.03**
BB005	**637.50**	**2263.13**	**541.88**	**29.96**	**2.55**	**2.74**
BB005	**621.10**	**2360.18**	**565.20**	**27.95**	**2.48**	**6.77**
BB006	643.80	3251.19	779.00	48.29	4.51	11.65
BB007	375.70	1281.14	304.32	9.02	1.88	6.31

Table 5.15 Nutritional Composition (per meal) of Chicken Chow Mein

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
CM001	**605.60**	**2973.50**	**708.55**	**29.07**	**2.42**	**6.18**
CM001	**710.90**	**3675.35**	**874.41**	**34.83**	**2.84**	**8.67**
CM001	**645.20**	**3187.29**	**735.53**	**27.74**	**2.58**	**5.42**
CM004	432.50	1695.40	406.55	22.06	3.03	6.27
CM005	649.10	3505.14	830.85	23.37	2.60	8.24
CM006	974.80	4493.83	1072.28	38.99	3.90	12.19
CM007	**677.70**	**3483.38**	**826.79**	**33.89**	**4.74**	**11.39**
CM007	**566.40**	**3562.66**	**849.60**	**36.82**	**4.53**	**9.23**
CM007	**710.60**	**4100.16**	**973.52**	**39.79**	**4.26**	**10.09**

Table 5.16 Nutritional Composition (per meal) of Chicken Satay

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
CS001	624.80	3705.06	880.97	41.24	4.37	10.31
CS004	**355.50**	**1997.91**	**479.93**	**34.84**	**4.62**	**3.70**
CS004	**479.80**	**2327.03**	**556.57**	**32.63**	**6.24**	**6.48**
CS004	**384.20**	**2309.04**	**553.25**	**37.27**	**5.76**	**4.50**
CS005	584.00	2131.60	508.08	23.36	2.34	8.58
CS006	496.00	1904.64	451.36	19.84	1.98	5.80
CS007	**496.80**	**2056.75**	**491.83**	**25.83**	**3.48**	**8.20**
CS007	**471.70**	**1632.08**	**386.79**	**16.98**	**2.36**	**6.84**
CS007	**381.00**	**1672.59**	**400.05**	**19.05**	**2.29**	**5.83**

Table 5.17 Nutritional Composition (per meal) of Egg Fried Rice

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
FR001	404.6	3151.83	748.51	24.28	2.023	4.41
FR003	273.4	2107.91	497.59	8.20	1.367	0.98
FR004	324.2	2509.31	593.29	7.46	0.9726	0.75
FR005	517.9	4743.96	1123.84	26.93	2.5895	5.54
FR006	521.1	4632.58	1099.52	27.62	3.6477	9.69
FR007	347.4	3425.36	816.39	31.27	4.5162	5.91

Table 5.18 Nutritional Composition (per meal) of Sweet and Sour Chicken

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
SS001	**450.80**	**3628.94**	**865.54**	**35.61**	**17.58**	**2.30**
SS001	**473.60**	**3883.52**	**923.52**	**36.47**	**16.58**	**2.42**
SS001	**451.40**	**3863.98**	**916.34**	**30.70**	**14.44**	**1.85**
SS002	290.30	2708.50	641.56	14.52	7.26	3.25
SS004	508.20	3684.45	874.10	31.00	3.05	2.85
SS005	541.80	4003.90	948.15	28.17	9.75	6.50
SS006	**541.60**	**5134.37**	**1224.02**	**54.70**	**28.16**	**4.66**
SS006	**463.80**	**4276.24**	**1020.36**	**46.84**	**21.33**	**3.43**
SS006	**553.80**	**3184.35**	**758.71**	**34.89**	**4.98**	**6.92**
SS007	444.60	3636.83	866.97	35.12	5.34	3.60

Table 5.19 Nutritional Composition (per meal) of Kung Po Chicken

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
KP001	453.70	2794.79	662.40	23.59	2.27	8.44
KP004	**538.30**	**2949.88**	**699.79**	**24.22**	**2.69**	**7.54**
KP004	**427.90**	**2203.69**	**522.04**	**13.69**	**1.71**	**4.58**
KP004	**471.50**	**2753.56**	**655.39**	**22.16**	**2.36**	**5.28**
KP005	570.40	3000.30	713.00	30.80	3.42	5.25
KP005	582.20	2916.82	692.82	20.38	2.33	7.57
KP005	586.20	2895.83	685.85	18.76	2.34	8.62
KP006	**580.10**	**3480.60**	**829.54**	**31.91**	**5.22**	**7.25**
KP006	**591.50**	**3501.68**	**834.02**	**34.90**	**5.32**	**8.10**
KP006	**417.90**	**3673.34**	**873.41**	**31.76**	**16.72**	**3.30**
KP007	409.00	1721.89	409.00	6.95	1.23	4.17

Table 5.20 Nutritional Composition (per meal) of Chicken Curry

Meal & Outlet Code	Weight (g)	Energy (kJ)	Energy (kcal)	Fat (g)	SFA (g)	Salt (g)
CC001	596.00	2765.44	661.56	31.59	9.54	7.87
CC002	**372.50**	**2126.98**	**510.33**	**28.31**	**8.94**	**5.70**
CC002	**398.40**	**2322.67**	**553.78**	**28.68**	**9.56**	**6.18**
CC002	**362.10**	**2121.91**	**506.94**	**31.86**	**8.69**	**5.43**
CC003	417.30	1831.95	438.17	23.37	5.42	7.85
CC003	524.10	2023.03	482.17	26.21	8.39	8.91
CC003	442.50	1964.70	469.05	28.32	5.75	6.42
CC004	477.50	1986.40	472.73	22.44	4.30	6.21
CC005	592.00	2066.08	491.36	18.94	9.47	6.93
CC006	566.90	2817.49	674.61	36.28	11.90	8.05
CC007	533.90	2124.92	507.21	25.09	6.41	5.55

5.6 Discussion

The primary objective was to reformulate takeaway food to reduce the salt content, whilst the secondary objective was to reduce the fat and energy content. The final objective was to access the acceptability of reformulated takeaway meals.

As mentioned previously, salt targets have been introduced for popular food groups purchased from the out of home sector which are now governed by the Office for Health Improvement and Disparities (OHID, 2022b). The targets cover a reproducible product (standardised item) that is offered for at least 30 days in a year (PHE, 2017c; PHE, 2020d). For the Chinese dishes in this research study, meal targets 6, subcategories 6.1 and 6.2 would be applicable (Table 5:21). These targets include any sides and accompaniments the dishes may be served with.

Table 5.21 UK Salt Reduction Target for 2017 and 2024 in the Out of Home Sector

Main Product Category	**Subcategory**	**2017 Maximum per serving targets**	**2024 Maximum per serving targets**	**Additional Information**[1]
MEAL TARGET 6. Sauce based main dishes	**6.1 Curry main meals – includes all curries of South / Southeast Asian origin (e.g., Indian, Thai) served with side dishes and accompaniments.**	4g salt or 1600mg sodium	3.8g salt or 1520mg sodium	Meal target includes sides and accompaniments (e.g., served with side dishes such as rice, naan). Baseline Rice on Eatright Egg fried rice: 0.8-9.7g Baseline Meals on Eatright Black bean: 2.7-11.7g Chow mein: 5.4-12.2g Satay: 3.7-10.3g Sweet and sour: 1.9-6.9g
	6.2 All other sauce based main meals Includes all dishes cooked in a sauce	3.2g salt or 1300mg sodium	3.2g salt or 1300mg sodium	

(PHE, 2020d) [1] Results from tables 5.14 to 5.20

Comparing the baseline PAL results for the Chinese dishes with the voluntary target of 3.2 g salt for a Chinese meal, it is evident that the majority exceed this amount: only one black bean dish, four sweet and sour dishes and two egg fried rice sides contained less than 3.2 g of salt. Except for chicken chow mein which is usually served with noodles, many of the Chinese dishes are usually eaten with rice, chips, or egg fried rice. Using the PAL results in Table 5.14 and 5.17, chicken and black bean served with egg fried rice could have a salt content as low as 3.4 g, but it could also be as high as 21.4 g. Chicken satay served with egg fried rice could have a salt content between 4.5 g and 20 g per portion (Tables 5.16 and 5.17).

These results show the large variability in nutritional composition of the same meals prepared by different outlets taking part in *Eatright* Liverpool. The results also show (per portion and per 100g) that some outlets can prepare meals at the lower end of the scale (healthier), so it should be possible to assist outlets which produce meals with the higher values to move towards the lower values. Hence the aim of this current study was to reformulate takeaway food served by selected independent takeaway outlets in Liverpool with the objectives of reducing salt (and / or fat and energy content).

Previous chapters have already shown that takeaway food is a common component of the populations' diet, and that takeaway food is high in salt. For these reasons, the reformulation of takeaway foods to reduce salt is recommended. Frequent consumption of high salt foods can lead to the suppression of salt taste receptors and greater consumer demand for highly salted foods (WHO, 2016b). Salt is an inexpensive and unregulated food additive which is added to food to enhance its taste and consuming too much salt in the diet is associated with an increased risk of hypertension and CVD (WHO, 2014). Most dietary salt comes from processed or restaurant foods whilst around 15% is added during cooking or at the table (He, Brinsden and MacGregor, 2014; WHO, 2016b). Common salt containing foods include bread, ready meals, bacon, cheese, and salty snacks. During cooking, salt may be added via stock cubes or bouillon and at the table via table salt and soy sauce (WHO, 2016b).

Salt cannot be completely removed due to its complex role in terms of taste, texture and overall flavour, food preservation and food safety (Liem, Miremadi and Keast, 2011) and it is essential when reducing salt in foods, that a stepwise approach is taken. As salt is reduced in food products over time, consumer salt taste receptors will become more sensitive to lower concentrations meaning consumers will not notice the reduction (Blais et al., 1986; Kloss et al., 2015). Currently, salt is being voluntarily reduced gradually over time in the food industry and by some fast-food chains (PHE, 2020d; Michael et al., 2021; Santos et al., 2021). So that reductions in salt are acceptable to the public, it is essential that reductions are also carried out simultaneously in the independent takeaway sector. If reductions are made in all food sectors except for the takeaway sector, then it makes the reductions elsewhere less effective as consumers salt taste receptors will not adapt to lower salt food products provided elsewhere in the food industry (Kloss et al., 2015).

This is one reason that warrants regulation of salt reduction in a monitored environment; it would create a level playing field for the whole sector. If a business voluntarily reduces salt but its competitors are still selling their higher salt meals, then the business that has made efforts to reformulate their meals could potentially lose out if customers decide to "vote with their feet". Furthermore, in their systematic review, Hyseni et al. (2017) showed mandatory reformulation produced larger reductions in population salt intake than voluntary reformulation and individually focussed interventions.

When reformulating foods, salt needs to be reduced gradually so consumers can adapt. Gressier, Sassi and Frost (2021) estimated salt intakes using four-day food diaries completed by participants of the rolling National Diet and Nutrition Survey. Their analysis showed a 16% reduction in UK dietary salt intakes between 2008/09 and 2016/2017.

The decrease in salt intake was attributed to the 10 to 20% sodium reductions in some of the food categories in the salt reduction programme such as bread, meat-based products, soups and sauces (Gressier, Sassi and Frost, 2021) and suggests that food manufacturers have successfully reduced the sodium contents of foods in some categories over that 9-year period.

The recipe reformulation work carried out in the present study shows that it is possible to reduce salt in takeaway meals as well as fat and energy. Furthermore, the pilot sensory acceptance sessions demonstrate that the changes were acceptable to consumers. PAL results show a 10 to 32% reduction (from 1.5 to 0.9 g/100g) in salt for chicken and black bean meals (excluding outlet 3 with a 35% increase). For outlets serving chicken chow mein, salt was reduced by 22 to 39% (1.5 to 0.8 g/100g) and for chicken satay there was a 21 to 54% reduction (1.7 to 0.7 g/100g). Although these are only modest changes, chefs were also encouraged to use measuring spoons when adding ingredients high in fat, salt, or sugar. The use of measuring spoons can assist the chefs in preparing meals with more consistency and help them to produce meals with less variation in salt, fat, or sugar content. These recipe changes could help to reduce dietary impacts on takeaway consumers health and reduce the prevalence of obesity, hypertension, T2D and CVD in the population.

5.6.1 Strengths and Limitations

5.6.1.1 Real-Word Setting

One strength of this research is that has been done in a real-world setting, this study reformulated takeaway meals to reduce salt, fat, and energy and improve their nutritional quality. This study used sensory acceptance testing, an established method of sensory analysis to determine whether the reformulated meals were acceptable with consumers. Specific sensory attributes were used such as appearance, aroma, flavour to determine overall acceptability. Based on the recipe information collected from the takeaway outlets, recipe changes and recommendations were produced to enable chefs to prepare healthier meals. Furthermore, the results show that salt can be successfully reduced in Chinese takeaway meals prepared by chefs working in small independent takeaway outlets. This study adds to the evidence base of local level public health interventions that aim to improve the healthiness of takeaway food served by small independent takeaway outlets and shows that recipe reformulation can be a useful public health measure. Considering that as of January 2023, 24% of consumers continue to order takeaways once a week or more, evidence from this study can be used to contribute to local and national public health policies to promote healthier takeaways (Mintel, 2023a).

5.6.1.2 Recipe Collection

There was a lack of standardised recipes which made collecting detailed recipe information quite challenging. Furthermore, chefs at the outlets prepared meals without the use of recipes or measuring spoons and different chefs did not cook meals in the exact same way. It became apparent that it was not always feasible to obtain all the required information such as quantities and brands of ingredients, and in many cases, there were gaps in the collected information. This could be due to various reasons such as chefs not wanting to disclose all the information regarding how meals were prepared or forgetting to add ingredients due to being observed. Some meals were made using different components, for example a sweet and sour meal might consist of chicken that has previously been battered and a quantity of sweet and sour sauce that has been made inhouse in a large batch. When the meal is prepared for the customer, the chef might add the prebattered chicken, home-made sweet and sour sauce as well as other ingredients (for example vegetables) to complete the meal. The team strove to gather the information with minimum disruption to the outlets, however inconsistencies in collected information meant that the Liverpool Trading Standards team needed to revisit outlets on several occasions to try to obtain further recipe information. Multiple conversations were often required between the researcher, the Trading Standards team and the chef which made documenting the recipes a costly and time-consuming process. The challenges of collecting recipes have also been reported by Britt et al. (2011) who carried out nutritional analysis for menu labelling at locally owned restaurants. They advise that collecting detailed recipe information required a “high degree of motivation and perseverance” and that the process was not only time-consuming but also demanding and costly (Britt et al., 2011).

As the project was reliant on the good will of the chefs and owners of the takeaways and the research team did not want to make excessive demands, compromises were made as well as allowances for the gaps in the provided information to keep the outlets onboard and minimise inconvenience. For example, recipe information gathered at one outlet advised that the chef added a tablespoon of a solution consisting of water, salt and MSG combined. Without knowing how this solution was made, it was not possible to quantify how much salt or MSG was being added to the meal. Sometimes the provided information was unclear, for example the recipe might advise that “half a ladle of water” was added, however no ladle size was provided to quantify this making it difficult to reproduce the recipe. This lack of detail could result in the meal being saltier/less salty than intended due to less/more water being added (Table 5.12). It should also be noted that the work presented in this chapter is a very small part of the recipe reformulation work that was carried out on *Eatright* Liverpool working with Chinese and Indian takeaway outlets.

Current government policy stipulates that out of home food businesses with more than 250 employees are required to provide calorie labelling for the food they serve whilst smaller business are encouraged to display this information voluntarily. In the present study, the difficulties experienced of collecting complete recipes highlights the difficulties these businesses may experience when tying to provide accurate nutritional information to their customers.

5.6.1.3 Pilot Sensory Acceptance Testing

In the present study, collected recipe information was compared with the PAL results for the same meal prepared at the outlet and sometimes this led to the identification of greater inconsistencies in the recipe information and the amount of salt or fat. Due to these difficulties, it was decided by the research team to carry out more informal taste sessions rather than continue with the more formal sensory acceptance testing. Future studies involving reformulation of takeaway meals might benefit from sensory evaluation carried out on a larger scale but using meals prepared at the outlet together with the chef, instead of in a research kitchen.

5.6.1.4 PAL Results

Once the Trading Standards team and chef had discussed the proposed changes and the chef had implemented the changes and made any adaptions they felt were warranted, the reformulated meal was sent to PAL for analysis. Due to difficulties arranging meet ups at the outlets and some of the outlets no longer taking part in the study, reformulated meals from only two of the outlets were sent for PAL analysis (Table 5.12: PAL results - Reformulation implemented at Outlet)

At the very end of the project, meals were purchased anonymously from the outlets in singlet and sent to PAL for nutritional analysis (Table 5.12: post-Project sample from Outlet). This was to allow comparison with the PAL results from the start of the project. Unfortunately, an oversight meant that the meals were not weighed upon receipt by PAL, so the provided PAL results are per 100g only, meaning the results per portion cannot be calculated (Table 5.13 and Figures 5.5-5.7).

5.6.1.5 Retention

The project had a retention rate of almost fifty percent. In total, seven Chinese takeaways and six Indian takeaways were recruited to the project; however, by the end of the reformulation part of the project, only four Chinese takeaways and three Indian takeaways were still involved. When the final PAL results were sampled between December 2014 and January 2015, additional outlets had dropped out.

In their evaluation of a sodium-reduction initiative in Chinese takeaway meals in Philadelphia, USA, Ma et al. (2018) also found a high turnover rate in ownership and chef positions at Chinese takeaways and recommends this should be considered when designing future studies in the industry. Redelfs et al. (2021) work with locally owned restaurants found it easier to engage restaurants where the owner and/or chef were interested in health and the owner was willing to engage. Some of the barriers included concerns about increased food costs, fear of food inspection, difficulty scheduling meetings (due to restaurant availability), competing responsibilities, staff turnover and industry volatility (Redelfs et al., 2021) and many of these barriers were applicable in the present study.

5.6.2 Further work

For reformulation to be successfully implemented in the takeaway sector, concerns about consumer acceptance, increased costs and fear of decreased sales should be addressed (Michael et al., 2021). Furthermore, the provision of long-term support and follow up will help to make it sustainable (Redelfs et al., 2021). Training sessions can also provide chefs with skills to prepare meals lower in energy, fat and salt as well as reduce portion sizes. In this study, all recipe development was carried out by the researcher in the product development kitchens at LJMU without the chefs. Future studies might benefit from nutritionists and chefs working together onsite at the takeaway outlet. Training courses could also be run, where chefs from several takeaway outlets come together to share practices and receive training in a group. This might result in more changes being implemented at the outlets and further reductions. This may also be a more cost-effective method, working with chefs on a group basis rather than individually.

One example of working in groups was the Healthy Chinese Take-Out Initiative which trained chefs from 206 Chinese take-out restaurants on strategies to reduce sodium in prepared dishes (Ma et al., 2018). Chefs received culturally tailored training sessions, low-sodium cooking materials, recipes, cooking utensils and standard measuring spoons

(Ma et al., 2018). The training sessions included information about the benefits of reducing sodium on health, as well as cooking demonstrations and hands on training (Ma et al., 2018). The chefs also received annual booster training sessions to reinforce what they had previously learned. Results from the study found significant improvement from baseline to post training in chefs' knowledge of the health effects of consuming too much sodium (Ma et al., 2018).

In 2014, the Food Initiatives and Nutrition Education (FINE) team for Kirklees council ran seven free masterclasses for local takeaway businesses over a two-year period (Hillier-Brown et al., 2019). The project provided training on food preparation habits, food ingredients, cooking techniques, healthier frying techniques and good oil management (Hirst, 2013; Kirklees Council, 2020). Following on from this, Hillier-Brown et al. (2019) evaluated the feasibility and acceptability of this takeaway masterclass when it was carried out in the northeast of England for Redcar and Cleveland Borough Council who commissioned its delivery for staff working in local independent takeaway food outlets. Kirklees health improvement team delivered their previous masterclass training, but with some adaptations recommended by the research team. Owners and managers of takeaway food outlets with a food hygiene rating of 3 or above were invited to take part in a 3-hour training session (Hillier-Brown et al., 2019). Findings from the research were similar to those found by other projects conducted in England, including Kirklees and Eating Out Coventry (Blackham et al., 2018; Hillier-Brown et al., 2019) where changes most likely to be implemented and sustained were those that only required a small amount of effort at little or no extra cost to the outlet. Such as reducing ingredients (salt, sugar) or changing to healthier products which were a similar cost to regular products and easy to source (such as replacing whole milk with semi-skimmed milk). Changes to products that were unpopular with customers or were difficult to source were less likely to be tried or maintained (Hillier-Brown et al., 2019).

Other areas of interest for further work include:

- encouraging takeaways to reduce portion sizes which would have the benefit of reducing nutrient content,
- working with suppliers to takeaways to reduce fat, salt and/or sugar in products being sold to the outlets,
- working with consumers, encouraging them to ask for healthier meals or smaller portion sizes when purchasing takeaways.

5.7 Conclusions

To summarize, this study investigated the reformulation of takeaway food in a real-world setting and has shown that it is possible to reformulate a takeaway meal served by small independent takeaway outlets without affecting its acceptability. Overall, the results from the pilot sensory work were positive and the final reformulated takeaway meal was preferred by consumers when compared with the original (unmodified) meal. This meant the Trading Standards team were comfortable with suggesting the recommended changes to the chef at the outlet.

Care should be taken not to generalise these findings to all takeaway outlets in the UK, however findings from this study do highlight some of the barriers of working in this research area. Furthermore, it should be remembered that this was a small study working with a hard-to-reach group. Despite these limitations, the study offers a unique insight into the preparation of takeaway meals by independent Chinese takeaway outlets and how they can feasibly be reformulated to reduce salt, fat, and energy whilst maintaining their acceptability with takeaway consumers.

Furthermore, encouraging and assisting chefs in takeaway outlets to make small improvements to the nutritional content of the takeaway food they serve (via reductions in energy, fat, SFA, salt or sugar) could help to improve the health of takeaway consumers. This could benefit society by reducing the risk of NCDs, reducing the number of DALYs in the UK population and decreasing the costs to society and the NHS.

Chapter 6

Synthesis

6 Synthesis

6.1 Introduction

The overall aim of this thesis was to investigate takeaway food served by small independent takeaway outlets in Merseyside. Three different aspects were investigated using multiple methods: an online cross-sectional questionnaire to explore takeaway food consumption, statistical analysis of the nutritional composition of takeaway food using PAL data provided by local councils Trading Standards teams and lastly, recipe reformulation of a takeaway meal using recipe information provided by an independent takeaway outlet in Liverpool. This chapter aims to provide a comprehensive discussion of the key findings from these three studies followed by a discussion of the limitations and includes recommendations for future research.

6.2 Synthesis of the research findings and conclusions

The first study examined the consumption of takeaway food purchased from small independent takeaway outlets in Merseyside. Predictors of and reasons for consumption as well as consumers' knowledge about the healthiness of takeaway foods and receptiveness to healthier takeaways were analysed (n = 461). Takeaway food was a popular meal choice (Chapter 3, Figure 3.5), and the frequency of its consumption was comparable with results from other UK studies of fast food and takeaway food consumption (22% 1-2 times a week, 48.3% 1-2 times a month). The popularity of takeaway food is concerning due to the health disparities in Liverpool compared with other regions in the UK such as higher levels of overweight and obesity, lower life expectancy and increased risk of early death from CVD.

Furthermore, the results revealed several outcomes which were mainly consistent with existing evidence in relation to fast food consumption. Frequent takeaway consumption was associated with males, younger adults (18-34 years) and individuals who were living with overweight or obesity (Chapter 3, Figures 3.11-3.13), which agrees with the existing literature. However, married individuals were also more likely to be frequent consumers which differs from existing literature where single individuals usually consume takeaway food more frequently (Chapter 3, Figure 3.14). Individuals with healthier BMI or who were divorced/separated were associated with consuming takeaway food less frequently (Chapter 3, Table 3.18). Lower levels of takeaway consumption were associated with individuals with healthier BMI and increasing age was associated with a decrease in frequency of takeaway consumption (Chapter 3, Table 3.22).

