Can independent takeaways change to offer healthier food? An exploration of the challenges for independent takeaways and public health

Thesis submitted for the degree of Doctor of Philosophy

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March 2018

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Abstract

Background

Meals from independent takeaways in the UK are generally characterised by large portion sizes and contain high levels of energy and salt. Regular consumption is associated with weight-gain, obesity and diet-related diseases. It has been suggested that low-agency interventions that reduce the obesogenic nature of our food environments have the potential to equitably improve dietary intake at population level. The research described in my thesis sought to: determine the frequency and socio-demographic correlates of eating takeaway meals and the association between habitual consumption of such meals and daily energy intake; identify the operational challenges of intervention delivery in takeaway contexts; and evaluate interventions targeted at takeaways for feasibility, acceptability, and, where possible, potential impact.

Methods

A multi-method approach was used. The UK National Diet and Nutrition Survey (NDNS) was analysed to identify frequency and socio-demographic correlates of those eating takeaways and the relationship between habitual consumption and mean daily energy intake. Subsequent studies included: interviews with practitioners with experience of delivering interventions in takeaways; testing of a salt reduction intervention that used a reduced-holed salt shaker; and mixed-method evaluation of the feasibility and acceptability of two interventions to improve the availability of healthier takeaway meals, one multi-criteria local authority-led and one promoting smaller portion meals led by an industry supplier.

Results

Analyses of NDNS data showed that 20% of adults ate takeaways at least once per week. The proportion of all participants eating takeaway meals regularly was highest in young adults (19–29 years). For children, more boys than girls were regular consumers, with consumption most prevalent in children from less-affluent households. Children and adults who ate takeaways regularly consumed more per-day than those who ate rarely. In children, there was an interaction with socio-economic position, where greater frequency of consumption of takeaway meals was associated with higher mean daily energy intake in those from less-affluent households.

The perceived barriers to implementation of interventions to improve food offered by takeaways were limited funding and difficulties engaging with traders. The perceived facilitators of increasing the potential effectiveness of interventions were delivering intensive, interactive and tailored interventions with clear and specific information, and providing setting specific incentives, whilst accounting for practical, primarily financial, constraints of running a takeaway.

A reduced-holed shaker (5-holed) delivered on average 33.7% of the salt of a traditional shaker (17-holed) in controlled conditions. However, in takeaways there was no difference in absolute sodium content of meals, despite the relative sodium content being significantly lower in meals served using the reduced-holed shaker.

The recruitment rate for the local authority-led training intervention was low. Among those attending, the changes subsequently made were those that required minimal effort or cost to the business. Least popular changes included the use of products more difficult to source from suppliers or perceived to be unpopular with customers. The supplier-led intervention achieved a higher recruitment rate, with those takeaways followed-up reporting an increased proportion of smaller portion meals sold.

Discussion

UK independent takeaways are ubiquitous and broadly provide a nutritionally poor offering. As a nation, we are high consumers of takeaway food and for many they constitute a component of their habitual diet. Interventions that require the voluntary engagement of traders are unlikely to yield significant improvements in the nutritional quality of the food. Further work should explore upstream structural policy-led interventions that require individuals to use a low-level of agency to benefit, as these interventions are established to have a greater impact and are more likely to reduce existing health inequalities.

Dedication

To my mother, Sarah Carolyn Goffe.

Mother I have learned enough now

To know I have learned nearly nothing.

Let me thank you

That my selfishness, ignorance, and mockery

Did not bring you to

Discard me like a broken doll

Which had lost its favour.

I thank you that

You still find something in me

To cherish, to admire, and to love.

I thank you, Mother.

I love you.

[Maya Angelou, Mother – a cradle to hold me]

Acknowledgements

The work I present here would not have been possible without the collaboration and support of many individuals and organisations. Many of the publications and related outputs are a direct result of the Foodscape study, led by Ashley Adamson and funded by the NIHR School for Public Health Research. As a result of this project I was fortunate to work alongside and benefit from the knowledge and experience of Martin White, Frances Hillier-Brown, Amelia Lake, Carolyn Summerbell, Vera Araujo-Soares and Wendy Wrieden. I would additionally like to single out Linda Penn, for her detailed and diligent guidance with regards the qualitative work, and my closest collaborator throughout, Jean Adams, whose knowledge, expertise, and detail feedback has been invaluable.

Both my PhD and the Foodscape project have benefited from numerous external research partnerships. I would like to thank Louise Muhammad, Kirklees Council, for her ingenuity and eternal optimism in researching, developing, and delivering ever inventive ways to improve the healthiness of the food in her community in West Yorkshire. Matthew Worsnop and Duncan McLean at Henry Colbeck Ltd. for their openness to engage and valuable insight and contacts within their industry.

Critically, much of the work reported here, is either a direct result of, or stems from ideas developed by Peter Wright and his team at Gateshead Council. He is far too modest to detail the extent of his work that he has done to improve the health of both the people of Gateshead and the wider North-East of England. He is my unofficial fourth supervisor and I am personally indebted to him for his time, advice and insight.

I would like to thank Andy Close, Mark Shirley, Zelda Van Der Waal and Alasdair Blain in the systems modelling group within the School of Natural and Environmental Science for their statistical support throughout the course of my studies. I would also like to thank Roy Sanderson for providing me with the first opportunity in science research and Payam Dadvand for encouraging me to take on a PhD.