Reasons why people consume takeaway food were also in alignment with findings from fast food studies, with significant associations between frequent consumption and respondents not liking to prepare food, being too busy to cook and liking the taste (Chapter 3, Table 3.26; Appendix 3.2, Figures 8.5-8.9). Men were also associated with thinking takeaway food was good value for money (Appendix 3.2, Figure 8.10). Younger consumers were associated with not liking to prepare food and liking the taste whilst younger and heavier consumers were associated with being too busy to cook (Appendix 3.2, Figures 8.11-8.14). These findings highlight barriers about time constraints, meal planning and preparing and cooking food at home which may need to be overcome. Blow et al. (2019b) explored the sociocultural factors that influence takeaway food consumption in an inner-city area of Manchester. They found takeaway consumption was influenced by perceived rather than actual time constraints and availability. Participants advised purchasing a takeaway because it provided a break in the week from preparing a home cooked meal or because it was too late to cook after finishing a shift at work (Blow et al., 2019b) suggesting policies which target working patterns may also be beneficial (Mills et al., 2018).

These barriers may also be related to the decline in teaching home economics in secondary schools in recent decades. In order for children to develop healthy eating habits and continue with these habits into adulthood, they need to be taught practical food skills in school by specialist teachers (McCloat and Caraher, 2019). This will encourage them to develop healthy eating habits and become responsible consumers of food (Owen-Jackson and Rutland, 2016). At present, the English national curriculum only requires children to be taught Food Technology until year 9 (age 14) (Department for Education, 2013). Years 10 and 11 (age 14-16) have the opportunity to do a GCSE in Food Preparation and Nutrition, however this is not mandatory. This GCSE has very low uptake due to pupils being limited on what subjects they can choose and other GCSEs being made mandatory in 2010 (English, maths, science, a language and history or geography) (Seabrook and Grafham, 2020). Food subjects are usually more popular with girls than boys however 2019 showed very low numbers for both boys and girls (2.5% and 8.2% respectively) choosing this GCSE (Gawedzka and Gill, 2022). Moreover, these numbers are likely to decline further as lessons in this subject area are facing a number of pressures including declining numbers of teaching staff (due to the withdrawal of bursaries for non-mandatory subjects) (Gawedzka and Gill, 2022), the cost-of-living crisis, ingredient price increases and pressures on already stretched school budgets (Mason, 2022; Searson, 2022).

In relation to knowledge about takeaway food, most respondents (90-95%) felt takeaway food was high in calories, salt, and fat (Chapter 3, Table 3.27). Respondents with higher takeaway knowledge scores had decreased odds (OR 0.87, 95% CI 0.82, 0.93) of being frequent takeaway food consumers. Furthermore, consumers who were more receptive to takeaway food being prepared in a healthier way had increased odds (OR 1.10, 95% CI 1.05, 1.14) of being frequent takeaway food consumers (Chapter 3, Table 3.29). The study also showed an association between increased receptiveness and more frequent takeaway consumption, increasing BMI and being female (Chapter 3, Table 3.33) suggesting it may be more difficult to persuade males to eat healthier takeaways. Traditionally, women have been more concerned about diet and weight due to social and gender norms, whilst men adopted bravado and lack of concern towards healthy eating to promote a more masculine identity, meaning adult men may be less receptive to health promotion (Munt, Partridge and Allman-Farinelli, 2017). This has been shown elsewhere, for example when Pepsi and Coke were unsuccessful in selling diet Pepsi or diet Coke to men, their strategy involved launching new brands Pepsi Max and Coke Zero to attract men into purchasing diet soda (Avery, 2012). Working with outlets to reformulate takeaway food without the customers' knowledge could be one way to improve its nutritional profile. This would mean that men could continue to enjoy eating takeaway food without having to choose healthier options as they would be eating healthier takeaway food by default (Blow, 2017). In a qualitative study by Goffe et al. (2018) covert interventions were perceived to be more feasible than overt interventions by professionals who had experience of working with independent takeaways to improve the healthiness of food on sale. Covert interventions are where changes are made to improve the healthiness of food without the customers knowledge such as reducing fat or salt. Overt interventions are obvious to the consumer, such as supplying customers with a menu which has lower fat options highlighted in order to support them to make healthier choices (Goffe et al., 2018).

As shown in previous studies, women had better knowledge than men about how healthy takeaway food is; furthermore, they were more receptive to healthier takeaways. Respondents who had higher scores for takeaway food knowledge consumed takeaway food less frequently, whilst frequent consumers of takeaway food were more receptive to healthier takeaways. However, knowledge about the healthiness/un-healthiness of takeaway food did not translate into non consumption of takeaway food demonstrating that motivators for diet are complicated and not straightforward. There are also positive cultural components of takeaway food consumption to consider. In a case-study of independent takeaway outlets in Tower Hamlets, London, Bagwell (2011) showed 70% of interviewed takeaway customers were concerned about eating a lot of fried food or food high in sugar or salt, however almost half of these customers (45%) were eating fried chicken and chips or burger with chips at the time of interview. The study suggested that eating habits were most likely being influenced by the high proliferation of independent takeaways selling affordable and culturally acceptable halal food whilst also providing a culturally acceptable meeting space for the Muslim community, particularly for young men and women (Bagwell, 2011). In Rusholme, Manchester, Blow et al. (2019b) showed sociocultural influences of takeaway consumption included a youth night-time drinking culture which supported social bonding and sharing takeaway food in a group was a marker of social belonging and intimacy. Other influences included routines and tradition such as going to the local fish and chip shop on a Friday night (Blow et al., 2019b).

The second study involved statistical analysis of nutritional composition data of various types of takeaway meals (5 cuisine types, 28 meal types, n = 511) sold in independent takeaway outlets across Merseyside. The meals were collected by Trading Standards teams in Merseyside and sent to PAL for nutritional analysis. The findings revealed large portion sizes as well as high levels of energy content per portion and per 100g (Chapter 4, Figures 4.1-4.6), which could contribute to the consumption of excess calories in the diet. Total fat and SFA content were high in many meals including pizzas and fish and chips (Chapter 4, Figures 4.7-4.14). Donner kebab and chips contained the highest amount of fat per portion and contained more than the recommended daily allowance of fat for a man or woman (Chapter 4, Table 4.4, Table 4.8, and Figure 9). Donner kebab (no side) and donner kebab with chips were also high in TFA (Chapter 4, Table 4.8, and Figures 4.15-4.18). Sugar content was exceedingly high in sweet and sour meals and tikka masala meals (Chapter 4, Table 4.7, and Figures 4.19-4.22) and some of the meals with the highest salt content were pizza, black bean, and satay (Chapter 4, Figures 4.23-4.26). These results emphasize the importance of working together with takeaway business owners and chefs to improve the nutritional composition of many of these takeaway meals.

The results also showed a high degree of variability between and within categories for total energy, fat, SFA, TFA, salt and sugar content of the meals both per portion and per 100 g (Chapter 4, Tables 4.5-4.9). This supports the findings in other studies such as Dunford et al. (2010), Dunford et al. (2012) and Ziauddeen et al. (2015) which investigated the composition of fast food rather than takeaway food. The large variability within meal categories provides evidence that some takeaway meals can be prepared in a healthier way when compared with the same meal prepared at a different outlet. This means there is scope for reformulating meals at the outlets which are preparing meals at the higher values and provides an opportunity for many independent outlets to provide takeaway food which is healthier than their usual offerings. Small improvements in the nutritional content via reductions in energy, fat, SFA, salt or sugar has the potential to improve the health of takeaway consumers which may help to reduce obesity, hypertension, T2D and CVD.

The third study in this thesis involved work which focused on the reformulation of takeaway meals available from Chinese takeaway outlets in Liverpool. This work was carried out in collaboration with Liverpool Trading Standards and takeaway outlets taking part in *Eatright* Liverpool. In 2011, Public Health Responsibility Deals were introduced to help the food industry reduce salt and other nutrients in food with the aim of improving population health. Targets were also introduced for the out of home sector for products that were offered for at least 30 days in a year. Some fast-food chains such as McDonalds signed up to improve the food they serve; however, these targets were voluntary and there was no obligation for independent takeaway outlets to prepare healthier meals. Public Health Responsibility Deals ended in 2015 with the change in government, however targets are still in place and responsibility for the country's reduction and reformulation programme was passed to the Office for Health Improvement and Disparities (OHID) in October 2021. As part of the government's obesity strategy, OHID now promotes the reduction of sugar, salt and calories in the food and drink sector which contribute towards children and adults dietary intakes (Department of Health and Social Care, 2020; OHID, 2022b).

At the time this research was started, there were limited studies which involved working with chefs in small independent outlets to improve the quality of the meals they sold. The results from this study were positive, showing takeaway meals can be reformulated, prepared with reduced amounts of salt and fat whilst maintaining acceptability with takeaway consumers. Furthermore, the reformulated takeaway meal was preferred to the original (unmodified) meal (Chapter 5, Table 5.7, and Figure 5.4). These results provide evidence that independent takeaway outlets can prepare healthier takeaway meals and suggests that further studies which involve working with takeaway outlets are warranted. This could have wider impacts by reducing the overall burden of health costs on society as well as contribute to improvements in the population's health.

6.3 Methodological strengths and weaknesses

One strength of the takeaway questionnaire study is that it only investigated the consumption of takeaway food from independent takeaways and not from fast-food chains (Chapter 3). This study will contribute to the existing evidence base related to takeaway food consumption, particularly in the UK. However, it does have its limitations: participants were recruited via convenience and snowball sampling and a large number of the participants had attended or were attending university, so the findings may not be representative of harder to reach participants. Furthermore, general dietary behaviours, socioeconomic status, and lifestyle factors (for example levels of physical activity, smoking status or alcohol consumption) were not assessed. Studies examining dietary intake as well as other lifestyle factors could help to understand the effect of takeaway food on energy intakes, weight gain, obesity, and other metabolic factors. There is also a likelihood that participants will have under-reported takeaway consumption and weight, in which case frequent takeaway consumers and consumers living with overweight or obesity may be underrepresented.

The second study in this research provided a detailed account of the nutritional quality of takeaway food served by small independent takeaway outlets in Merseyside (Chapter 4). One of the limitations was that only one sample of each meal was purchased from each outlet and there were no repeat purchases at a later date and time. However, the meals were purchased from many different outlets in Liverpool, Knowsley and the Wirral and analysed by Public Analyst Laboratories (accredited by the United Kingdom Accreditation Service) to ensure the accuracy of the nutritional analysis. A further limitation is that analysis of the samples was limited to standard nutrients including energy content, macronutrients, and sodium. In future studies it may be worthwhile analysing samples for phytochemicals or other micronutrients apart from sodium to see if there are any redeeming qualities about any of these foods, for example high in vitamins or minerals or sources of phytochemicals which may have a positive effect on health. Furthermore, energy and nutrients were analysed separately, an area of future exploration could involve examining the results in a more holistic way using nutrient profiling to produce an overall nutritional quality score.

The third study involved the reformulation of takeaway meals served by independent Chinese takeaways in Liverpool (Chapter 5). One strength of this study is that it showed improvements could be made to meals by reducing salt and fat content and that the changes were agreeable with consumers. Nevertheless, working in this area can be challenging, chefs and takeaway owners were often hard to reach, and collection of detailed recipe information was time consuming and costly, with repeat visits often needed by the Trading Standards team to gather more information. Furthermore, some of the chefs did not want to reveal all the details in relation to how they prepared the meals. Future studies would need to be aware of and consider potential barriers when working in this area as well as ensuring owners and chefs were interested in preparing and selling healthier takeaways to their customers. In addition, the takeaway industry is fast paced, challenging and competitive and these businesses would need to be assured that any suggested changes were not costly in terms of time and money and were not detrimental to their business in so much as they would lose customers. In addition, takeaway businesses see portion size as a selling point, so asking them to reduce portion sizes can be complicated, particularly as many customers will not want to see a reduction in portion sizes. Blow et al. (2019b) showed takeaway food was often used to mark social events with takeaway consumption associated with sharing large portion sizes.

6.4 Contribution to existing knowledge and recommendations for practice

National and local government will be able to use the evidence from this research when planning interventions involving small independent takeaway food outlets. Other Local Authorities or agencies who plan to have takeaway food analysed will be able to compare their results with the nutritional composition data in this thesis. This research will also be useful for other agencies planning health promotion interventions which seek to improve takeaway food served by independent outlets. The results can be used to determine whether progress has been made in the sector and whether takeaway meals are being prepared more healthily. Although the research presented in Chapter 5 was only a small part of *Eatright* Liverpool, this research has shown salt and fat can be reduced in takeaway meals, which could have a positive impact on the diets of takeaway consumers, benefitting wider society by improving the health of the population and potentially reducing costs to the NHS.

Furthermore, as takeaway food is a popular food choice, this thesis provides evidence that strategies should also focus on encouraging the population to eat more healthily. This could include encouraging people to eat fewer takeaways or directing them towards healthier takeaways. Findings from this research suggest that males and younger age groups eat more takeaways and areas of future research could focus on working with men and younger adults to encourage healthier eating and reduce takeaway consumption. Additionally, health promotion classes for adults which develop food skills such as meal planning, budgeting, and teaching time-efficient cooking techniques like batch cooking could be beneficial (Mills et al., 2018).

Takeaway food is popular for a wide variety of reasons, aside from consumers liking the taste, there is also the socialising aspect of it. Takeaway consumption can be habitual, such as families getting a takeaway because it's the weekend or individuals may be influenced by their peers, such as going out drinking after work and getting a takeaway at the end of the night (Blow et al., 2019b). Furthermore, people's lives are busier with more time constraints, and takeaways are seen as convenient, especially with the ability to order takeaway food online and having it delivered to the home with no need to leave the house. The recent cost of living crisis might also motivate people into ordering takeaway food rather than eating meals out at restaurants which may be more expensive. In addition, takeaway food is more widely available now with companies such as Deliveroo and Just Eat promising takeaway food delivery at the click of a button. The popularity of purchasing fast food and takeaway food using delivery apps has risen over the last decade and has led to Just Eat enlisting popular celebrities such as Snoop Dogg (May 2020, December 2020), Eric Cantona (May 2021) and Katy Perry (June 2022) to appear in memorable and appealing adverts (Dishman, 2020; Farrelly, 2021; Houston, 2022).

This highlights the need for restrictions on advertising this kind of food. Cancer Research UK has shown that almost half of all food adverts (47.6%) shown over a one month period on ITV1, Channel 4, Channel 5 and Sky1 were for HFSS products and this increased to 55% between 6pm to 9pm (Cancer Research UK, 2020). Advertising restrictions on high fat, salt and/or sugar are needed, and a policy to do this was due to come into effect on the 1st of January 2023 (Sustain, 2022). The current UK government have backtracked on the implementation of this policy due to Covid-19 and the cost-of-living crisis and have delayed its implementation until 1st January 2024 (Department of Health and Social Care, 2022). Furthermore, they have ordered an official review of their anti-obesity strategy in view of the cost-of-living crisis which could result in this being scrapped altogether, as well as the ban on sugary products displayed at checkouts and buy one get one free multi-buy deals in shops which came in to effect on the 1st October 2022 (Campbell, 2022). Additionally, the calorie labelling scheme which came into force in April 2022 for cafes, restaurants and takeaways with 250 employees or more could also be ditched (Department of Health and Social Care, 2021).

Other reasons for consuming takeaway food are that people find cooking burdensome or time consuming. This research showed significant associations for frequent consumers not liking to prepare food or being too busy to cook, particularly with younger consumers. It seems that health promotion strategies should focus on encouraging people to prepare meals in the home, providing training on budgeting, meal planning, meal preparation and cooking skills, and encouraging meals to be prepared from scratch rather than purchasing takeaways, ultra-processed or readymade food. Preparing healthy meals does not need to be expensive and can be cheaper than purchasing takeaways. However, it is not always easy to build healthy eating into busy daily lives, so another area of research could involve investigating time scarcity with a view to providing suggestions on how to make healthier food choices (Jabs and Devine, 2006). Interestingly the amount of time spent on foodwork (tasks required to access food, including home food preparation) has gone down in recent years. Analysis of cross-sectional time surveys between 1983 and 2014 showed a decline in the amount of time spent on foodwork on a daily basis. However, the results showed an increase in time spent on sleep and leisure screen time, but not work (Clifford Astbury et al., 2022). The authors suggest that when people say they have no time to cook, in reality there are more interesting things they could be spending their time on, such as leisure screen time. Furthermore, the availability of other sources of food and meals that do not need to be prepared at home might make foodwork even less appealing, which makes the reformulation of out of home foods even more important (Clifford Astbury et al., 2022). Other factors which may have decreased the amount of time spent on foodwork could be the preparation of ‘quick’ recipes or the use of pre-prepared ingredients (Clifford Astbury et al., 2022). More recently, there has also been an influx of meal-kit subscription businesses such as Hello Fresh and Gousto (Murphy, 2022), which came about in response to busy lives, people not having time to meal plan or go shopping whilst still wanting to eat home cooked food (Goldstein, 2020). Customers sign up online, choose and pay for the meals they want to eat that week and are then sent meal kits comprising easy to follow recipes and ready-measured fresh ingredients to prepare the meals in the home (Goldstein, 2020).

With respect to independent takeaway outlets, strategies are needed which motivate chefs and show them why improvements are necessary whilst providing them with the tools to prepare healthier takeaways. Recruiting a number of outlets and providing training to chefs in groups could be one way to keep costs down. This type of intervention has been shown to be feasible and acceptable in the northeast of England by Hillier-Brown et al. (2019) in their evaluation of a Takeaway Masterclass, a three-hour training session delivered to staff from eighteen independent takeaways. It is important to consider that staff working in these businesses can be time restricted and hard to reach, furthermore there may be cultural and language barriers. For successful implementation of these kind of interventions (Hillier-Brown et al., 2019) advise focussing on engagement, building a mutual relationship of trust and the use of translators where

English language skills are limited. It is also important to consider the competitive business environment and tight profit margins (Hillier-Brown et al., 2019). For instance, takeaway businesses will want to keep their prices low whilst still making a profit. They may also wish to continue to provide large portion sizes in order to retain their customers (Blow et al., 2019b). Providing smaller portions at a lower cost (in addition to usual portion sizes) might be one way of offering an intervention that is acceptable to takeaway outlets and more health-conscious consumers (Goffe et al., 2019). Furthermore, the cost-of-living crisis is making things challenging for these small independent businesses, due to increased energy and food prices squeezing their profit margins. One example of this is fish and chip shops where in addition to increasing energy costs, there have also been significant price increases for fish, potatoes, and sunflower oil (Smith, 2022). This could have a knock-on effect of reducing consumption of fish and chips as consumers may no longer feel it is an affordable treat. However, they may just choose to purchase a cheaper takeaway meal instead.

Aside from food businesses dealing with price increases, the cost of energy and food has also risen for the general UK population. The Broken Plate Report by the Food Foundation (2022) shows food costs in the UK are rising disproportionally, with healthy food increasing more than unhealthy food, driven by factors such as labour shortages and increased fertiliser and fuel costs. Healthy foods have increased in price by twice as much as unhealthy foods from 2021 to 2022 and on average, healthy food now costs £8.51 per 1,000 kcal, compared with £3.25 for less healthy foods (Food Foundation, 2022). When looking at fruit and vegetables specifically, the Broken Plate report found HFSS foods were considerably cheaper, costing £4.50 per 1,000 kcal compared with £10.56 per 1,000 kcal for fruit and vegetables, and this was without taking price promotions into consideration which are usually on the HFSS options (Food Foundation, 2022). At a time when the government should be encouraging people to eat healthier foods, the large price difference between healthy and unhealthy foods is more likely to discourage the purchase of healthy foods. For instance, to meet the cost of the government's recommended Eatwell guidelines, the richest fifth UK households would only need to spend one tenth (11%) of their disposable income compared with almost half (47%) for the poorest fifth (Food Foundation, 2022). This shows the need for government policies which make healthier foods more affordable. Consumers should also be supported to exercise their 'choice freedom' to choose healthy, tasty, and affordable foods instead of being compelled to consume an unhealthier harmful diet due to price, access, time and lack of information (Lasko-Skinner, 2020).

6.5 Implications and recommendations for national and local policy

In their analysis of government obesity policies between 1992 and 2020, Theis and White (2021) concluded that the government should prioritize policies that have the potential for population-wide reach thereby maximising their potential for equitable impacts. In addition, government policies should shape external influences rather than rely on individuals to change their behaviour (Theis and White, 2021). As recipe reformulation can be used in a covert way, it does not rely on takeaway consumers changing their behaviour.

A government national reformulation strategy involving all takeaway outlets in the UK could have a positive impact on population health when taking into account the proportion of people who regularly eat takeaway food. Government reformulation strategies in the independent takeaway sector could involve funding councils to carry out projects which motivate chefs to produce healthier takeaways. Local councils might consider projects similar to *Eatright* Liverpool, but which engage with chefs on a one-to-one basis or Takeaway Masterclasses which involve working with a larger number of chefs.

The government could also introduce mandatory legislation which requires takeaway outlets to produce food in relation to specific targets for fat, salt and/or sugar: currently, targets are only voluntary. This has worked elsewhere in the food industry, where food manufacturers have reformulated soft drinks to reduce sugar content via introduction of the sugar tax (Mozaffarian et al., 2018), although reductions need to be done gradually over time. Thus, longer term projects are also needed which continue working with the takeaway outlets so that any improvements that are made are sustained. Progress could also be monitored with the use of healthy takeaway award schemes, encouraging them to make changes and improve the food they serve in order to keep the award.

Unfortunately, the cost of these types of projects can be prohibitive and extremely time consuming for not much reward. Furthermore, local authority budget cuts over the last decade suggest that funding for these types of projects is scarce, particularly in Merseyside (Thorp et al., 2022). Similarly, it is unlikely that Trading Standards teams will have budgets to sample meals from takeaways and send them for costly nutritional analysis by PAL, like local authorities were when this research commenced. Furthermore, since 2013, Alexiou et al. (2021) has shown cuts to local government funding have been greater in more deprived areas in England and that the gap in health inequalities has widened. One area in which local government could make an impact is by introducing planning regulations to restrict the number of hot food takeaways to encourage healthier food environments (St. Helens Council, 2011; Metropolitan Borough of Knowsley, 2016; Moore et al., 2022). Alternatively, local governments could encourage start-ups which want to open healthy takeaways and this might drive competition with existing local takeaway outlets to improve the meals they serve.

6.6 Recommendations for further research

The impact of Covid-19 led to changes in consumer behaviour due to closures of restaurants and an increase in businesses providing takeaway food (O'Connell, Smith and Stroud, 2022). The convenience of ordering takeaway food online has led to an upsurge in the use of websites and mobile apps and an increase in takeaway food consumption (Just Eat, 2021). The rise of fast-food delivery apps has also led to dark kitchens (food businesses which only prepare meals for takeaway and/or delivery) which are common in urban areas with a high population density (Fitzpatrick, 2021; Rinaldi, D'Aguilar and Egan, 2022). Dark kitchens are purpose-built kitchen units, which are staffed and stocked by the restaurant, they have no front of house and customers are not able to collect their food order themselves (Fitzpatrick, 2021). This means when food is ordered online it is not always possible to know where it is coming from, how it has been produced or its nutritional quality. Furthermore, dark kitchens may undermine local government policy which aims to reduce the proliferation of fast food outlets, such as the use of urban planning restictions (Rinaldi, D'Aguilar and Egan, 2022).

Further areas of research could include working with consumers to enable them to prepare healthy meals in the home and teach budgeting, meal planning, meal preparation and cooking skills. Behaviour change could also be encouraged via a Randomized Controlled Trial (RCT) where participants are supplied with healthier takeaway meals at the start of the study (with known nutrient content). As the study progresses, participants are taught how to prepare these healthier meals, so by the end of the study they are cooking their own healthy takeaways rather than purchasing unhealthy meals from takeaways. The effect on their dietary intake could be investigated using home blood test kits which examine biomarkers. This would provide further evidence that takeaway meals are associated with NCDs, and biomarkers from the blood tests may show a healthier profile as the study progresses.

With respect to takeaway outlets, areas of research could include public health initiatives that involve working with chefs to reformulate meals without affecting profitability. This could involve several approaches. 1) Health by stealth where the meals are improved without the customers' knowledge, so customers purchase healthier takeaways by default. 2) Outlets could prepare healthier meals and advertise them for consumers who want to make better choices, this could also include offering smaller portion sizes at a slightly reduced price. It should also be proven to the takeaway outlets that reformulated meals are acceptable to consumers: in the present study, the reformulated meals were only tested on a small sample size. Larger scale studies which test reformulated meals on a larger population could provide further evidence that reformulated meals are acceptable to consumers. Ideally, this kind of study would need to be carried out at a takeaway outlet and trialled with their usual customers. Investigation of the impact of these types of initiatives on takeaway consumers' energy and nutrient intakes is also needed.

At present, this research is just as, or even more, important than when it commenced. This changing food landscape shows the necessity of public health campaigns to reformulate takeaway food and to encourage healthier eating, although funding in the current climate might prove difficult.

Chapter 7

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7 References

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Chapter 8

Appendices

8 Appendices

Appendix 1.0 – Ethical Approval

From: Williams, Mandy
To: Davies, Ian
Cc: Jaworowska, Agnieszka
Subject: Ethical Approval
Date: 10 January 2012 10:14:53

Ethical Approval

11/ECL/015, Ian Davies, Staff, Takeaway consumption in Merseyside (Agnieszka Jaworowska)

Liverpool John Moores University Research Ethics Committee (REC) reviewed the above application and following the satisfaction of provisos, I am happy to inform you the Committee are content to give a favourable ethical opinion and recruitment to the study can now commence.

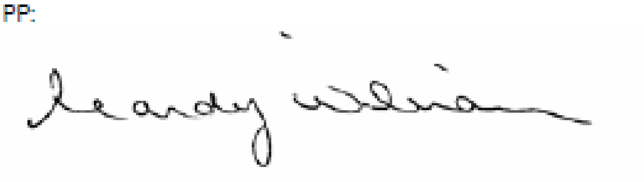
Approval is given on the understanding that:

- any adverse reactions/events which take place during the course of the project will be reported to the Committee immediately;
- any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately;
- any substantive amendments to the protocol will be reported to the Committee immediately.
- the LJMU logo is used for all documentation relating to participant recruitment and participation eg poster, information sheets, consent forms, questionnaires. The JMU logo can be accessed at www.ljmu.ac.uk/images/jmulogo

For details on how to report adverse events or amendments please refer to the information provided at http://www.ljmu.ac.uk/RGSO/RGSO_Docs/EC8Adverse.pdf

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be November 2016. An application for extension of approval must be submitted if the project continues after this date.

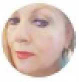
Yours sincerely
PP:



Brian Kerrigan
Chair of the LJMU REC
Tel: 0151 231 3110
E-mail:a.f.williams@ljmu.ac.uk
CC: Supervisor

Appendix 1.1 – Ethical Approval

RE: Major Amendment Approval - 11ECL015



Williams, Mandy
To **Research Ethics Proportionate Review**; Davies, Ian
Cc Blackham, Toni

01/09/2016

Dear Ian

Further to the above applications for major amendments which you recently submitted for consideration by the University's Research Ethics Committee. Please accept this email as formal confirmation that REC agreed to approve this application by Chairs action.

LIVERPOOL JOHN MOORES UNIVERSITY

Mandy Williams, Research Support Officer
(Research Ethics and Governance)
Research and Innovation Services
Kingsway House, Hatton Garden, Liverpool L3 2AJ
t: 01519046467 e: a.f.williams@ljmu.ac.uk

Appendix 2.0 - Pilot Takeaway Questionnaire (Informed Consent)

Takeaway Survey

Page 1: Welcome to the Takeaway Food Survey

Participant information

You are invited to take part in a research questionnaire about takeaway food. Before you decide to complete the questionnaire, it is important that you understand its purpose and what it involves. Please take time to read the following information and decide if you want to take part or not.

This questionnaire will investigate frequency and reasons of takeaway consumption among people in Merseyside.

Completion of the questionnaire is voluntary and anonymous; the answers provided by you will be unidentifiable in any publications.

You will be asked to complete a short questionnaire, which will be used to collect information regarding your demographical characteristics (e.g. gender, age, and education), some lifestyle factors and frequency and attitudes towards takeaway food.

You do not have to answer all of the questions, if you find that there are some questions you do not like to answer, leave them blank. It is expected that it should not take longer than 5-10 minutes to complete.

The results of this questionnaire will help us to understand attitudes towards takeaway food. Your opinion about takeaway meals will be useful in helping design further research in public health.

Any personal information collected during this study will be stored securely on password protected computers or in locked filing cabinets.

If you have any questions regarding your participation or the study, please do not hesitate to contact us:

Dr Ian Davies I.G.Davies@ljmu.ac.uk, Ms Toni Blackham T.M.Blackham@ljmu.ac.uk.

By completing this questionnaire, I confirm that I have read the participant information above and I am happy to complete the questionnaire voluntarily. Thank you for your time.

Cookies, personal data stored by your Web browser, are not used in this survey. Note that once you have clicked on the CONTINUE button at the bottom of each page you cannot return to review or amend that page.

A few questions about you:

1. Are you Male? Female?

2. How old are you?

3. How tall are you? (in feet and inches or metres/centimetres)

4. How much do you weigh? (in stone and pounds or in kilogrammes)

5. What is the postcode of your residence?

6. What is your education level?
   - primary/secondary school
   - college
   - university degree

7. Are you
   - single
   - married
   - divorced
   - partnership
   - widowed

8. Who do you live with?
   - on my own
   - parents
   - friends
   - wife / husband / partner

9. How many children do you have?
   - 0
   - 1
   - 2
   - 3
   - 4 or more

10. What is your employment status
   - I am employed / self employed
   - I am unemployed
   - I am retired
   - I am a full time student
   - Other

a. If you selected Other, please specify: ___________________________________

Takeaway Food

In this section we would like to ask some questions on your eating behaviour with takeaway food.

For the purposes of this survey, 'takeaway food' is defined as that which is purchased from small, individual outlets such as chip shops/Chinese/Indian/Kebab takeaways (and restaurants when using their takeaway service). Please also include any takeaway meals which are delivered to your home from the establishment.

11. Do you eat takeaway food? (If no, please go to question 20 and carry on with the questionnaire)

Yes
No

12. How often do you usually buy a takeaway?

more than once a day
most days (3-6 times a week)
once or twice a week
once or twice a month
less than once a month
never

13. What is the main reason you usually eat takeaway food?

It is cheap
It is easily available
I do not like to prepare food
I am usually too busy to cook
I like the taste
I do not know how to cook
It is a good alternative to eating out
For a change / treat

14. I buy takeaway meals mostly for (which of these statements is true for you?)

breakfast
lunch
dinner
a snack

15. Which type of takeaway meal do you buy the most often?

Chinese
Indian
Fried chicken
Pizza
Kebabs
Fish and chips
Chips

16. What is your most favourite takeaway meal? ______________________________

17. Who do you most often eat takeaway food with?

alone
friends
husband / wife / partner
whole family
parents
brothers / sisters

18. Thinking about the last takeaway meal you had, did you..?

eat your portion all by yourself
share your portion with someone else
share your portion with more than one person
don't know / can't remember

19. When buying a takeaway, do you usually..?

eat the whole portion in one session
eat some and save some for later
eat some and throw the rest away
share with someone else
Other

a. If you selected Other, please specify: ___________________________________

20. I tend not to buy takeaways because (which of these statements is true for you?)

I don't like the taste
they are expensive
I like to prepare food
too far to travel
Other

a. If you selected Other, please specify: _____________________________________

Takeaway Opinions

In this section we would like to ask your opinion on certain aspects of takeaway food

21. I think takeaway food is unhealthy
    strongly agree
    agree
    neither agree nor disagree
    disagree
    strongly disagree

22. I think that takeaway food is low in salt
    strongly disagree
    disagree
    neither agree nor disagree
    agree
    strongly agree

23. I think that takeaway food is low in fat
    strongly agree
    agree
    neither agree nor disagree
    disagree
    strongly disagree

24. I consider takeaway food to be low in calories
    strongly disagree
    disagree
    neither agree nor disagree
    agree
    strongly agree

25. I think that takeaway food is linked with gaining weight
    strongly agree
    agree
    neither agree nor disagree
    disagree
    strongly disagree

26. I think that takeaway food is tasty
    strongly disagree
    disagree
    neither agree nor disagree
    agree
    strongly agree

Takeaway Opinions (continued)

27. I think that a standard portion of takeaway food is too big
    - strongly agree
    - agree
    - neither agree nor disagree
    - disagree
    - strongly disagree

28. I think takeaway food is healthy
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

Changes to Takeaway Food

In this section we would like to find out your opinion on potential changes to takeaway food

29. If meals with reduced salt content were introduced in takeaway outlets, would you be likely to purchase them?
    - strongly agree
    - agree
    - neither agree nor disagree
    - disagree
    - strongly disagree

30. If meals with reduced fat content were introduced in takeaway outlets, would you be likely to purchase them?
    - strongly agree
    - agree
    - neither agree nor disagree
    - disagree
    - strongly disagree

31. If meals with reduced sugar content were introduced in takeaway outlets, would you be likely to purchase them?
    - strongly agree
    - agree
    - neither agree nor disagree
    - disagree
    - strongly disagree

32. If smaller portions of your chosen meal were introduced at a reduced price, would you be likely to purchase them?

strongly agree
agree
neither agree nor disagree
disagree
strongly disagree

33. If nutritional information were available on the menu (for example, amounts of salt, fat, sugar, calories), would you find this useful?

strongly agree
agree
neither agree nor disagree
disagree
strongly disagree

34. If a rating scheme indicating which outlets serve healthier food was introduced, would you be interested in this information?

strongly agree
agree
neither agree nor disagree
disagree
strongly disagree

35. Is there anything else you would like to add about takeaway food?

36. Before clicking on the continue button - If there are any questions throughout this questionnaire that need clarifying please let us know by stating the question number and your comment

Finish ☐

If you submit your answers, you will not be able to return to this page.

Appendix 2.1 - Takeaway Questionnaire (Informed Consent)

Takeaway Food Survey

Welcome to the Takeaway Food Survey

You are invited to take part in a research questionnaire concerning/regarding takeaway food consumption among people in Merseyside from small independent takeaway outlets.

Please note when defining takeaway food this survey ***DOES NOT*** include:
• meals purchased from chains (for example: McDonalds, KFC, Dominoes, etc)
• sandwiches, soups, salads, baked potatoes, pies, pasties, etc

What the research ***IS*** concerned with, is takeaway food defined as meals purchased from:
• small, independent outlets such as chip shops/pizza outlets/fried chicken outlets/Chinese/Indian/Kebab takeaways.
• small, independent restaurants when using their takeaway service.
• these types of establishments, which deliver takeaway food to your home.

Before completing the questionnaire, it is important that you understand its purpose and what it involves. Please take time to read the following information and decide if you want to take part or not.

You will be asked to complete a short questionnaire, which will be used to collect information regarding your demographical characteristics (e.g. gender, age, and education), some lifestyle factors, frequency of consumption and attitudes towards takeaway food.

Completion of the questionnaire is voluntary and anonymous; the answers provided by you will be unidentifiable in any publications. Any personal information collected during this study will be stored securely on password protected computers or in locked filing cabinets.

You do not have to answer all of the questions, if you find that there are some questions you do not like to answer, leave them blank. It is expected that it should take no longer than 5-10 minutes to complete.

Your answers to this questionnaire will be useful in helping design further research in public health.

If you have any questions regarding your participation or the study please do not hesitate to contact us:

Dr Ian Davies, email: I.G.Davies@ljmu.ac.uk; **Ms Toni Blackham**, email: T.M.Blackham@ljmu.ac.uk.

By completing this questionnaire, I confirm that I have read the participant information above and I am happy to complete the questionnaire voluntarily.

Thank you for your time.

Cookies, personal data stored by your Web browser, are not used in this survey. **Note that once you have clicked on the CONTINUE button at the bottom of each page you cannot return to review or amend that page.**

Takeaway Food

In this section we would like to ask some questions regarding your eating behaviour and takeaway food.

Please note when defining takeaway food this survey **DOES NOT** include:

- meals purchased from chains (for example: McDonalds, KFC, Dominoes, etc)
- sandwiches, soups, salads, baked potatoes, pies, pasties, etc

What the research **IS** concerned with, is takeaway food defined as meals purchased from:

- small, independent outlets such as chip shops/pizza outlets/fried chicken outlets/Chinese/Indian/Kebab takeaways.
- small, independent restaurants when using their takeaway service.
- these types of establishments, which deliver takeaway food to your home.

1. Do you eat takeaway food? (If no, please go to question 12 and carry on with the questionnaire)
   - o Yes
   - o No

2. How often do you usually buy a takeaway?
   - o more than once a day
   - o most days (3-6 times a week)
   - o once or twice a week
   - o once or twice a month
   - o less than once a month
   - o never

3. If you are a frequent takeaway eater (once per week or more), approximately how long (in months/years) have you been eating takeaway food at this frequency

   ____

4. Do you eat more takeaway food now compared to a year ago?
   - o Yes
   - o No

5. Which meal do you mainly buy takeaway meals for?
   - o breakfast
   - o lunch
   - o dinner
   - o a snack

6. Which type of takeaway meal do you buy the most often?
   - Chinese
   - Indian
   - Fried chicken
   - Pizza
   - Kebabs
   - Fish and chips
   - Chips

7. There are many different types of Chinese meals, Indian meals, English meals, etc takeaway meals. Which particular **takeaway meal** do you enjoy the most?

   ____

8. What are the main reasons why you usually eat takeaway food?

   a) I think that takeaway food is cheap/good value for money
      - Yes
      - No

   b) It is easily available
      - Yes
      - No

   c) I do not like to prepare food
      - Yes
      - No

   d) I am usually too busy to cook
      - Yes
      - No

   e) I like the taste
      - Yes
      - No

   f) I do not know how to cook
      - Yes
      - No

   g) It is a good alternative to eating out
      - Yes
      - No

   h) For a change / treat
      - Yes
      - No

   i) Other

   If you selected Other, please specify:

   ____

9. Do you have takeaway food delivered? If Yes then please answer the following; if No then please tick ‘No’ and move on to question 10

   - Yes
   - No

   a) I order more items on the menu to qualify for free delivery
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

   b) I eat more because I have ordered more food
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

   c) I eat more because I want to have value for money
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

   d) I eat some and save the rest for the next day
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

   e) I eat some and dispose of the rest
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

   f) I eat some and share the rest with family/friends/colleagues
      - strongly disagree
      - disagree
      - neither agree nor disagree
      - agree
      - strongly agree

10. When buying a takeaway, do you usually...?

a) eat your portion on your own, in one session
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

b) eat some and save some for later
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

c) eat some and throw the rest away
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

d) share your portion with one other person
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

e) share your portion with more than one person
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

11. Who do you most often eat takeaway food with?
   - alone
   - friends
   - husband / wife / partner
   - whole family
   - parents
   - brothers / sisters
   - Other

If you selected Other, please specify:

12. I tend not to buy takeaways because (which of these statements is true for you?)

a) I do not like the taste
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

b) They are expensive
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

c) I like to prepare food
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

d) Too far to travel
   - strongly disagree
   - disagree
   - neither agree nor disagree
   - agree
   - strongly agree

e) Other

If you selected Other, please specify:

____

Takeaway Opinions

In this section we would like to ask your opinion on certain aspects of takeaway food

Please note when defining takeaway food this survey **DOES NOT** include:

- meals purchased from chains (for example: McDonalds, KFC, Dominoes, etc)
- sandwiches, soups, salads, baked potatoes, pies, pasties, etc

What the research **IS** concerned with, is takeaway food defined as meals purchased from:

- small, independent outlets such as chip shops/pizza outlets/fried chicken outlets/Chinese/Indian/Kebab takeaways.
- small, independent restaurants when using their takeaway service.
- these types of establishments, which deliver takeaway food to your home.

13. I think takeaway food is unhealthy
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

14. I think that takeaway food is low in salt
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

15. I think that takeaway food is low in fat
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

16. I consider takeaway food to be low in calories
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

17. I think that takeaway food is linked with gaining weight
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

18. I think that takeaway food is tasty
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

19. I think that a standard portion of takeaway food is too big for one adult
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

20. I think takeaway food is healthy
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

21. I consume takeaway foods rarely (less than once every 1-2 months) and am therefore not concerned with their nutritional content
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

22. I consider takeaway foods as an indulgent treat, consumed rarely, and therefore consider this to be in moderation as part of a balanced diet
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

Changes to Takeaway Food

In this section we would like to find out your opinion on potential changes to takeaway food

Please note when defining takeaway food this survey **DOES NOT** include:

• meals purchased from chains (for example: McDonalds, KFC, Dominoes, etc)

• sandwiches, soups, salads, baked potatoes, pies, pasties, etc

What the research **IS** concerned with, is takeaway food defined as meals purchased from:

• small, independent outlets such as chip shops/pizza outlets/fried chicken outlets/Chinese/Indian/Kebab takeaways.

• small, independent restaurants when using their takeaway service.

• these types of establishments, which deliver takeaway food to your home

23. If meals with reduced salt content were introduced in takeaway outlets, would you be more likely to purchase them?
    - o strongly disagree
    - o disagree
    - o neither agree nor disagree
    - o agree
    - o strongly agree

24. If meals with reduced fat content were introduced in takeaway outlets, would you be more likely to purchase them?
    - o strongly disagree
    - o disagree
    - o neither agree nor disagree
    - o agree
    - o strongly agree

25. If meals with reduced sugar content were introduced in takeaway outlets, would you be more likely to purchase them?
    - o strongly disagree
    - o disagree
    - o neither agree nor disagree
    - o agree
    - o strongly agree

26. If smaller portions of your chosen meal were introduced at a reduced price, would you be more likely to purchase them?
    - o strongly disagree
    - o disagree
    - o neither agree nor disagree
    - o agree
    - o strongly agree

27. If nutritional information were available on the menu (for example, amounts of salt, fat, sugar, calories), would you find this useful?
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

28. If consumer guidance were available on the menu (for example, Guideline Daily Amounts, traffic light system), would you find this useful?
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

29. If a rating scheme indicating which outlets serve healthier food was introduced, would you be interested in this information?
    - strongly disagree
    - disagree
    - neither agree nor disagree
    - agree
    - strongly agree

30. Is there anything else you would like to comment on, within this questionnaire, about takeaway food?

    ____

    ____

    ____

and finally a few questions about you..

31. Are you?
    - male
    - female

32. How old are you? ________________

33. How tall are you?
    In feet and inches ________ ________

34. How tall are you?
    In metres or centimetres ________________

35. How much do you weigh?
    In stones and pounds ________ ________

36. How much do you weigh?
    In kilogrammes ____________________

37. What is the postcode of your residence? __________________________

38. Who do you live with?
    - o on my own
    - o parents
    - o friends
    - o wife / husband / partner
    - o Other

    If you selected Other, please specify: _______________________________________

39. Are you
    - o single
    - o married
    - o divorced / separated
    - o partnership
    - o widowed

40. How many children do you have?
    - o 0
    - o 1
    - o 2
    - o 3
    - o 4 or more

41. What is your education level?
    - o primary/secondary school
    - o college
    - o university degree

42. What is your employment status?
    - o I am employed / self employed
    - o I am unemployed
    - o I am retired
    - o I am a full-time student
    - o Other

    If you selected Other, please specify:

    ____

43. Before clicking on the continue button - If there are any questions throughout this questionnaire that need clarifying please let us know by stating the question number and your comment

    ____

    ____

    ____

    ____

Finish

If you submit your answers, you will not be able to return to this page.

Appendix 3.0 - Principal Components Analysis of Takeaway Questionnaire

Prior to performing PCA the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Oklin (KMO) measure of sampling adequacy value was 0.831, a value that exceeds the "meritorious" 0.80 value described by Kaiser (1974). Barlett's Test of Sphericity (p <0.05) was highly statistically significant (p <0.0001), supporting the factorability of the correlation matrix (Field, 2018). PCA revealed the presence of four components with eigenvalues exceeding 1, explaining 30%, 22.8%, 8.7% and 6.9% of the variance respectively, a cumulative percentage of 68.5%.

Table 8.1 Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.503	30.017	30.017	4.503	30.017	30.017	3.692
2	3.427	22.846	52.863	3.427	22.846	52.863	3.699
3	1.308	8.719	61.582	1.308	8.719	61.582	3.353
4	1.038	6.918	68.500	1.038	6.918	68.500	1.216
5	0.914	6.093	74.593				
6	0.839	5.590	80.183				
7	0.586	3.909	84.092				
8	0.502	3.347	87.439				
9	0.424	2.829	90.268				
10	0.412	2.744	93.012				
11	0.341	2.276	95.288				
12	0.210	1.403	96.691				
13	0.194	1.296	97.988				
14	0.165	1.098	99.086				
15	0.137	0.914	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Inspection of the scree plot (figure XXXX) shows a large break between factors 1 and 2 and a larger break between factors 2 and 3. Factors 3 through 15 have no breaks due to their relatively small eigenvalues, hence are considered unimportant factors. A scree test supports the retention of the first two components for further investigation (Cattell, 1966; O'Rourke and Hatcher, 2013).

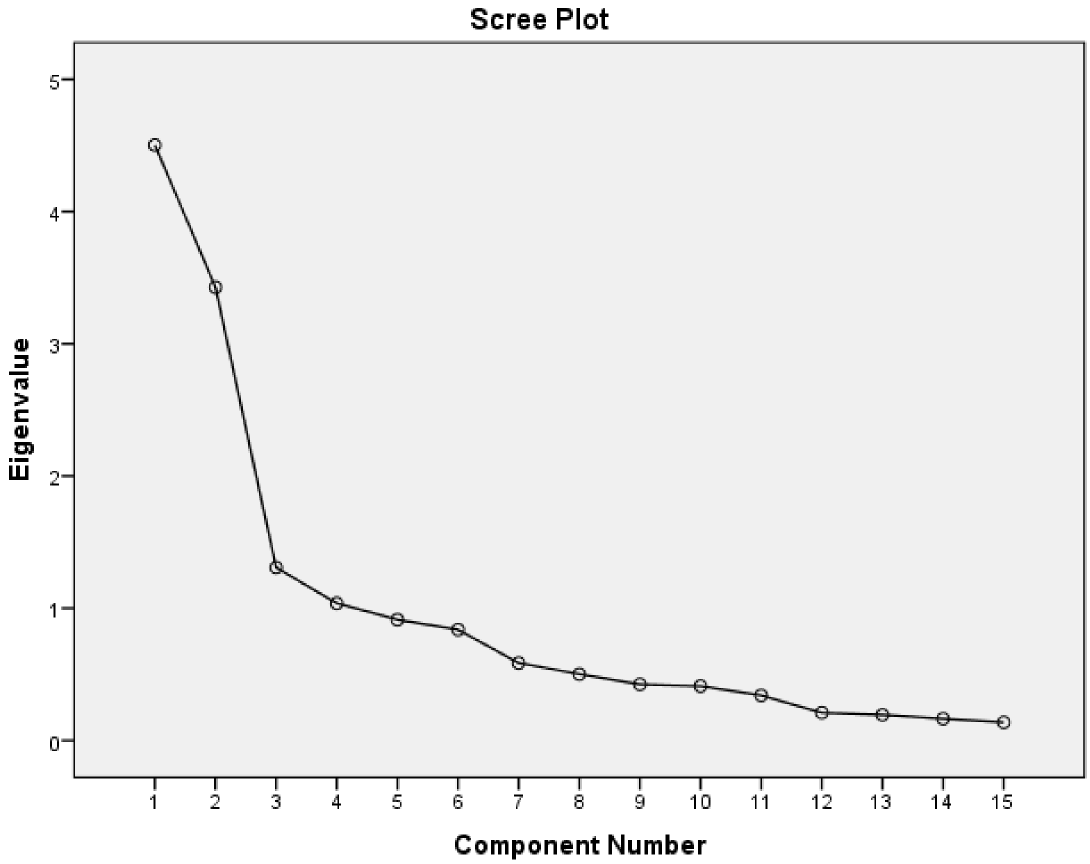


Figure 8.1: Scree Plot of Eigenvalues from Analysis

The results of Parallel Analysis showed only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (15 variables x 461 respondents). Examination of the component matrix found the third and fourth components had few items which loaded above 0.4. Inspection of the pattern matrix found four items loading above 0.3 on component 1, six items on component 2, three items on component 2 and only 2 items on component 4. The three-component solution was considered; however, examination of the component matrix found few items with a loading above 0.4.

Figure 8.1 Parallel Analysis

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++
Monte Carlo PCA for Parallel Analysis
++++++++++++++++++++++++++++++++++++++++++++++++++++++
31/10/2016   13:40:58
Number of variables:     15
Number of subjects:     461
Number of replications: 100
++++++++++++++++++++++++++++++++++++++++++++++++++++++
Eigenvalue #     Random Eigenvalue     Standard Dev
++++++++++++++++++++++++++++++++++++++++++++++++++++++
1               1.3186              .0407
2               1.2501              .0264
3               1.1942              .0258
4               1.1471              .0241
5               1.1060              .0195
6               1.0667              .0207
7               1.0283              .0176
8               0.9887              .0172
9               0.9538              .0175
10               0.9178              .0174
11               0.8818              .0170
12               0.8489              .0198
13               0.8089              .0192
14               0.7704              .0210
15               0.7188              .0287
++++++++++++++++++++++++++++++++++++++++++++++++++++++
31/10/2016   13:40:59
Monte Carlo PCA for Parallel Analysis

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```

To find the best factor solution it has been suggested that the following selection criteria be used to avoid overestimating the number of factors to retain (Schonrock-Adema et al., 2009; O'Rourke and Hatcher, 2013).

1) use scree test to find the "break" between factors
2) only use eigenvalues > 1.5
3) selecting a minimum proportion of variance, for example 5% or 10%

Using these criteria, a group of components should be retained which will account for a relatively large proportion of variance in the dataset (Schonrock-Adema et al., 2009).

In the present study, inspection of the scree plot, limitation of eigenvalues to > 1.5 and setting proportion of variance to > 10% (Table XXX) supports the two-component solution.

In addition, a two-component solution met the interpretability criterion, suggested by (O'Rourke and Hatcher, 2013):

a) There are at least three items with significant loadings of > 0.40 on each retained component,

b) The variables that load on the component share the same conceptual meaning,

c) Variables loading on different components seem to measure different conceptual meanings

and

d) The rotated factor pattern demonstrates a "simple structure".

The two-component solution explained 52.8% of the total variance. To aid in the interpretation of these two components, oblique rotation (Oblimin) was performed as it was assumed that the items of the different components were interrelated to some degree (Costello and Osborne, 2005). The rotated solution revealed the presence of simple structure with both components showing a number of strong loadings, and all variables loading substantially on only one component (Osborne, 2015). The Component Correlation Matrix showed the strength of the relationship between the two factors to be quite low (r=0.176). The pattern matrix table shows the factor loadings for the variables. The main loadings on component 1 were questions 24, 25, 23 (receptiveness to takeaways served with reduced fat, sugar and salt content). On component 2, the main loadings were questions 15, 16 and 14 (opinion on whether takeaways were low in fat, calories, and salt).

The communalities table showed question 18, "I think that takeaway food is tasty" had the lowest communalities value of 0.008, and a low value (less than 0.3) indicates that it does not fit well with the other items in its component. In the component matrix, it had a value of 0.086 and 0.014 respectively for components 1 and 2 and a value less than 0.3 in the pattern matrix; hence it was decided to remove this item from the PCA.

Rerunning the analysis for the 14 items, the two-component solution explained 56.6% of the variance, with component 1 contributing 32.1% and component 2 contributing 24.5%. There was a weak positive correlation of 0.141.

Figure 8.2 Unrotated Loadings

	Component 1	Component 2
Reduced fat content	**0.794**	-0.348
Reduced sugar content	**0.729**	-0.387
Rating scheme for healthier food	**0.723**	-0.205
Nutritional information on the menu	**0.713**	-0.294
Reduced salt content	**0.704**	-0.419
Consumer guidance on the menu	**0.683**	-0.333
Smaller portions at reduced price	**0.544**	-0.265
Standard portion size is too big	0.411	**0.235**
Takeaways are low in fat	0.424	**0.771**
Takeaways are low in calories	0.370	**0.737**
Takeaways are low in salt	0.364	**0.666**
Takeaway food is healthy	0.337	**0.660**
Takeaway food is unhealthy	0.358	**0.618**
Takeaway food is linked with weight gain	0.430	**0.464**

Appendix 3.1 - Scales developed from the Takeaway Questionnaire

The interpretation of the data was consistent with the "**Receptiveness to healthier takeaways**" attributes on component 1 and the "**Healthiness of takeaway food**" attributes on component 2. Component loadings and communalities of the rotated solution are presented in Table 8.4 with major loadings in bold.

Table 8.2 Pattern and Structure Matrix for PCA with Oblimin Rotation of Two Factor Solution of Takeaway Questionnaire Items

	Item	Pattern Coefficients		Structure Coefficients		Communalities
	Question	Component 1	Component 2	Component 1	Component 2	
Receptiveness to Healthier Takeaways scale						
24	Reduced fat content	**0.866**	0.011	**0.867**	0.133	0.753
25	Reduced sugar content	**0.831**	-0.052	**0.824**	0.066	0.682
23	Reduced salt content	**0.827**	-0.091	**0.814**	0.025	0.670
27	Nutritional information on the menu	**0.766**	0.027	**0.770**	0.135	0.594
28	Consumer guidance on the menu	**0.763**	-0.022	**0.760**	0.086	0.578
29	Rating scheme for healthier food	**0.727**	0.113	**0.743**	0.216	0.565
26	Smaller portions at reduced price	**0.608**	-0.017	**0.605**	0.069	0.367
Takeaway Health Literacy scale						
15	Takeaways are low in fat	-0.057	**0.886**	0.068	**0.878**	0.775
16	Takeaways are low in calories	-0.085	**0.833**	0.033	**0.821**	0.681
14	Takeaways are low in salt	-0.051	**0.765**	0.057	**0.758**	0.577
20	Takeaway food is healthy	-0.071	**0.748**	0.035	**0.738**	0.550
13	Takeaway food is unhealthy	-0.031	**0.717**	0.071	**0.713**	0.509
17	Takeaway food is linked with weight gain	0.114	**0.607**	0.200	**0.623**	0.401
19	Standard portion size is too big	0.222	**0.388**	0.277	**0.419**	0.224

Appendix 3.2 – Takeaway Questionnaire - Additional Graphs and Tables

3.2.1 Takeaway Food Consumption

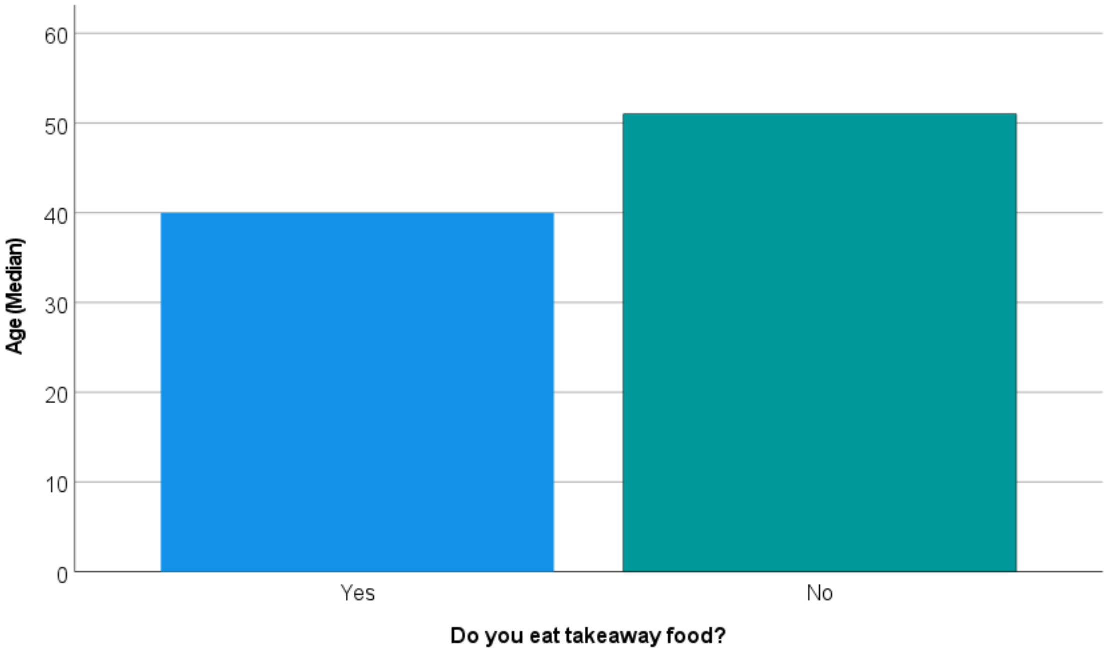

Figure 8.3 Age and "Do you eat takeaway food?"

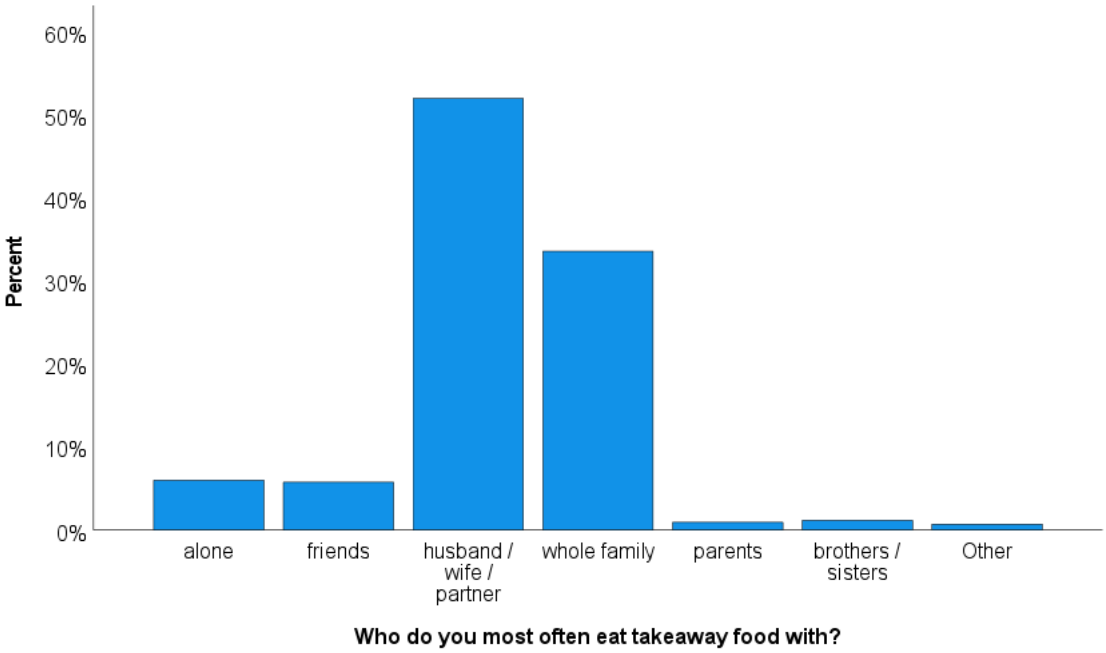

Figure 8.4 Who takeaway consumers eat takeaway food with

3.2.2 Takeaway Delivery Service

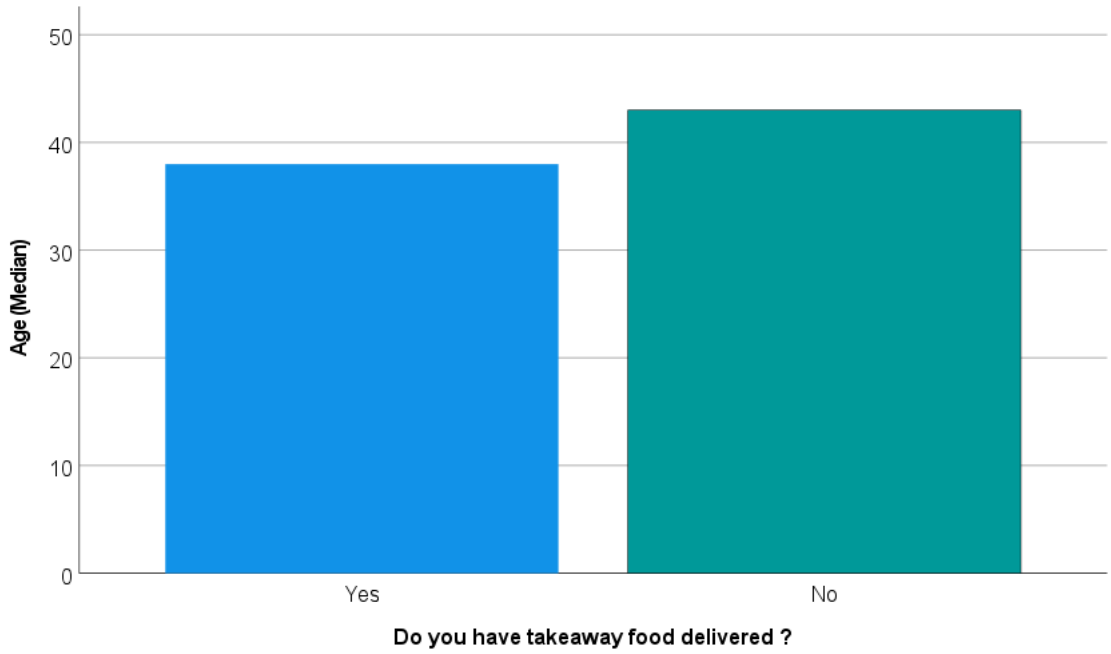

Figure 8.5 Age and Takeaway Delivery

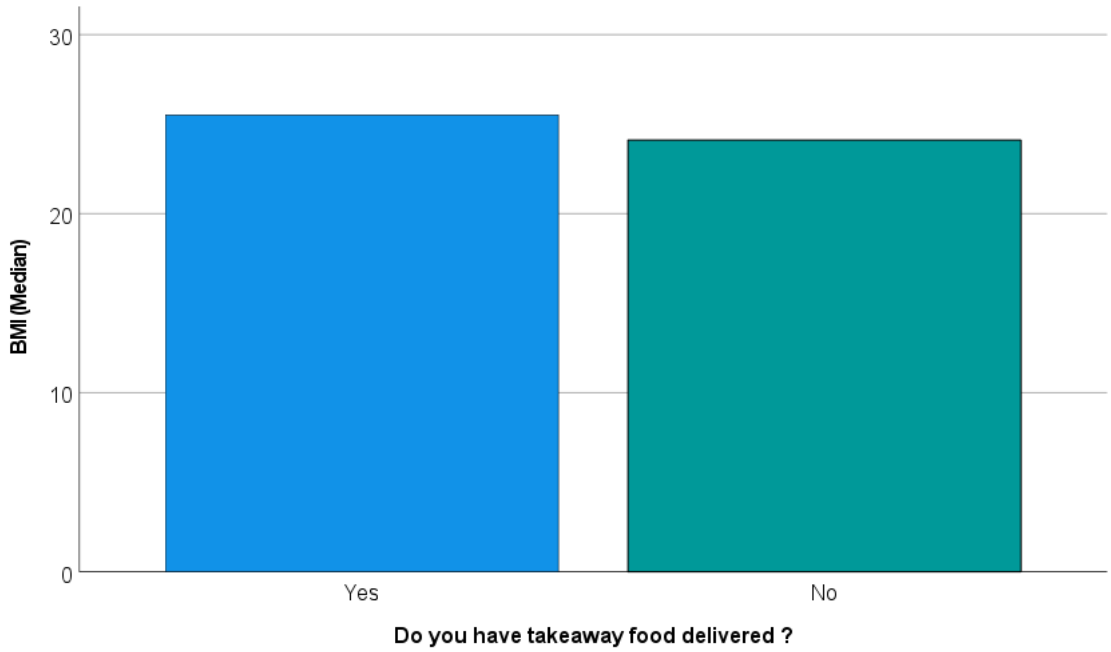

Figure 8.6 BMI and Takeaway Delivery

3.2.3 Demographics

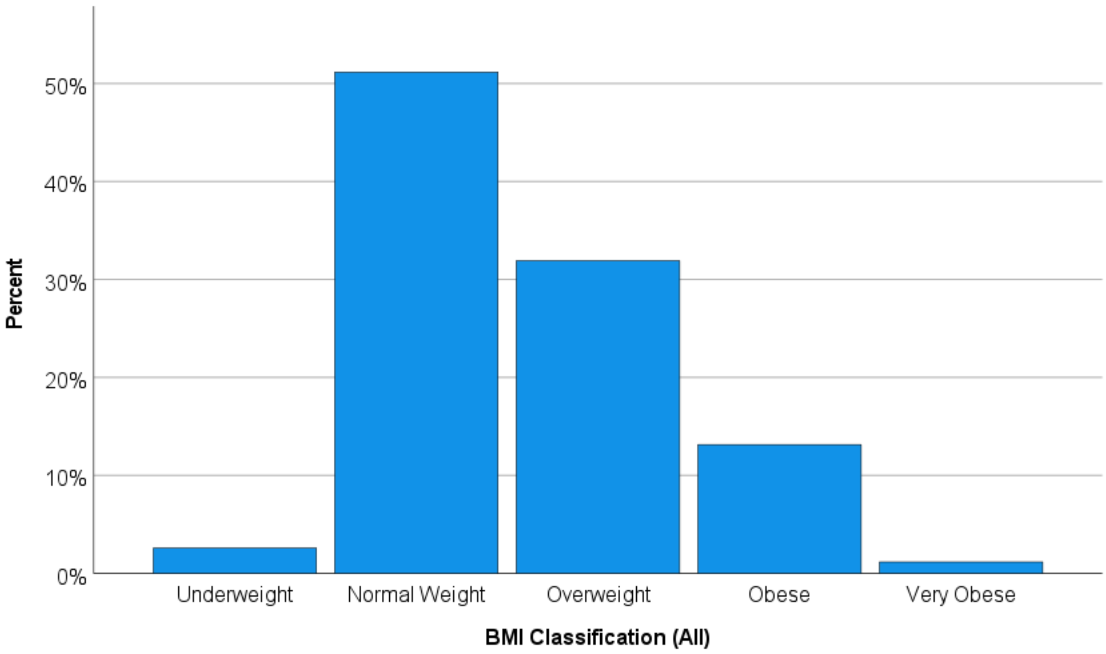

Figure 8.7 BMI Classification for respondents using self-reported weight and height

3.2.4 Reasons for purchasing takeaway food

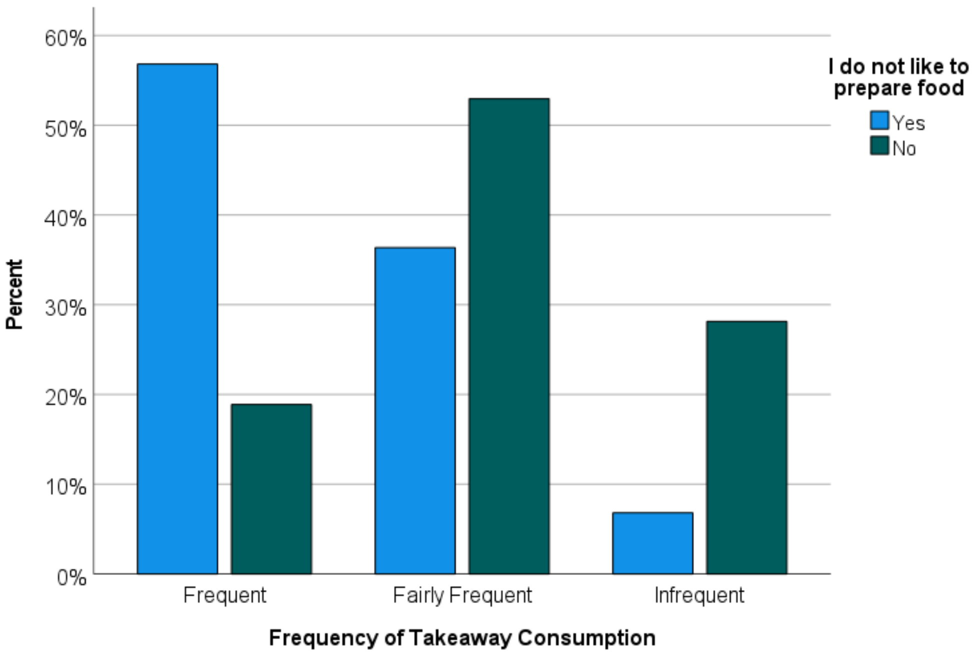

Figure 8.8 Frequency of Takeaway Consumption and “I do not like to prepare food”

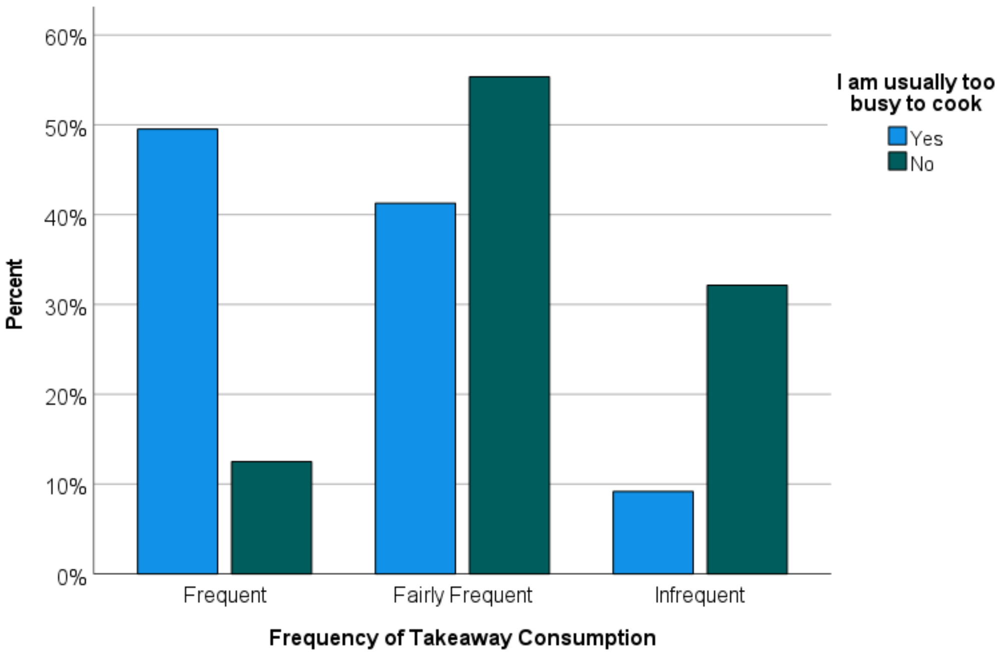

Figure 8.9 Frequency of Takeaway Consumption and “I am usually too busy to cook”

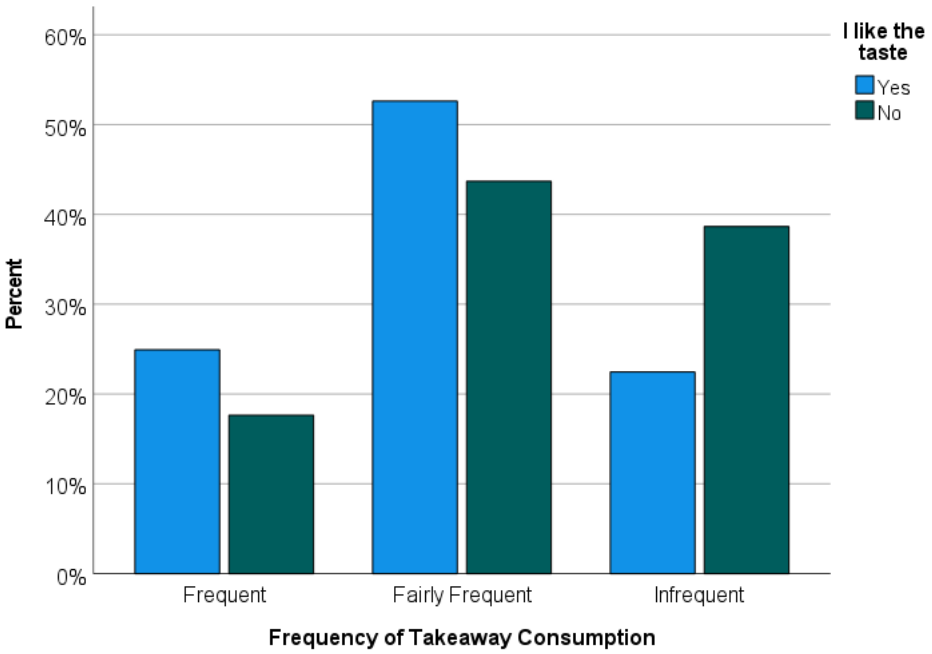

Figure 8.10 Frequency of Takeaway Consumption and “I like the taste”

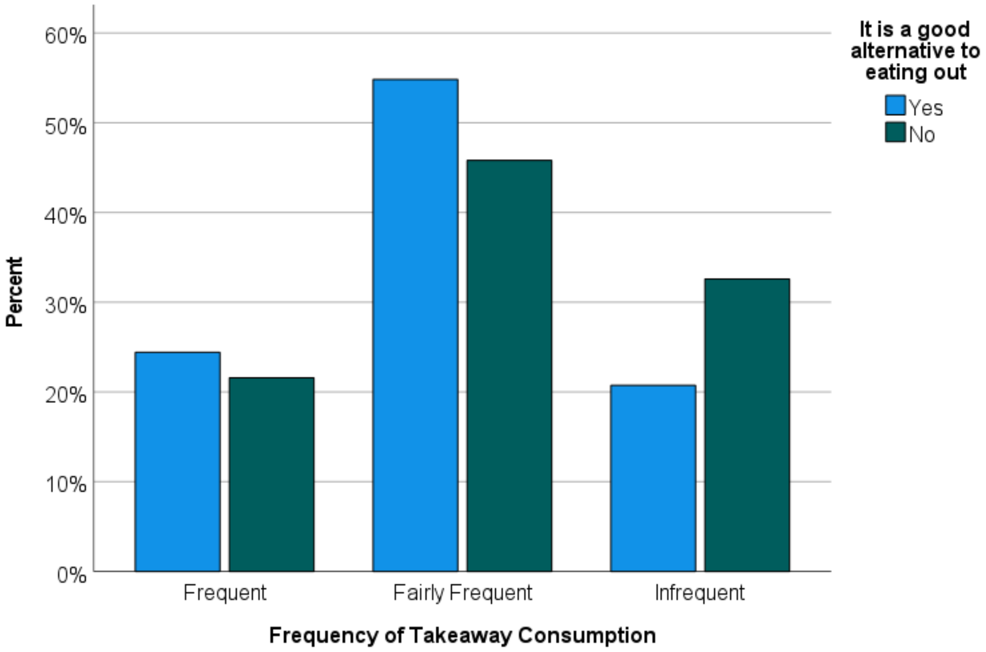

Figure 8.11 Frequency of Takeaway Consumption and “It is a good alternative to eating out”

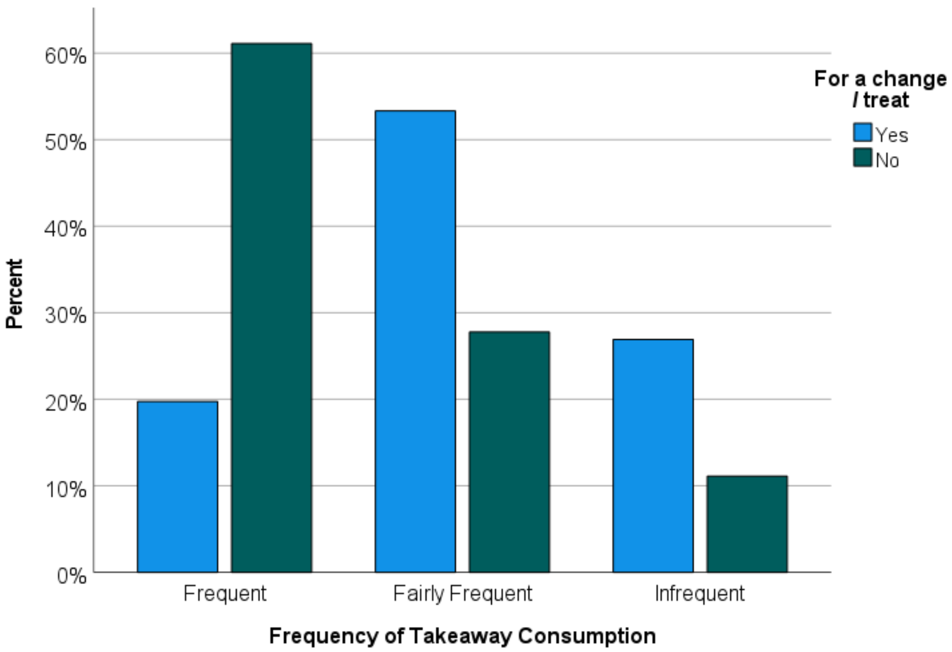

Figure 8.12 Frequency of Takeaway Consumption and “For a change / treat”

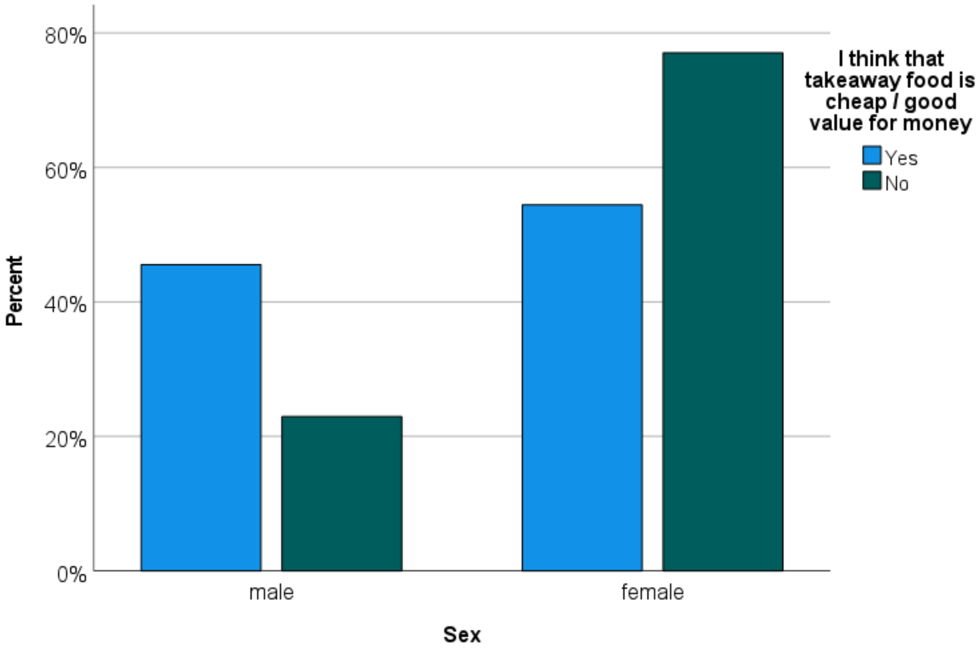

Figure 8.13 Sex and “I think that takeaway food is cheap / good value for money”

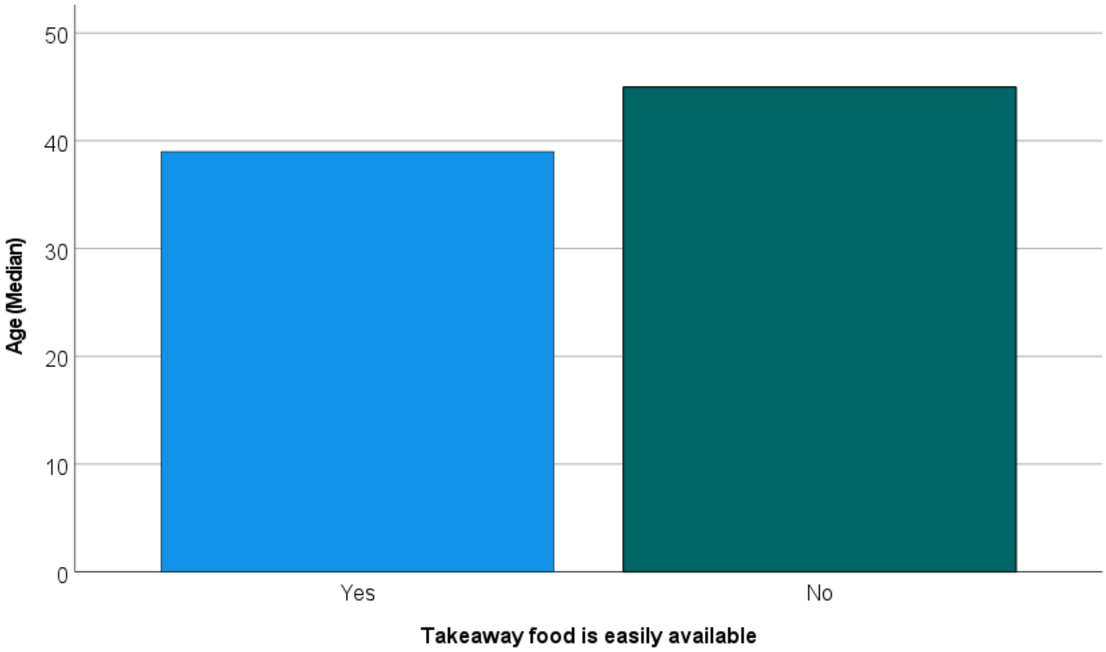

Figure 8.14 Age and “I think that takeaway food is easily available”

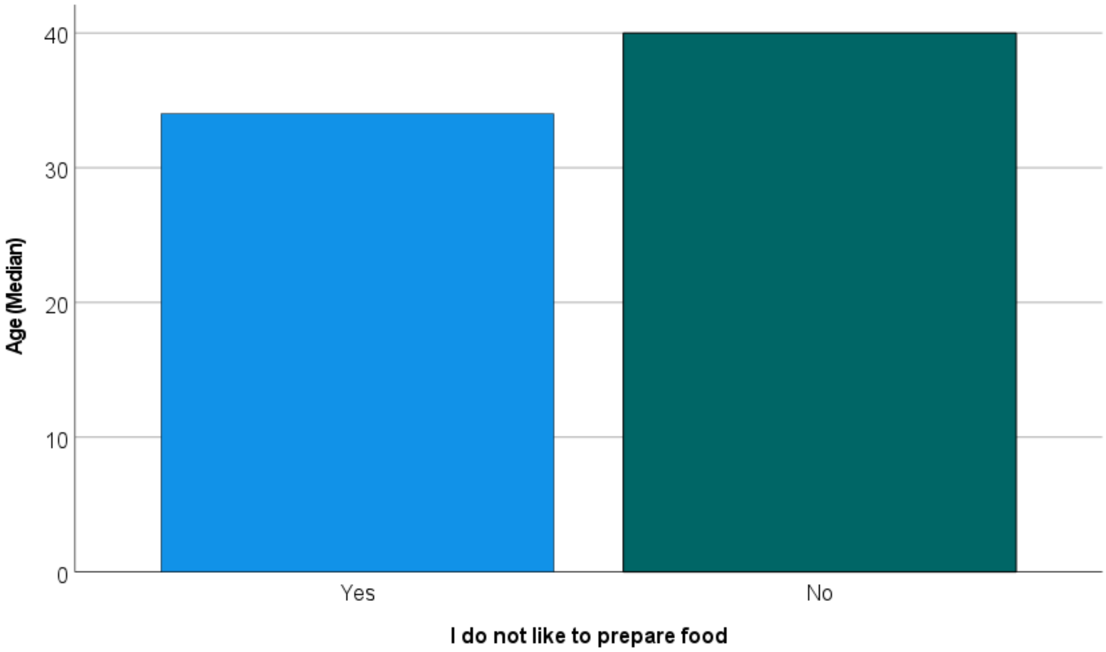

Figure 8.15 Age and “I do not like to prepare food”

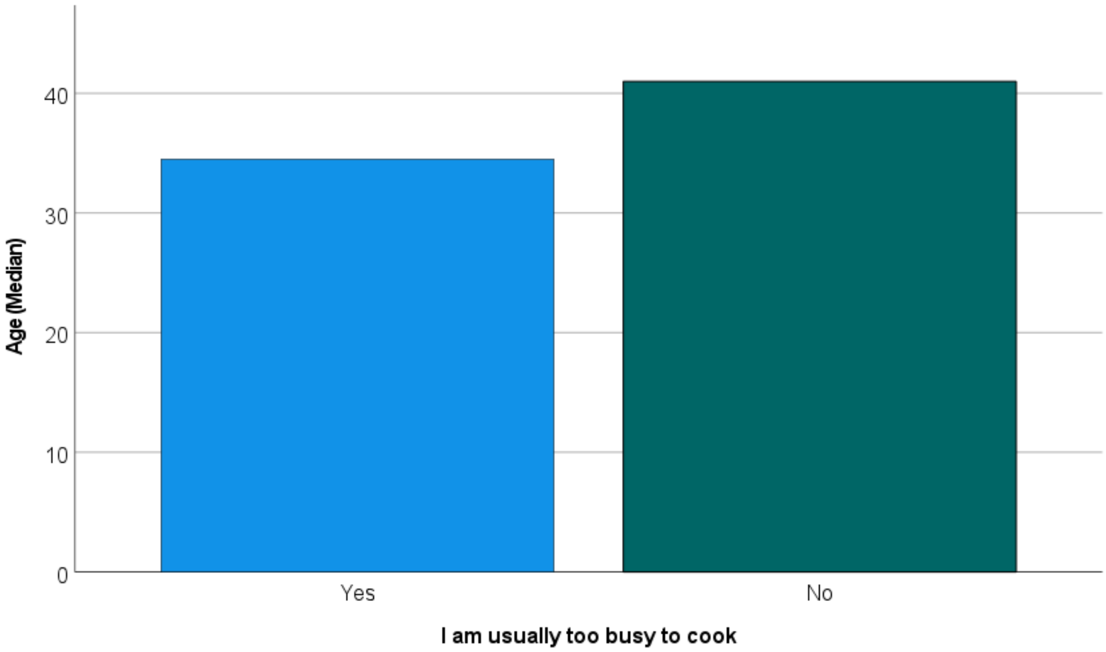

Figure 8.16 Age and “I am usually too busy to cook”

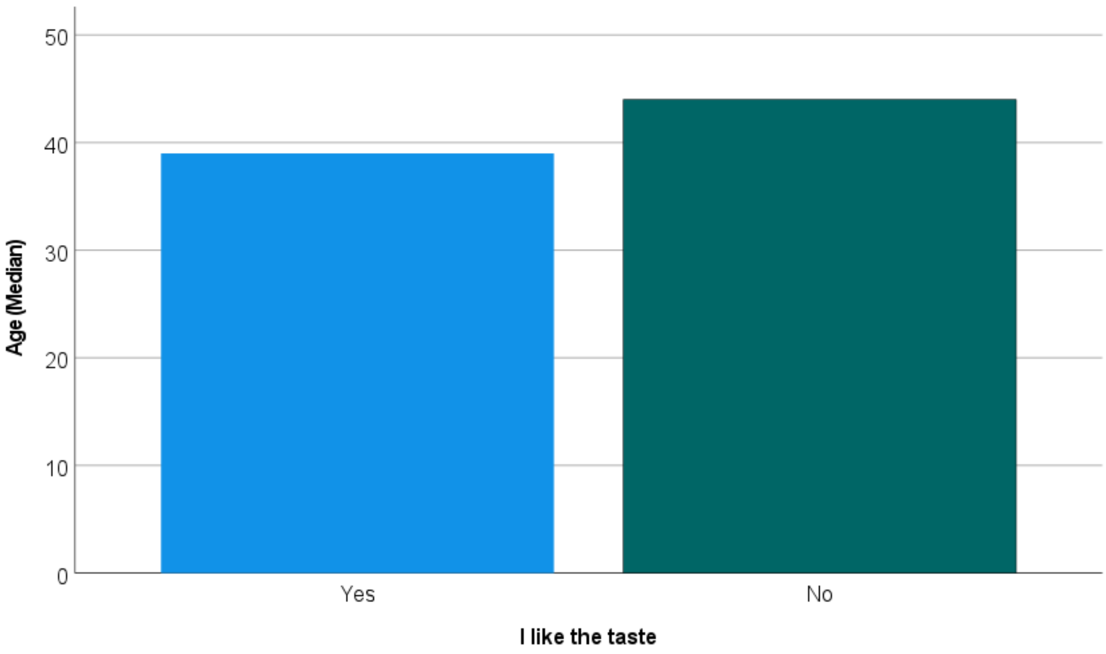

Figure 8.17 Age and “I like the taste”

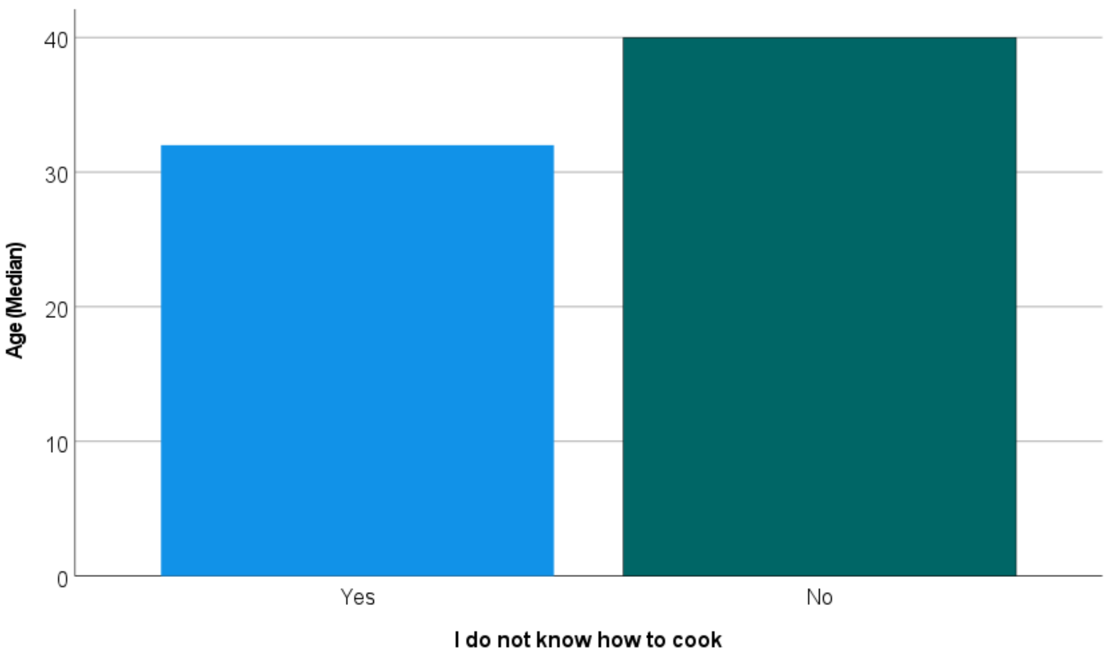

Figure 8.18 Age and “I do not know how to cook”

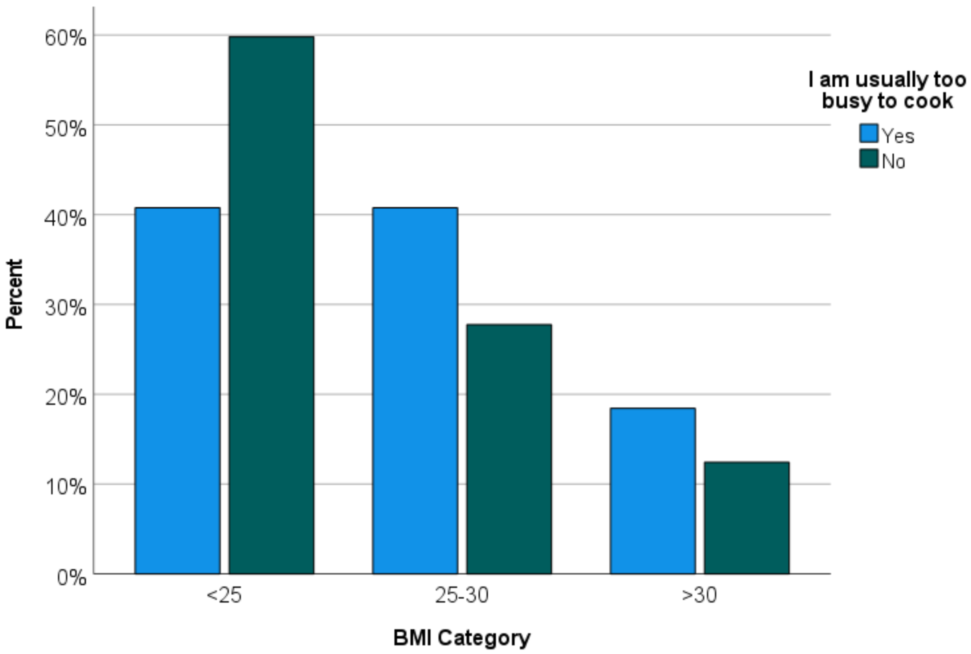

Figure 8.19 BMI Category and “I am usually too busy to cook”

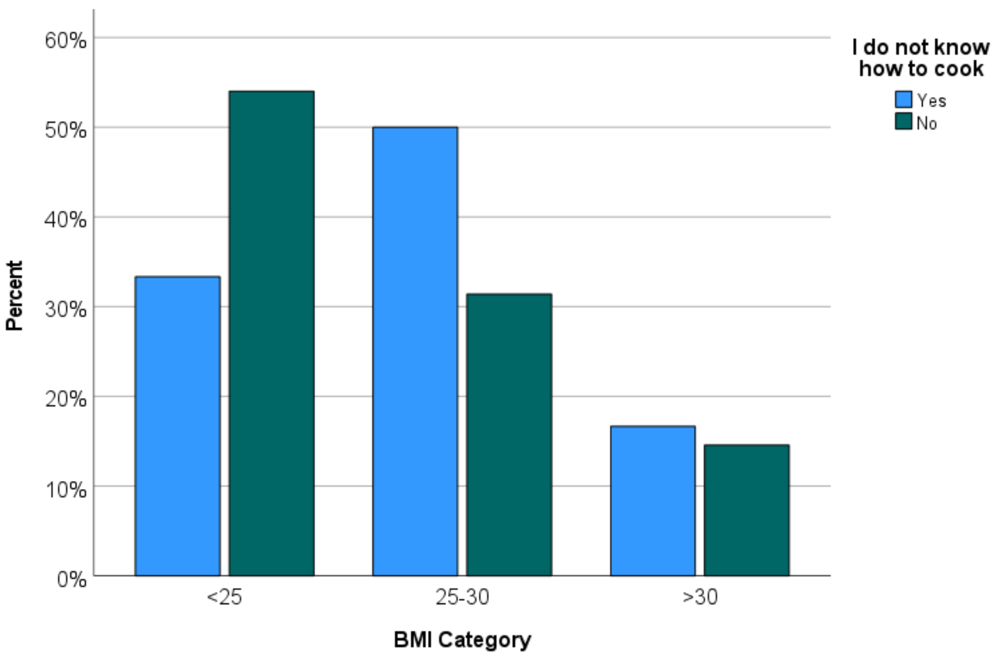

Figure 8.20 BMI Category and “I do not know how to cook”

Appendix 4.0 - Nutritional composition of takeaway meals per portion

Table 8.3 Nutritional composition of takeaway meals per portion – Portion size, Energy, Protein, Carbohydrate, Sugars, and Salt

Meal Type	n	Weight g	Energy kcal/meal	Protein g/meal	Carbohydrate g/meal	n[1]	Sugars g/meal	Salt g/meal
Chinese (all meals)	**185**	**749 (588-910)**	**1124 (805-1477)**	**51.2 (42.7-67.7)**	**137.9 (87.7-188.6)**	**123**	**12.7 (6.7-71.1)**	**6.60 (4.28-9.33)**
Beef in black bean sauce with fried rice	31	915 (871-1013)	1386 (1170-1559)	62.4 (48.5-70.5)	167.0 (148.8-189.5)	21	11.0 (8.9-15.8)	10.72 (8.13-13.88)
Beef in black bean sauce	12	424 (396-560)	432 (335-552)	38.3 (33.8-46.3)	20.0 (17.6-38.1)	12	6.2 (2.1-8.7)	6.13 (5.05-6.79)
Sweet & sour chicken with boiled rice	10	766 (744-868)	1501 (1415-1619)	51.5 (44.6-65.3)	225.3 (214.1-246.3)		n/d	3.13 (1.83-3.76)
Sweet & sour chicken with chips	22	931 (785-1199)	2031 (1680-2230)	51.9 (46.9-65.9)	263.5 (185.5-301.1)	21	78.1 (47.4-106.0)	4.14 (2.94-4.98)
Sweet & sour chicken	28	469 (419-586)	914 (698-1067)	43.6 (38.9-51.0)	108.0 (75.1-121.5)	28	77.2 (53.8-85.7)	3.74 (2.30-5.12)
Prawn chow mein	21	679 (584-834)	725 (651-884)	40.5 (37.3-45.3)	93.1 (71.5-106.6)	21	8.4 (5.2-10.8)	7.88 (5.58-9.99)
Chicken chow mein	10	690 (567-873)	839 (697-1024)	56.4 (50.2-65.1)	81.6 (69.9-105.7)	10	2.1 (0.9-6.6)	6.23 (4.50-7.45)
Char sui chow mein	10	716 (680-848)	1095 (806-1159)	78.4 (56.8-105.8)	72.1 (58.9-93.9)		n/d	8.07 (7.18-8.46)
Chicken satay & fried rice	10	891 (781-1063)	1247 (1095-1727)	61.4 (55.1-74.9)	152.9 (136.0-183.0)		n/d	10.30 (7.50-13.40)
Kung po king prawns with boiled rice	10	882 (794-931)	1098 (984-1318)	37.8 (31.8-46.4)	181.3 (172.9-199.8)		n/d	5.45 (3.51-7.37)
Special fried rice	21	686 (604-742)	1367 (1235-1547)	78.2 (66.7-88.7)	156.0 (127.0-183.7)	10	3.3 (1.2-11.6)	9.41 (7.17-12.33)
Indian (all meals)	**95**	**803 (731-864)**	**1391 (1170-1585)**	**56.0 (35.4-67.3)**	**138.0 (119.8-156.0)**	**63**	**14.0 (10.9-19.4)**	**4.73 (3.61-6.10)**
Chicken korma with pilau rice	10	869 (819-923)	1595 (1459-1744)	67.3 (58.2-72.6)	156.5 (143.9-168.5)		n/d	3.81 (3.18-4.35)
Chicken tikka massala with keema rice	21	808 (746-872)	1480 (1331-1689)	69.7 (61.0-77.3)	138.0 (117.0-152.3)	21	22.6 (18.6-31.7)	6.68 (5.64-8.18)
King prawn rogan josh with pilau rice	22	772 (701-828)	1027 (838-1155)	33.9 (29.6-38.9)	135.1 (125.7-163.2)	21	13.6 (11.2-16.1)	4.20 (3.44-6.08)
Lamb rogan josh with pilau rice	10	758 (719-857)	1356 (1246-1479)	64.4 (53.5-77.1)	120.6 (114.2-148.0)		n/d	3.49 (2.78-5.23)

Table continued next page

Meal Type	n	Weight g	Energy kcal/meal	Protein g/meal	Carbohydrate g/meal	n[1]	Sugars g/meal	Salt g/meal
Lamb bhuna with chips	22	745 (714-830)	1522 (1379-1765)	53.8 (48.5-62.3)	134.1 (114.2-155.4)	21	11.7 (10.0-14.2)	4.12 (3.10-5.14)
Vegetable biryani	10	834 (747-910)	1311 (1102-1519)	22.8 (20.3-26.8)	134.3 (112.7-154.6)		n/d	5.63 (4.77-6.47)
Chicken tikka massala	3	510 (393-549)	882 (664-1224)	55.6 (46.0-59.3)	65.8 (60.9-86.7)	3	52.5 (49.9-64.2)	3.71 (3.54-4.08)
Lamb rogan josh	3	470 (419-551)	870 (771-992)	56.4 (31.8-71.1)	30.2 (26.4-31.0)	3	14.2 (0.6-18.8)	4.21 (2.82-4.40)
English (all meals)	**119**	**716 (638-830)**	**1606 (1431-1881)**	**48.4 (42.0-61.8)**	**174.2 (135.1-204.1)**	**87**	**3.0 (1.7-5.6)**	**2.98 (2.10-4.39)**
Chicken and chips	25	694 (606-828)	1575 (1320-1858)	81.7 (68.5-88.8)	169.5 (129.2-197.6)	24	2.6 (1.7-3.0)	2.18 (1.68-3.23)
Fish and chips	64	749 (656-827)	1658 (1515-1968)	47.7 (44.1-56.4)	193.0 (169.7-214.3)	33	2.5 (1.5-4.8)	2.89 (2.31-4.47)
Chips and curry sauce	9	487 (459-548)	1053 (830-1124)	13.1 (11.5-13.5)	130.3 (105.4-142.5)	9	2.7 (1.5-5.0)	3.31 (1.88-4.55)
Mushroom omelette and chips	21	783 (662-917)	1568 (1376-1920)	42.9 (33.0-55.9)	127.5 (112.9-151.5)	21	6.7 (4.7-9.4)	3.77 (2.15-5.55)
Chicken nuggets and chips	2	394 (294-298)	1028 (738-804)	28.3 (18.0-24.5)	127.1 (93.8-97.0)	2	0.4 (0.3-0.4)	3.26 (2.06-2.92)
Pizza (all meals)	**65**	**637 (538-768)**	**1820 (1469-2152)**	**90.3 (73.5-107.5)**	**186.9 (149.9-223.1)**	**44**	**12.6 (10.7-17.8)**	**9.12 (6.79-11.96)**
Pepperoni Pizza	12	750 (639-855)	2137 (1928-2598)	99.0 (80.5-131.0)	219.8 (203.0-250.3)	12	13.6 (11.3-19.4)	12.87 (5.94-13.70)
Seafood Pizza	11	765 (690-971)	2004 (1697-2515)	108.8 (97.1-135.9)	217.0 (170.4-244.7)	11	12.8 (11.9-18.4)	11.09 (8.66-13.62)
Margherita Pizza	12	674 (575-740)	1986 (1712-2270)	90.6 (68.9-100.2)	222.7 (208.6-256.4)	11	12.1 (11.1-22.1)	8.83 (6.63-10.81)
Ham and Pineapple Pizza	10	558 (497-605)	1469 (1261-1526)	77.2 (66.3-86.2)	170.2 (122.1-188.5)		n/d	7.72 (5.37-9.75)
Meat Pizza	20	550 (462-646)	1563 (1323-2008)	88.8 (73.6-101.5)	147.1 (118.8-166.1)	10	10.5 (8.3-14.4)	8.20 (6.93-9.82)
Kebabs (all meals)	**87**	**491 (418-636)**	**1125 (690-1673)**	**64.4 (54.6-76.2)**	**74.1 (52.2-134.1)**	**75**	**5.3 (3.0-8.3)**	**6.62 (4.27-8.48)**
Donner kebab and chips	32	751 (561-979)	1865 (1577-2221)	68.8 (58.7-81.7)	167.9 (128.9-224.4)	21	4.4 (2.1-6.6)	7.50 (5.90-9.71)
Chicken kebab	22	481 (436-539)	726 (650-819)	74.5 (56.2-90.7)	52.9 (49.8-61.3)	21	6.3 (3.6-8.4)	5.94 (3.95-7.27
Shish kebab	21	386 (334-478)	634 (509-709)	60.5 (51.5-68.3)	52.2 (44.5-58.1)	21	4.6 (2.9-7.0)	4.27 (3.47-5.99)
Donner kebab	12	447 (338-503)	1164 (1121-1355)	56.0 (47.2-74.2)	76.3 (68.1-85.8)	12	6.4 (3.9-15.3)	7.98 (6.64-9.73)

Notes: n = number of meals for Portion Size, Energy, Protein, Carbohydrate, Salt, n[1] = number of meals for sugars, n/d = no data

Table 8.4 Nutritional composition of takeaway meals per portion – Fat, SFA, MUFA, PUFA and TFA

Meal Type	n	Fat g/meal	SFA g/meal	n^2	MUFA g/meal	PUFA g/meal	TFA g/meal
Chinese (all meals)	**185**	**37.5 (25.0-54.8)**	**8.5 (4.0-14.1)**	**121**	**17.1 (9.7-22.4)**	**8.0 (4.5-11.7)**	**0.41 (0.20-0.58)**
Beef in black bean sauce with fried rice	31	48.0 (36.9-63.6)	9.1 (6.3-12.3)	10	26.5 (10.1-36.4)	6.7 (4.1-14.3)	0.30 (0.19-0.36)
Beef in black bean sauce	12	17.4 (13.3-25.4)	3.1 (2.2-4.0)	12	8.4 (6.8-10.3)	4.8 (3.4-8.4)	0.42 (0.40-0.56)
Sweet & sour chicken with boiled rice	10	41.6 (30.8-47.6)	11.7 (6.4-19.2)	10	19.3 (14.5-21.3)	6.2 (2.6-9.3)	0.19 (0.16-0.25)
Sweet & sour chicken with chips	22	78.7 (60.2-90.9)	33.1 (25.1-36.8)		n/d	n/d	n/d
Sweet & sour chicken	28	34.3 (23.2-44.4)	6.6 (2.5-14.8)	28	13.5 (8.2-19.7)	6.2 (3.8-10.3)	0.47 (0.42-0.59)
Prawn chow mein	21	24.5 (17.3-31.5)	3.8 (3.1-5.3)		n/d	n/d	n/d
Chicken chow mein	10	27.9 (17.1-41.8)	3.9 (3.0-4.5)	10	11.7 (5.7-20.0)	10.3 (7.4-12.7)	0.69 (0.57-0.87)
Char sui chow mein	10	45.5 (22.9-53.7)	14.6 (9.6-18.9)	10	21.4 (8.2-24.9)	3.9 (1.3-9.3)	0.19 (0.13-0.43)
Chicken satay with fried rice	10	35.8 (32.6-59.2)	6.2 (4.7-10.1)	10	18.7 (17.3-34.4)	12.0 (8.5-17.8)	0.08 (0.06-0.12)
Kung po king prawns with boiled rice	10	24.8 (12.2-31.6)	4.8 (3.0-6.2)	10	13.1 (7.3-16.7)	6.5 (3.2-8.1)	0.36 (0.09-0.47)
Special fried rice	21	50.0 (37.7-62.5)	11.1 (9.1-14.4)	21	23.6 (16.5-27.9)	12.2 (8.2-15.2)	0.53 (0.21-0.70)
Indian (all meals)	**95**	**69.6 (50.4-86.3)**	**18.4 (11.8-26.3)**	**30**	**20.4 (18.0-26.1)**	**23.4 (16.0-30.1)**	**0.79 (0.50-0.88)**
Chicken korma with pilau rice	10	75.9 (66.2-96.5)	34.5 (27.5-45.1)	10	19.8 (18.7-25.2)	22.4 (13.9-25.6)	0.83 (0.59-0.92)
Chicken tikka massala with keema rice	21	73.3 (67.0-91.6)	22.7 (18.9-31.5)		n/d	n/d	n/d
King prawn rogan josh with pilau rice	22	32.1 (18.7-44.2)	9.3 (6.7-15.2)		n/d	n/d	n/d
Lamb rogan josh with pilau rice	10	66.5 (50.0-70.7)	15.2 (12.4-17.7)	10	20.0 (15.0-25.4)	20.4 (15.9-31.0)	0.73 (0.62-0.84)
Lamb bhuna with chips	22	84.5 (76.1-92.9)	18.3 (15.0-20.3)		n/d	n/d	n/d
Vegetable biryani	10	71.7 (50.8-90.6)	17.2 (9.8-28.5)	10	23.6 (16.0-31.4)	28.7 (19.0-36.9)	0.76 (0.22-0.88)
Chicken tikka massala	3	43.9 (26.3-71.4)	15.6 (12.0-31.1)	3	17.6 (6.7-22.6)	8.0 (5.9-13.0)	0.51 (0.39-0.55)
Lamb rogan josh	3	58.2 (53.4-71.4)	10.5 (9.2-11.7)	3	20.7 (15.4-21.2)	28.5 (20.1-34.8)	0.47 (0.42-0.55)

Notes: n = number of meals for Fat, SFA, n^2 = number of meals for MUFA, PUFA, TFA, n/d = no data

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Meal Type	n	Fat g/meal	SFA g/meal	n^2	MUFA g/meal	PUFA g/meal	TFA g/meal
English (all meals)	**119**	**79.8 (65.7-94.0)**	**35.7 (27.2-43.7)**	**54**	**28.0 (21.7-35.2)**	**6.4 (5.4-8.5)**	**0.31 (0.16-0.64)**
Chicken and chips	25	66.2 (53.9-79.4)	31.2 (25.2-36.8)	25	12.2 (3.4-13.5)	10.7 (4.4-22.4)	0.33 (0.20-0.36)
Fish and chips	64	82.8 (71.6-96.7)	42.0 (34.8-48.8)	64	32.4 (26.6-37.6)	6.9 (5.8-8.5)	0.25 (0.15-0.67)
Chips and curry sauce	9	45.5 (38.6-60.0)	21.0 (17.0-27.8)	9	17.5 (13.3-21.0)	4.4 (3.2-5.7)	0.49 (0.46-0.55)
Mushroom omelette and chips	21	92.3 (79.9-114.3)	26.5 (23.4-33.2)		n/d	n/d	n/d
Chicken nuggets and chips	2	45.1 (29.5-38.3)	8.7 (6.0-7.1)	2	17.6 (9.8-16.7)	16.1 (11.9-12.4)	0.39 (0.29-0.39)
Pizza (all meals)	**65**	**74.9 (56.5-96.4)**	**35.7 (27.8-43.3)**	**31**	**19.1 (14.5-29.2)**	**9.1 (5.7-13.6)**	**1.01 (0.81-1.56)**
Pepperoni Pizza	12	95.4 (75.3-130.7)	37.8 (32.9-59.1)		n/d	n/d	n/d
Seafood Pizza	11	91.8 (66.9-109.5)	39.6 (31.7-49.5)		n/d	n/d	n/d
Margherita Pizza	12	83.4 (59.6-103.6)	37.2 (29.1-52.8)		n/d	n/d	n/d
Ham and Pineapple Pizza	10	55.3 (45.3-59.1)	28.1 (22.9-31.9)	10	14.2 (11.6-18.7)	7.8 (4.6-12.6)	0.99 (0.77-1.71)
Meat Pizza	20	75.1 (55.9-92.1)	33.1 (26.6-40.6)	20	24.1 (18.2-32.9)	10.6 (6.1-13.9)	1.04 (0.81-1.50)
Kebabs (all meals)	**87**	**58.9 (22.3-93.3)**	**19.2 (4.4-41.1)**	**22**	**30.2 (25.3-37.4)**	**6.6 (3.7-11.9)**	**2.68 (1.85-4.45)**
Donner kebab and chips	32	100.5 (83.6-118.3)	47.63 (34.7-55.2)	32	36.1 (27.4-40.9)	12.1 (6.2-15.4)	4.48 (2.69-5.22)
Chicken kebab	22	26.9 (20.3-40.4)	4.93 (3.00-7.75)		n/d	n/d	n/d
Shish kebab	21	16.2 (10.2-22.2)	4.41 (3.35-8.15)		n/d	n/d	n/d
Donner kebab	12	71.8 (63.1-82.1)	29.92 (26.08-34.95)	12	28.0 (24.8-31.0)	4.3 (3.2-7.7)	1.99 (1.83-2.79)

Notes: n = number of meals for Fat, SFA, n^2 = number of meals for MUFA, PUFA, TFA, n/d = no data

Appendix 4.1 - Nutritional composition of takeaway meals per 100g

Table 8.5 Nutritional composition of meals per 100 g - Energy, Protein, Carbohydrate, Sugars and Salt

Meal Type	n	Energy kcal/100g	Protein g/100g	Carbohydrate g/100g	n[1]	Sugars g/100g	Salt g/100g
Chinese (all meals)	**185**	**150 (124-189)**	**7.3 (5.9-9.5)**	**18.5 (13.3-23.8)**	**123**	**1.9 (0.9-9.8)**	**0.97 (0.58-1.32)**
Beef in black bean sauce with fried rice	31	147 (132-153)	6.5 (5.4-7.2)	17.4 (16.9-19.8)	21	1.2 (1.0-1.7)	1.19 (0.91-1.50)
Beef in black bean sauce	12	88 (80-108)	9.1 (7.1-10.0)	4.9 (4.3-6.4)	12	1.1 (0.5-2.1)	1.39 (1.16-1.58)
Sweet & sour chicken with boiled rice	10	188 (168-196)	6.3 (5.6-7.8)	28.4 (27.7-29.3)		n/d	0.37 (0.27-0.49)
Sweet & sour chicken with chips	22	208 (180-222)	5.9 (4.6-7.0)	26.7 (24.2-28.3)	21	7.7 (5.6-10.0)	0.44 (0.36-0.52)
Sweet & sour chicken	28	175 (138-198)	9.4 (8.0-10.5)	21.4 (16.6-23.7)	28	15.1 (12.0-18.3)	0.71 (0.56-1.03)
Prawn chow mein	21	102 (93-124)	5.8 (5.1-6.7)	12.8 (11.3-14.0)	21	1.2 (0.8-1.7)	1.12 (0.80-1.51)
Chicken chow mein	10	129 (108-134)	8.3 (7.2-9.7)	12.0 (10.0-14.5)	10	0.3 (0.1-0.8)	0.96 (0.68-1.16)
Char sui chow mein	10	129 (119-143)	10.3 (8.2-14.0)	9.6 (8.5-13.2)		n/d	1.06 (0.97-1.25)
Chicken satay with fried rice	10	146 (130-157)	7.4 (6.2-8.1)	17.8 (15.1-19.1)		n/d	1.04 (0.81-1.51)
Kung po king prawns with boiled rice	10	126 (114-152)	4.1 (3.7-5.6)	22.5 (19.5-23.8)		n/d	0.62 (0.39-0.85)
Special fried rice	21	200 (189-217)	11.5 (10.1-12.2)	22.8 (19.1-26.1)	10	0.5 (0.2-1.8)	1.37 (1.15-1.66)
Indian (all meals)	**95**	**176 (145-197)**	**6.9 (4.9-8.2)**	**17.2 (15.5-19.2)**	**63**	**1.7 (1.5-2.4)**	**0.61 (0.46-0.79)**
Chicken korma with pilau rice	10	179 (168-213)	7.4 (7.1-8.9)	17.3 (16.9-19.0)		n/d	0.45 (0.37-0.54)
Chicken tikka massala with keema rice	21	187 (175-199)	8.9 (7.3-10.1)	16.9 (14.8-18.1)	21	2.6 (2.1-4.0)	0.81 (0.70-0.97)
King prawn rogan josh with pilau rice	22	136 (117-142)	4.6 (3.9-5.1)	17.8 (17.0-19.9	21	1.7 (1.6-2.0)	0.59 (0.48-0.74)
Lamb rogan josh with pilau rice	10	174 (155-187)	7.6 (7.5-9.7)	16.1 (15.0-17.9)		n/d	0.46 (0.37-0.57)
Lamb bhuna with chips	22	206 (188-215)	7.0 (6.2-8.0)	18.4 (15.6-20.2)	21	1.5 (1.3-1.8)	0.51 (0.38-0.65)
Vegetable biryani	10	151 (139-171)	2.8 (2.5-3.3)	15.4 (14.0-19.6)		n/d	0.69 (0.55-0.78)
Chicken tikka massala	3	173 (169-223)	10.9 (10.8-11.7)	15.5 (12.9-15.8)	3	11.7 (10.3-12.7)	0.80 (0.68-0.90)
Lamb rogan josh	3	184 (158-211)	12.0 (7.6-12.9)	6.6 (4.8-7.2)	3	3.4 (0.1-4.0)	0.77 (0.50-1.05)

Notes: n = number of meals for Energy, Protein, Carbohydrate, Salt, n[1] = number of meals for sugars, n/d = no data

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Meal Type	n	Energy kcal/100g	Protein g/100g	Carbohydrate g/100g	n[1]	Sugars g/100g	Salt g/100g
English (all meals)	**119**	**234 (207-240)**	**6.7 (5.7-7.9)**	**24.3 (21.9-26.8)**	**87**	**0.4 (0.3-0.8)**	**0.41 (0.30-0.59)**
Chicken and chips	25	226 (210-247)	10.9 (9.5-13.3)	24.4 (22.6-27.1)	24	0.3 (0.3-0.4)	0.36 (0.24-0.56)
Fish and chips	64	229 (215-251)	6.7 (6.0-7.2)	25.8 (23.8-27.7)	33	0.3 (0.2-0.6)	0.41 (0.31-0.59)
Chips and curry sauce	9	191 (177-213)	2.5 (2.4-2.8)	24.2 (23.0-25.4)	9	0.4 (0.3-0.9)	0.63 (0.47-0.82)
Mushroom omelette and chips	21	205 (190-223)	6.1 (5.0-6.7)	16.6 (15.6-17.8)	21	0.9 (0.6-1.2)	0.48 (0.31-0.66)
Chicken nuggets and chips	2	261 (186-206)	7.2 (4.6-6.2)	32.3 (23.6-24.8)	2	0.1 (0.1-0.2)	0.83 (0.52-0.81)
Pizza (all meals)	**65**	**283 (260-304)**	**14.5 (13.2-15.6)**	**28.1 (25.4-31.9)**	**45**	**2.0 (1.5-2.5)**	**1.48 (1.26-1.70)**
Pepperoni Pizza	12	304 (283-315)	14.1 (13.0-15.3)	31.7 (27.3-34.4)	12	2.2 (1.5-2.8)	1.63 (1.15-1.87)
Seafood Pizza	11	253 (250-262)	13.9 (13.0-14.9)	25.4 (24.7-29.1)	11	1.8 (1.5-2.3)	1.32 (0.99-1.83)
Margherita Pizza	12	301 (281-312)	13.6 (12.2-14.7)	32.7 (30.8-37.0)	12	1.9 (1.4-3.0)	1.40 (1.06-1.70)
Ham and Pineapple Pizza	10	257 (247-280)	13.7 (12.3-14.6)	28.0 (25.9-32.7)		n/d	1.44 (1.21-1.57)
Meat Pizza	20	288 (278-312)	15.8 (14.7-18.0)	26.4 (23.7-29.2)	10	2.3 (2.0-2.8)	1.49 (1.39-1.71)
Kebabs (all meals)	**87**	**206 (155-257)**	**13.5 (9.5-16.2)**	**17.8 (12.4-22.5)**	**75**	**1.08 (0.60-1.50)**	**1.17 (0.91-1.58)**
Donner kebab and chips	32	254 (224-306)	8.6 (7.6-12.7)	22.9 (21.9-25.0)	21	0.60 (0.25-0.90)	1.07 (0.84-1.22)
Chicken kebab	22	147 (135-184)	15.2 (11.4-17.1)	11.8 (9.9-12.9)	21	1.30 (0.80-1.65)	1.15 (0.91-1.42)
Shish kebab	21	155 (139-164)	15.0 (13.6-17.2)	13.8 (12.1-17.0)	21	1.20 (0.95-1.60)	1.17 (0.91-1.51)
Donner kebab	12	277 (223-325)	13.4 (11.3-16.6)	18.2 (14.8-19.7)	12	2.01 (1.06-3.12)	1.90 (1.61-2.16)

Notes: n = number of meals for Energy, Protein, Carbohydrate, Salt, n[1] = number of meals for sugars, n/d = no data

Table 8.6 Nutritional composition of takeaway meals per 100 g - Fat, SFA, MUFA, PUFA and TFA

Meal Type	n	Fat g/100g	SFA g/100g	n^2	MUFA g/100g	PUFA g/100g	TFA g/100g
Chinese (all meals)	**185**	**5.1 (3.7-7.1)**	**1.04 (0.60-1.85)**	**121**	**2.34 (1.60-3.24)**	**1.14 (0.73-1.68)**	**0.10 (0.03-0.10)**
Beef in black bean sauce with fried rice	31	5.3 (4.0-6.5)	0.98 (0.70-1.30)	10	2.75 (1.07-3.82)	0.72 (0.42-1.46)	0.03 (0.02-0.04)
Beef in black bean sauce	12	3.5 (3.0-4.7)	0.60 (0.52-0.79)	12	1.98 (1.39-2.13)	1.03 (0.80-1.46)	0.10 (0.10-0.10)
Sweet & sour chicken with boiled rice	10	5.2 (3.5-6.1)	1.55 (0.82-2.34)	10	2.30 (1.83-2.63)	0.73 (0.35-1.03)	0.02 (0.02-0.03)
Sweet & sour chicken with chips	22	8.0 (7.1-9.6)	3.35 (2.58-4.13)		n/d	n/d	n/d
Sweet & sour chicken	28	6.6 (4.5-7.7)	1.22 (0.61-2.87)	28	2.56 (1.58-4.07)	1.30 (0.81-1.75)	0.10 (0.10-0.10)
Prawn chow mein	21	3.5 (2.4-4.4)	0.60 (0.40-0.80)		n/d	n/d	n/d
Chicken chow mein	10	4.1 (3.1-5.2)	0.54 (0.41-0.62)	10	1.93 (1.01-2.43)	1.45 (1.01-1.78)	0.10 (0.10-0.10)
Char sui chow mein	10	5.3 (3.3-6.5)	1.93 (1.43-2.34)	10	2.75 (1.19-3.03)	0.50 (0.20-1.09)	0.03 (0.02-0.06)
Chicken satay with fried rice	10	4.4 (4.1-6.1)	0.72 (0.55-0.98)	10	2.28 (2.02-3.06)	1.27 (1.0-2.13)	0.01 (0.01-0.01)
Kung po king prawns with boiled rice	10	2.7 (1.8-4.2)	0.52 (0.33-0.80)	10	1.35 (0.94-2.21)	0.66 (0.35-0.94)	0.05 (0.01-0.05)
Special fried rice	21	7.3 (5.2-8.8)	1.59 (1.39-1.90)	21	3.62 (2.32-4.11)	1.67 (1.41-2.18)	0.10 (0.03-0.10)
Indian (all meals)	**95**	**8.6 (6.1-10.7)**	**2.30 (1.70-3.20)**	**30**	**2.49 (2.06-3.27)**	**2.93 (1.92-3.59)**	**0.10 (0.06-0.10)**
Chicken korma with pilau rice	10	8.5 (7.6-11.1)	3.92 (3.24-4.97)	10	2.38 (2.01-3.02)	2.48 (1.63-2.94)	0.10 (0.07-0.10)
Chicken tikka massala with keema rice	21	9.6 (8.5-10.8)	3.00 (2.25-4.10)		n/d	n/d	n/d
King prawn rogan josh with pilau rice	22	4.6 (2.8-5.7)	1.20 (0.88-1.80)		n/d	n/d	n/d
Lamb rogan josh with pilau rice	10	7.9 (6.8-9.5)	1.91 (1.71-2.09)	10	2.49 (2.06-3.10)	2.98 (1.92-4.06)	0.10 (0.09-0.10)
Lamb bhuna with chips	22	11.2 (10.4-12.1)	2.50 (2.18-2.63)		n/d	n/d	n/d
Vegetable biryani	10	7.9 (7.2-10.7)	2.17 (1.27-2.91)	10	2.94 (2.05-3.53)	3.42 (2.64-4.42)	0.10 (0.03-0.10)
Chicken tikka massala	3	8.6 (6.7-13.0)	3.07 (3.06-5.67)	3	3.45 (1.71-4.12)	1.57 (1.49-2.36)	0.10 (0.10-0.10)
Lamb rogan josh	3	13.9 (9.7-15.2)	2.48 (1.67-2.51)	3	3.75 (3.68-4.50)	6.81 (3.65-7.41)	0.10 (0.10-0.10)

Notes: n = number of meals for Fat, SFA, n^2 = number of meals for MUFA, PUFA, TFA, n/d = no data

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Meal Type	n	Fat g/100g	SFA g/100g	n^2	MUFA g/100g	PUFA g/100g	TFA g/100g
English (all meals)	**119**	**10.9 (9.3-12.7)**	**4.90 (3.90-5.98)**	**54**	**4.15 (3.67-4.76)**	**0.97 (0.82-1.15)**	**0.07 (0.02-0.10)**
Chicken and chips	25	9.7 (8.5-11.0)	4.60 (3.75-5.00)	3	3.76 (1.05-6.06)	5.31 (1.36-6.24)	0.10 (0.10-0.10)
Fish and chips	64	11.1 (9.6-12.8)	5.53 (4.81-6.63)	42	4.27 (3.93-5.02)	0.96 (0.82-1.15)	0.03 (0.02-0.10)
Chips and curry sauce	9	9.0 (8.0-10.5)	4.21 (3.96-5.12)	9	3.40 (2.80-3.88)	0.86 (0.59-1.11)	0.10 (0.10-0.10)
Mushroom omelette and chips	21	12.5 (10.9-15.1)	3.40 (3.20-3.90)		n/d	n/d	n/d
Chicken nuggets and chips	2	11.5 (7.4-9.8)	2.20 (1.51-1.89)	2	4.47 (2.46-4.33)	4.10 (3.00-3.24)	0.10 (0.08-0.17)
Pizza (all meals)	**65**	**12.1 (10.6-14.0)**	**5.62 (5.00-6.48)**	**31**	**4.08 (3.04-4.61)**	**1.59 (1.30-2.34)**	**0.18 (0.15-0.26)**
Pepperoni Pizza	12	14.3 (10.9-15.0)	5.85 (5.03-7.18)		n/d	n/d	n/d
Seafood Pizza	11	10.7 (9.7-11.4)	4.80 (4.60-5.10)		n/d	n/d	n/d
Margherita Pizza	12	12.8 (10.3-14.0)	6.20 (4.73-7.23)		n/d	n/d	n/d
Ham and Pineapple Pizza	10	9.95 (8.8-11.5)	5.36 (4.62-5.69)	10	2.72 (2.31-3.21)	1.36 (0.94-2.18)	0.18 (0.15-0.30)
Meat Pizza	20	12.9 (12.1-14.7)	5.91 (5.36-6.52)	20	4.31 (3.92-4.69)	1.68 (1.34-2.44)	0.19 (0.14-0.30)
Kebabs (all meals)	**87**	**9.9 (4.9-14.0)**	**4.00 (1.10-6.00)**	**22**	**6.30 (4.96-8.28)**	**1.42 (0.81-2.60)**	**0.54 (0.41-0.89)**
Donner kebab and chips	32	13.3 (11.2-18.1)	5.95 (5.10-7.58)	10	6.30 (5.03-7.88)	2.41 (1.01-3.38)	0.85 (0.53-0.98)
Chicken kebab	22	5.6 (3.7-8.4)	1.05 (0.68-1.60)		n/d	n/d	n/d
Shish kebab	21	4.0 (2.8-5.3)	1.40 (0.85-1.90)		n/d	n/d	n/d
Donner kebab	12	15.6 (12.5-20.4)	6.18 (5.48-8.87)	12	6.27 (4.92-8.29)	1.07 (0.68-1.54)	0.44 (0.41-0.55)

Notes: n = number of meals for Fat, SFA, n^2 = number of meals for MUFA, PUFA, TFA, n/d = no data

Appendix 4.2 – Nutritional composition of takeaway meals - Additional Boxplots

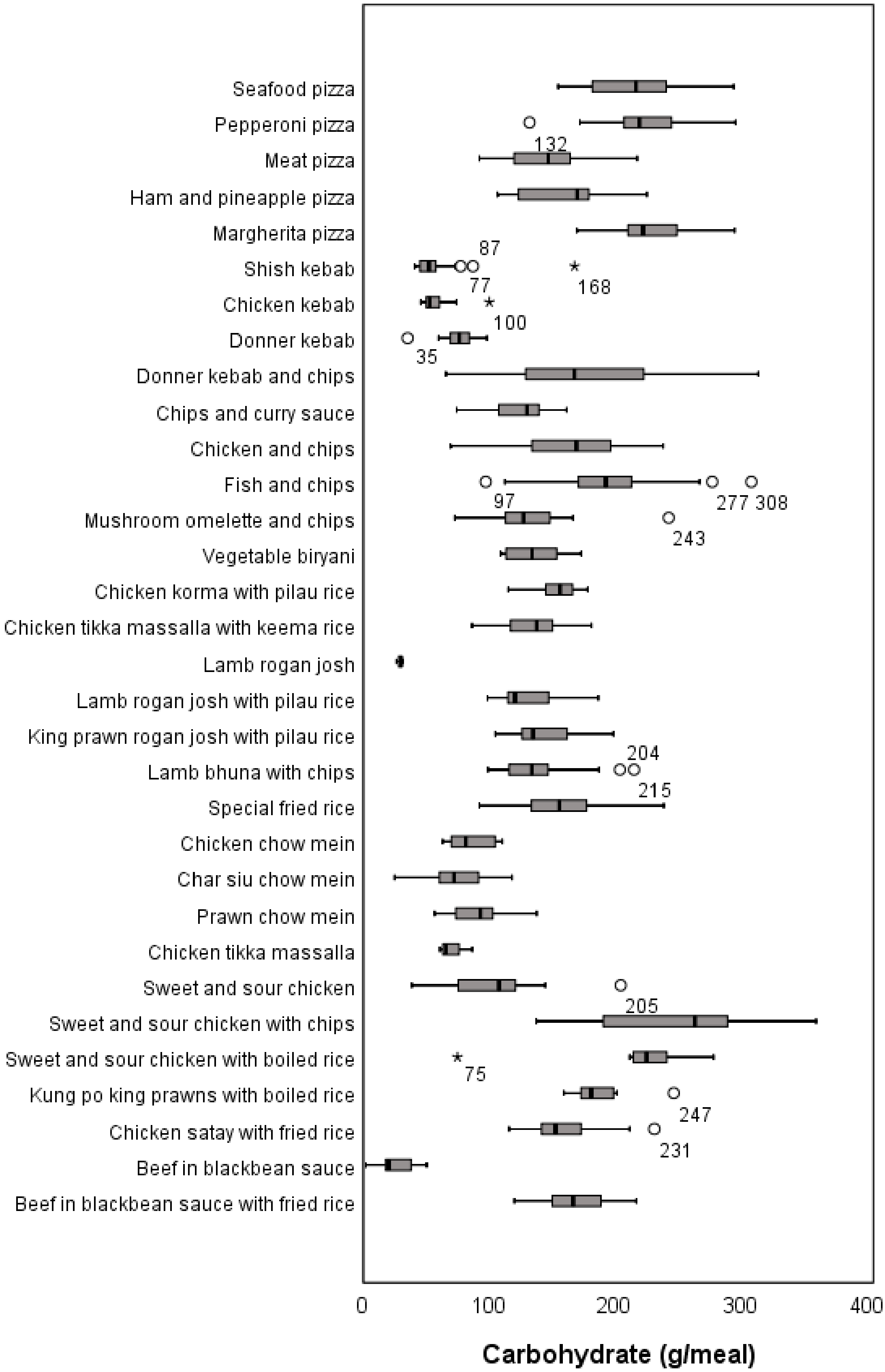

Figure 8.21 Median carbohydrate content per portion for each meal type

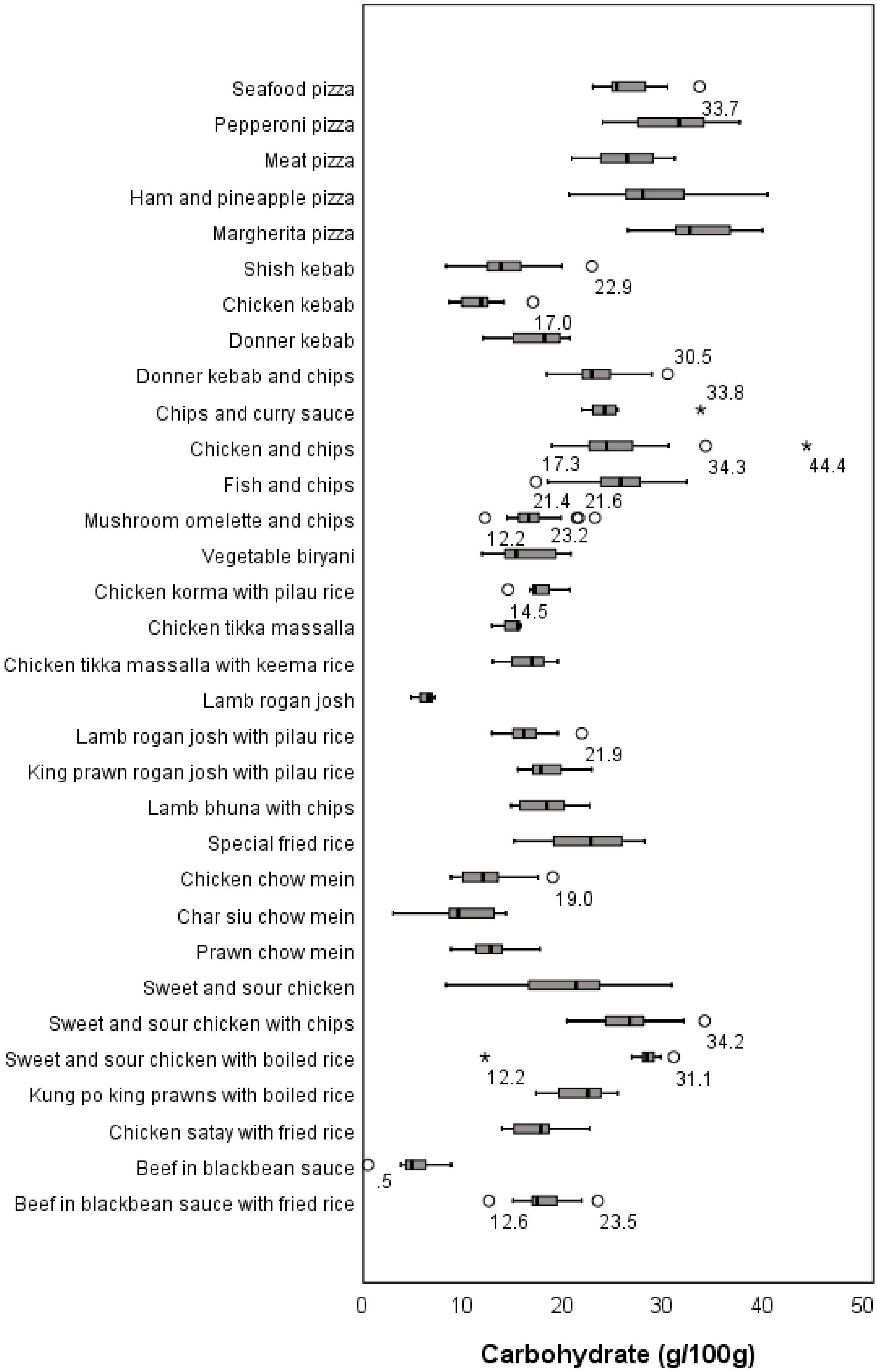

Figure 8.22 Median carbohydrate content per 100g for each meal type

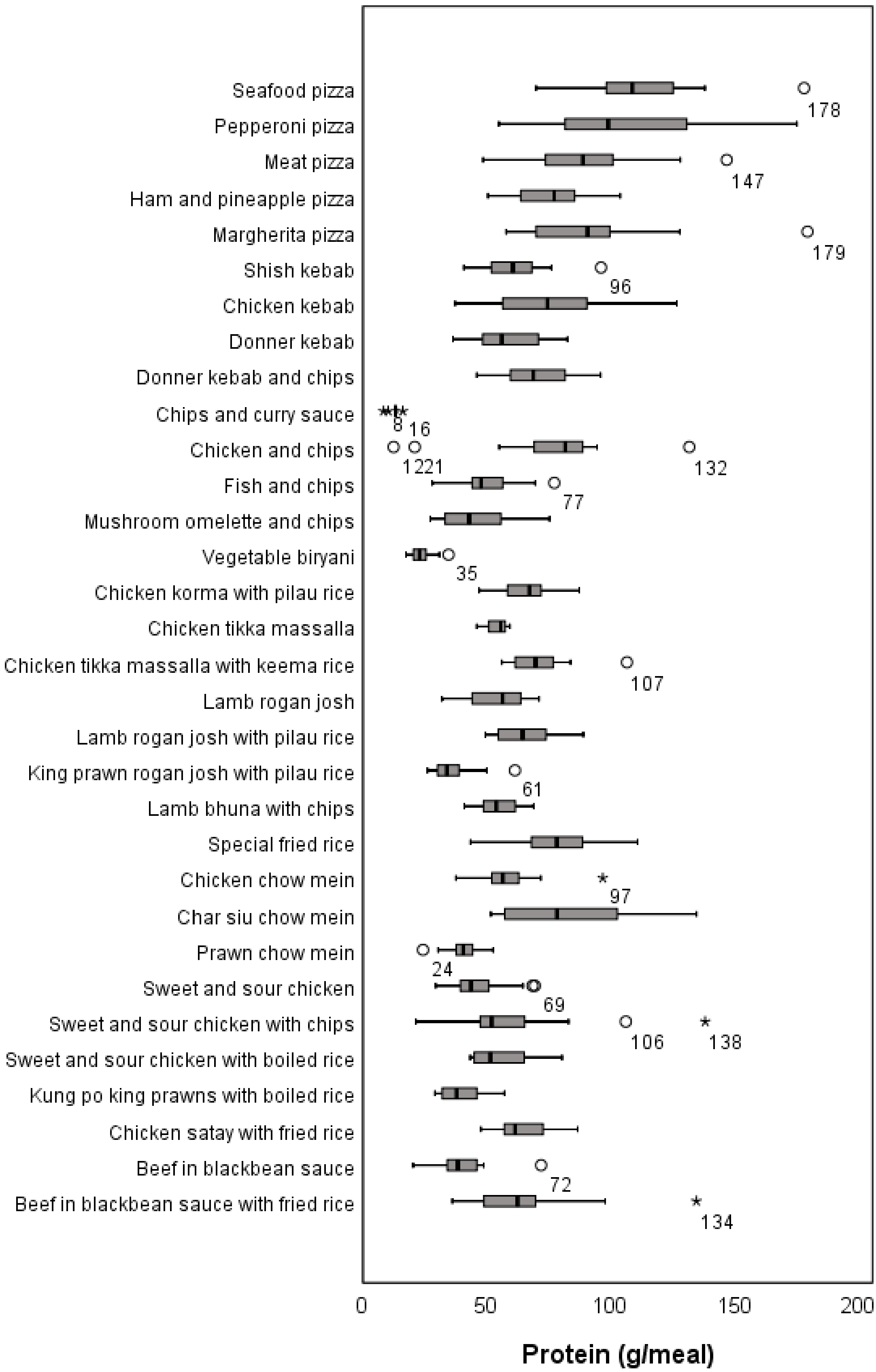

Figure 8.23 Median protein content per meal for each meal type

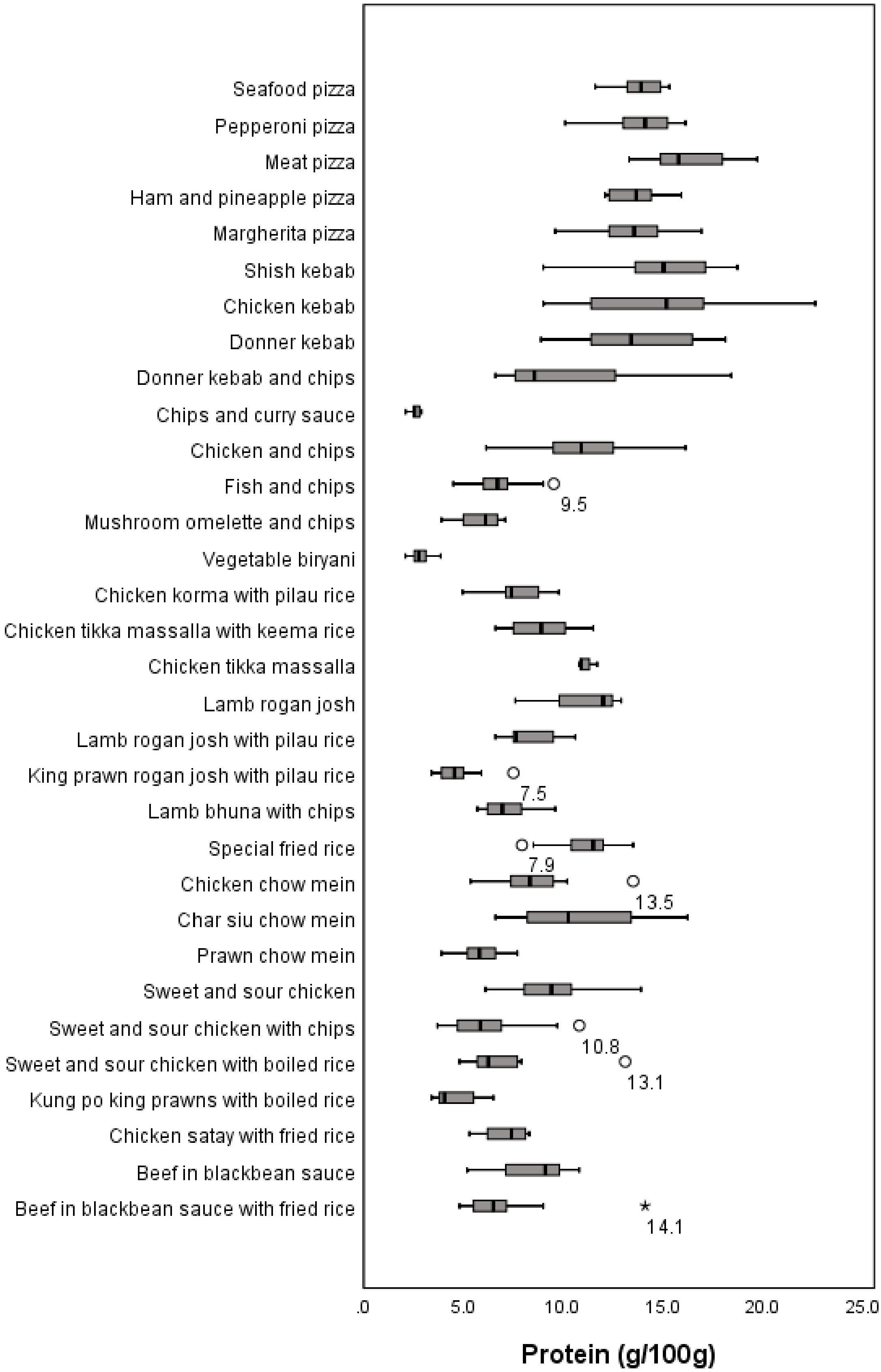

Figure 8.24 Median protein content per 100g for each meal type

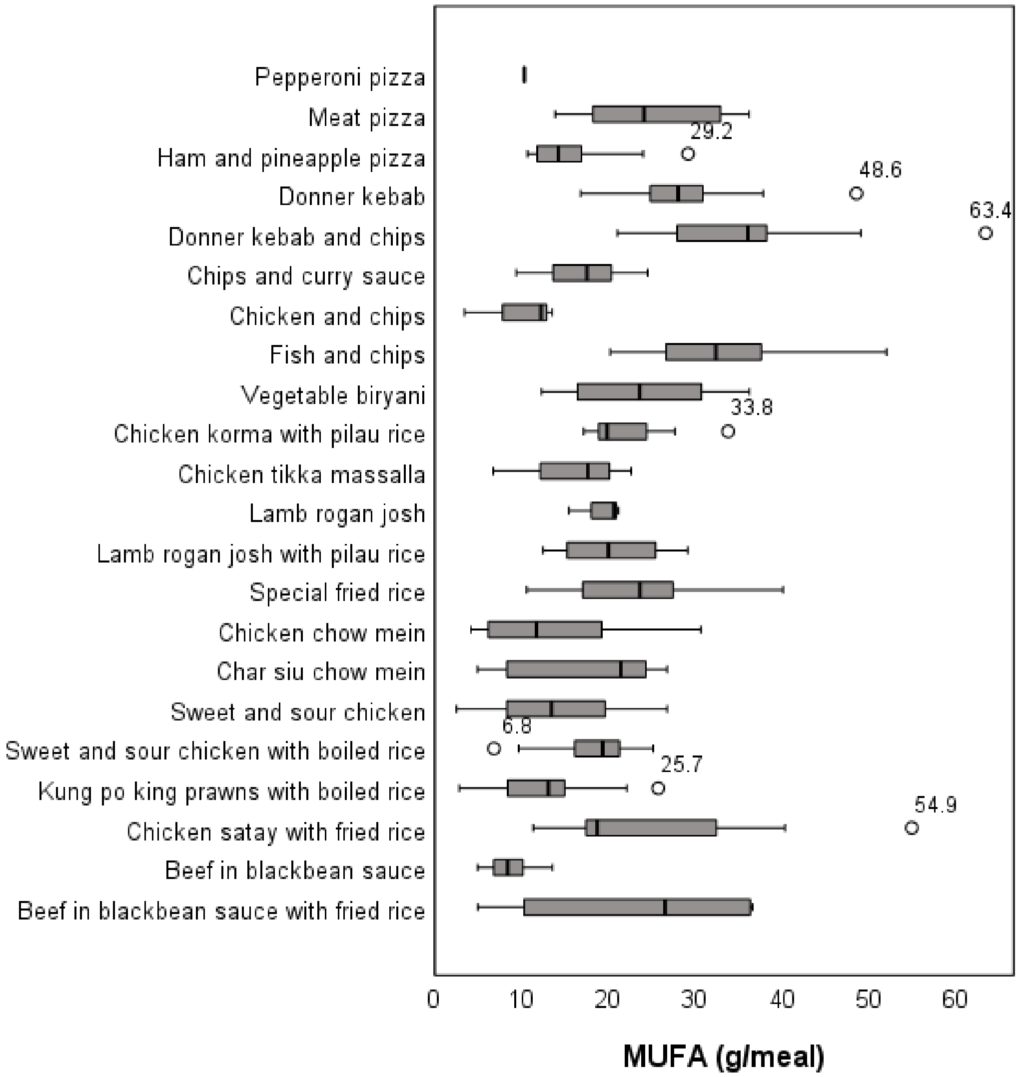

Figure 8.25 Median MUFA content per meal for each meal type

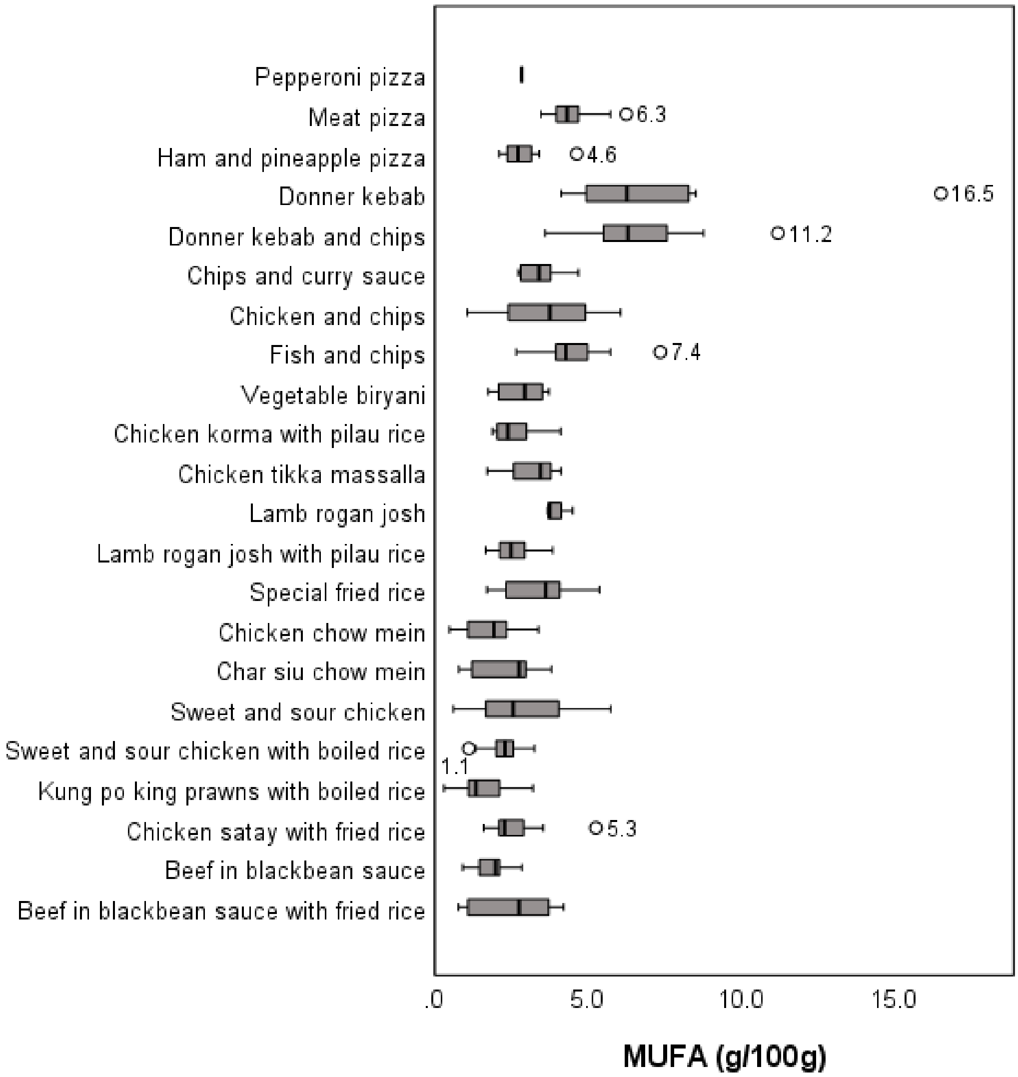

Figure 8.26 Median MUFA content per 100g for each meal type

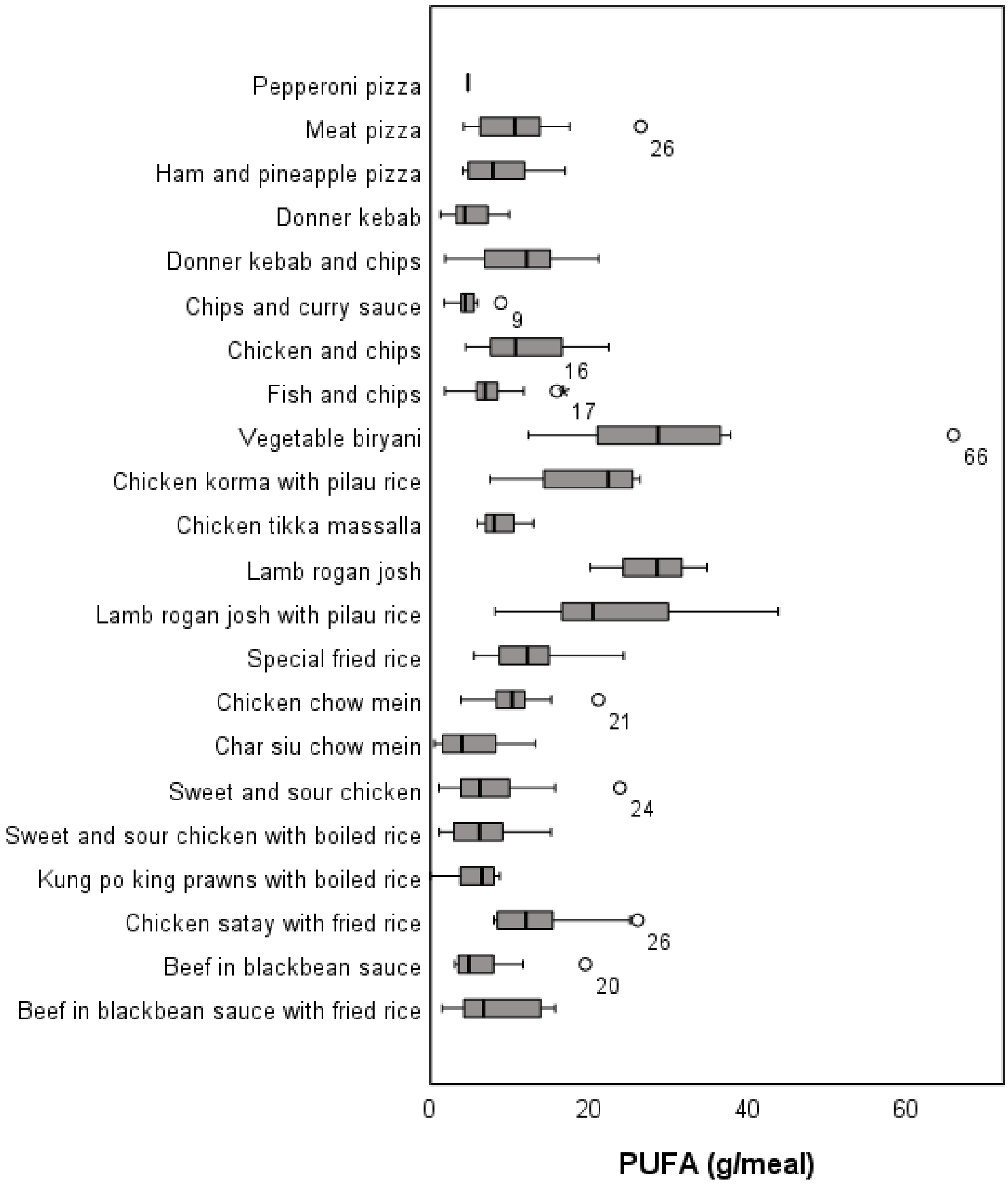

Figure 8.27 Median PUFA content per meal for each meal type

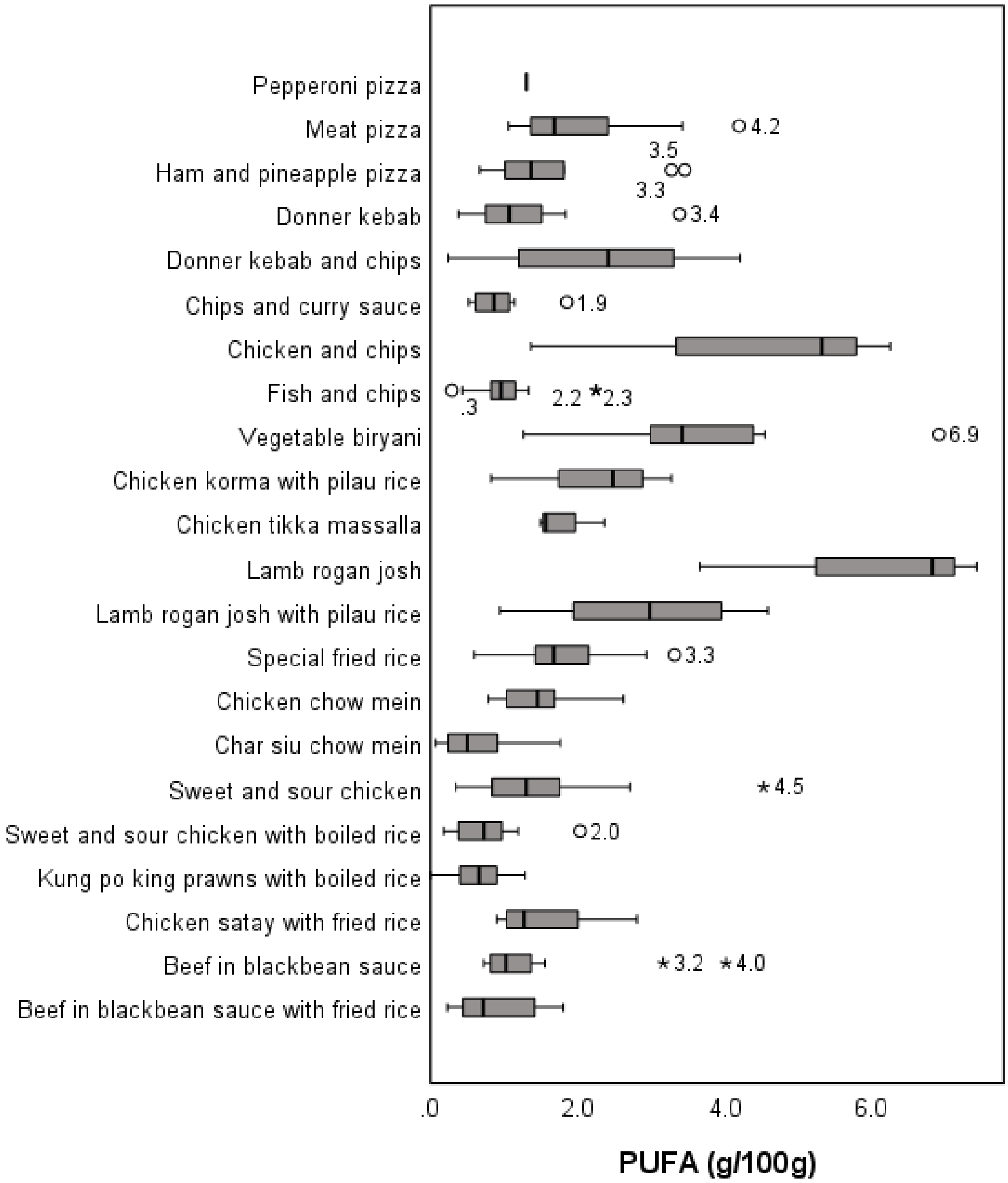

Figure 8.28 Median PUFA content per 100g for each meal type

Appendix 5.0 – Participant Information Sheet - Sensory Evaluation

Takeaway consumption in Merseyside

Dr Ian Davies, Faculty of Education, Community and Leisure

You are invited to take part in the 'Takeaway consumption in Merseyside' project. Before you decide it is important that you understand the purpose of the present study and what it involves. Therefore, please take time to read the following information and decide if you want to take part or not. If there is anything unclear or you would like to obtain more information, please do not hesitate to ask us.

1. **What is the purpose of the study?**

A number of previous studies have reported a generally unhealthy nutritional profile of fast and takeaway foods, which are characterised by a high content of energy, total fat, saturated fatty acids, trans fatty acids and salt. Furthermore, evidence suggests that frequent consumption of such kinds of food is associated with obesity, and an increased risk of diabetes (type 2).
This research will investigate frequency and reasons of takeaway consumption among people in Merseyside. Also, it will evaluate if it is possible to reduce fat and salt content in popular takeaway food.

2. **Do I have to take part?**

No. It is up to you to decide if you would like to take part or not. Participation in the study is absolutely voluntary. Also, if you decide to participate you are still free to withdraw at any time without giving a reason. If you decide to take part you will be asked to sign a consent form.

3. **What will happen to me if I take part?**

You will be asked to take part in sensory evaluation (tasting the meals) of some takeaway meals. This is a simple procedure where you will be given a sample/samples of a meal and asked to rate it based on e.g. taste, flavour and appearance. It should not take more than 10 – 15 minutes.

1. **Are there any risk/benefits involved?**

The proposed study involves sensory evaluation (tasting the meals), and the meals may contain potentially allergic ingredients. However, meals will be fully prepared by an experienced research assistant who will know all ingredients of the meal, thus all participants will be informed before tasting about any potentially allergic ingredients in the meal. Also all meals will be prepared according to Food Hygiene Legislation. (The Food Hygiene (England) Regulations 2006 (SI 2006/14) came into force on 11 January 2006).

There are no personal benefits in participating, however it is hoped that results of the present study will help to understand people attitudes towards takeaways. Your opinion about these selected takeaway meals will be useful in helping to find a strategy to reduce the negative impact of takeaway consumption on public health.

2. **Will my taking part in the study be kept confidential?**

Yes. Any personal information collected during this study will be stored securely on password protected computers or in locked filing cabinets and access to the information will be restricted to myself and two research assistants.
Personal information collected as part of the study will be retained for a period of 3 years following completion of the study and after that will be destroyed.

Contact details of researcher

If you have any questions regarding your participation or the study please do not hesitate to contact us:

Dr Ian Davies
I.Davies@ljmu.ac.uk t: 0151 231 5290

Dr Agnieszka Jaworowska
A.Jaworowska@ljmu.ac.uk t: 0151 231 4639

Ms Toni Blackham
T.Blackham@ljmu.ac.uk t: 0151 231 4639

Liverpool John Moores University
Faculty of Education, Community and Leisure
I.M. Marsh Campus
Barkhill Road
L17 6BD
Liverpool

Appendix 5.1 – Recipe Collection Forms

Eatright Liverpool – Chinese Meals Date: ______________________ Time: ________________

Name of Establishment:_____________________ Name of Dish: Chicken with green peppers and black bean sauce

If possible, please provide sample of cooked dish, takeaway container Please circle Yes or No where appropriate

Are there any written recipes?	Yes	No	
Ingredients	Quantity Weight/gm/mls	Brand Name (if applicable)	Supplier

Pre-preparation	Meat	Vegetables	Sauce	Noodles	Rice	Other
Please explain e.g. quantity of msg in marinade, pre-cooking, frying, salting, marinating, rinsing						

What is the recipe (as observed)			Please write with as much detail as possible, including any additional ingredients added during cooking			
Note: Please state any changes that would be made if this meal was made for more than one customer e.g. estimating quantities *Please pay particular attention to salt/oil/fat/msg/soy-sauce*						
Include details of any home-made sauces:						
Include details of any home-made batter mix:						
Include any details of types and amounts of oil used **during** cooking: e.g. rapeseed, sunflower, palm oil, etc						
Reasons for choosing particular brand sauce or ingredient: e.g. time constraints, cost						
Does the chef add any of the following during cooking:						
	Stock	Salt	MSG	Soy-sauce	Oil	Other
Quantity:						
Cooking method:		(Please tick as appropriate)				
	Meat	Vegetables	Sauce	Noodles	Rice	Other
Stir-Fried						

Deep-Fried						
Baked						
Boiled						
Steamed						
Grilled						

Is anything drained after cooking? (1 not at all - 4 very thoroughly)

e.g. use of slotted spoons, fryer basket shaken, food blotted with kitchen towel

	Meat	Vegetables	Noodles	Rice	Other	
How thoroughly						
Cooking times						

Overall cooking time				
How are portion sizes estimated?				
Containers used	Polystyrene	Plastic	Foil + Card	Other
Lined with greaseproof paper		Yes	No	
Shift Patterns - how many chefs could prepare the meal?				
Do they each follow their own recipe?				
If yes, how do they potentially differ?				
How is the meal served:				
Potential additions at the counter e.g. soy sauce, salt and vinegar				
Additional requests the consumer may make e.g. extra sauce, sauce on the side				

Sensory Evaluation

Write meal type here

Participant number______ Sample Number_______ Date____________

Rating	Sensory Attribute					
	Appearance	**Aroma**	**Flavour**	**Mouthfeel**	**Aftertaste**	**Overall Acceptability**
Like extremely	9	9	9	9	9	9
Like very much	8	8	8	8	8	8
Like moderately	7	7	7	7	7	7
Like slightly	6	6	6	6	6	6
Neither like nor dislike	5	5	5	5	5	5
Dislike slightly	4	4	4	4	4	4
Dislike moderately	3	3	3	3	3	3
Dislike very much	2	2	2	2	2	2
Dislike extremely	1	1	1	1	1	1

State one aspect of the dish you like……………………………………………………………………….

………

………

State one aspect of the dish you dislike…………………………………………………………………….

………

………

Would you be satisfied if you bought this dish from a takeaway (Yes/No)?..

How do you rate this dish in terms of saltiness?

Too salty ☐ Right level of salt ☐ Not salty enough ☐

Other comments………………………………………………………………………………………

For the sample provided for you to taste, please tick one box which best describes your overall opinion.

Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither Like nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely

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Sensory Evaluation

E.g. Chicken Sweet and Sour with Egg Fried Rice

Participant number______ Sample number ________ Date______________

Rating	Sensory Attribute					
	Appearance	Aroma	Flavour	Mouthfeel	Aftertaste	Overall Acceptability
Like extremely	9	9	9	9	9	9
Like very much	8	8	8	8	8	8
Like moderately	7	7	7	7	7	7
Like slightly	6	6	6	6	6	6
Neither like nor dislike	5	5	5	5	5	5
Dislike slightly	4	4	4	4	4	4
Dislike moderately	3	3	3	3	3	3
Dislike very much	2	2	2	2	2	2
Dislike extremely	1	1	1	1	1	1

State one aspect of the complete dish (e.g. blackbean chicken and fried rice together) you like ……………………………………………………………………………………………………….

……

State one aspect of the complete dish (e.g. sweet & sour chicken and fried rice together) you dislike……………………………………………………………………………………………..

……

Please state any comments about the individual elements of the dish……………………………..

……

Would you be satisfied if you bought this dish from a takeaway? (Yes/No)..........................

How do you rate this dish in terms of saltiness?

Too salty ☐ Right level of salt ☐ Not enough salt ☐

Other comments……………………………………………………………………………………

……

……

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Appendix 5.3 – Recipe Guidelines for Black Bean meals

1. To make the meal healthier, try adding some extra vegetables.

   ✓ for example, peppers, onions, carrots, mushrooms, bamboo shoots, beansprouts, broccoli, baby sweetcorn.

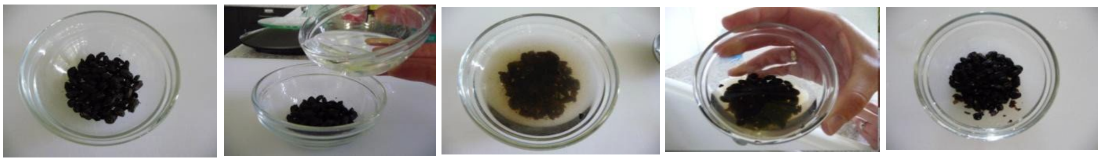
   ✓ When using tinned vegetables, always rinse them first as they are preserved in salt water (brine)

2. When preparing homemade black bean pastes, **soak** and **rinse** black beans thoroughly

   ✓ Rinsing can reduce their salt content by approximately 50%

   1 tablespoon of black beans could contain as much as 2g of salt

   - if rinsed this could be reduced to less than 1g of salt



Black beans   Add Water   Soak   Rinse   Drain

3. Avoid adding salt as an ingredient. Salt is 'hidden' in other ingredients including:
   - MSG
   - soy sauce
   - oyster sauce
   - black bean sauce/paste
   - stocks and seasonings

4. Use measuring spoons to measure all ingredients carefully.

   - ✓ A healthier meal should contain less than 2.4g of salt.

5. When buying ingredients choose ones with reduced salt or reduced sodium content.

   - ✓ For example, reduced salt soy sauce contains 25% less salt, but can cost the same as standard soy sauces.

   - ✓ When using salt, consider using salt with a lower sodium content

6. When buying meat or chicken stocks or seasonings, chooses ones without monosodium glutamate (MSG) in the ingredients list.

7. When stir frying meat and vegetables, use a minimal amount of oil, and drain off any excess.

   - ✓ Try coating the surface of the wok with one teaspoon of oil.
   - ✓ Try steaming vegetables to reduce the amount of fat in the meal.

8. Instead of shallow or deep-frying chicken, poach chicken in unsalted boiling water.

   - ✓ This will make the meal healthier, by reducing the amount of fat.

9. When using chicken, remove the skin where possible and trim off any visible fat.

10. When using red meat, use lean meat where possible and trim off any visible fat.

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Appendix 5.4 – Recipe Guidelines for Egg Fried Rice

1) Use measuring spoons to measure salt, MSG, and soy sauce carefully.

2) When stir frying rice, minimise the amount of vegetable oil added to the wok and drain of any excess
   - ✓ Try coating the surface of the wok with one teaspoon of vegetable oil.

3) To make a healthier egg fried rice
   - ✓ Try adding some vegetables, for example peas, mushrooms, sweetcorn

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Reply | Reply All | Forward

Wed 28/06/2023 15:39

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S Paul
Public Liaison Unit

NHS health information and advice about coronavirus can be found at nhs.uk/coronavirus

The GLA stands against racism. Black Lives Matter.

Permission to use Figure 2.6 Impacts of FFO proliferation and opportunities for action (London Food Board, CIEH and Mayor of London, 2012)