It was a privilege to spend the majority of my studies within the Public Health Nutrition research group within Newcastle University. It is a wonderful community of researchers who share a passion for both the research and the fun side of food. I had conversations with Joel Halligan, Suzanne Spence and Wendy Wrieden that went from the frivolous to serious and back again resulting in numerous research, recipe, and restaurant ideas. And of course I am greatly indebted to both Sue Bell and Karen Patterson for their know-how and organisational skills.

I would like to thank my three supervisors Ashley Adamson, Martin White and Steve Rushton for their guidance, support and the excellent training programme they delivered. They have kept me employed throughout my studies and provided a wealth of exciting challenges and opportunities and critical feedback that I hope have made me a well-rounded researcher.

Finally, I would like to thank my parents Tim & Sarah and my wife Kayoung for their love, encouragement and unfaltering support in helping to make this thesis a reality.

Declaration

I declare that this doctoral statement is my own work and that I have correctly acknowledged, where appropriate, the contributions of others, in accordance with Newcastle University and Institute of Health & Society guidance on good academic conduct. No part of the material offered has been previously submitted for a degree or other qualification in this or any other university. My individual contributions to all jointly-authored published works are detailed both within each publication and the appropriate co-authorship forms.

Signature: 

Date: 29 March 2018

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Foodscape project

Much of the academic work that has contributed to my doctoral submission was completed while employed as a researcher on the NIHR School of Public Health Research (SPHR) funded project '*Transforming the foodscape: development and feasibility testing of interventions to promote healthier takeaway, pub or restaurant food*', henceforth referred to as the 'Foodscape' project. This project, led by Professor Ashley Adamson, was a three-year, multi-institution collaboration that aimed to identify potentially effective interventions or intervention components in the out-of-home catering sector, based on current theory and evidence, and test them for feasibility and acceptability, leading to pilot testing of effectiveness and, ultimately, the development of protocols for definitive outcome evaluations [1].

Consent and ethical approval

All the fieldwork that is reported, as part of the Foodscape study, received ethical approval by the Newcastle University Research Ethics Committee, application numbers: 00761/2014, 00835/2014 and 05025/2016. All participants provided written informed consent prior to participation where appropriate. All information sheets and consent forms are detailed in Appendix A.

Ethical approval for the UK National Diet and Nutrition Survey was obtained from the Oxfordshire A Research Ethics Committee. Additional ethical approval was not required for the secondary analysis of the anonymised data.

Thesis outputs

My thesis is based on the work in the following published papers and manuscripts under review:

Published papers (PP)

PP1. Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK national diet and nutrition survey, waves 1-4 (2008-12). Adams J, **Goffe L**, Brown T, Lake AA, Summerbell C, White M, Wrieden W, Adamson AJ. *International Journal of Behavioral Nutrition and Physical Activity* 2015, **12**(51).

PP2. Relationship between mean daily energy intake and frequency of consumption of out-of-home meals in the UK National Diet and Nutrition Survey. Goffe L, Rushton S, White M, Adamson A, & Adams J. *International Journal of Behavioral Nutrition and Physical Activity* 2017, **14**(131).

PP3. Prevalence and socio-demographic correlates of cooking skills in UK adults: cross-sectional analysis of data from the UK National Diet and Nutrition Survey. Adams J, **Goffe L**, Adamson AJ, Halligan J, O'Brien N, Purves R, Stead M, Stocken D, White M. *International Journal of Behavioral Nutrition and Physical Activity* 2015, **12**(99).

PP4. The challenges of interventions to promote healthier food in independent takeaways in England: qualitative study of intervention deliverers' views. Goffe L, Penn L, Adams J, Araujo-Soares V, Summerbell CD, Abraham C, White M, Adamson A & Lake AA. *BMC Public Health* 2017 **18**(184).

PP5. Reducing the salt added to takeaway food: within-subjects' comparison of salt delivered by five and 17 holed salt shakers in controlled conditions. Goffe L, Wrieden W, Penn L, Hillier-Brown F, Lake AA, Araujo-Soares V, Summerbell C, White M, Adamson AJ & Adams J. *PLOS ONE* 2016, **11**(9).

PP6. Comparison of sodium content of meals served by independent takeaways using standard versus reduced holed salt shakers: cross-sectional study. Goffe L, Hillier-Brown F, Doherty A, Wrieden W, Lake AA, Araujo-Soares V, Summerbell C, White M, Adamson AJ & Adams J. *International Journal of Behavioral Nutrition and Physical Activity* 2016 **13**(102).

Manuscripts under review (MUR)

MUR1. Feasibility and acceptability of a Takeaway Masterclass aimed at encouraging healthier cooking practices and menu options in takeaway food outlets. Hillier-Brown F, Lloyd S, Muhammad L, Summerbell C, **Goffe L**, Hildred N, Adams J, Penn L, Wrieden W, White M, Lake AA, Moore H, Abraham C, Adamson A, & Araujo-Soares V. *In submission to Public Health Nutrition* December 2018.

MUR2. Feasibility of working with a wholesale supplier to co-design and test acceptability of an intervention to promote smaller portions: an uncontrolled before-and-after study in British Fish & Chip Shops. Goffe L, Hillier-Brown F, Hildred N, Worsnop M, Adams J, Araujo-Soares V, Penn L, Wrieden W, Summerbell C, Lake AA, White M, Adamson A. *Accepted by BMJ Open* December 2018.

Published conference abstracts

- **What Factors Drive Unhealthy Diet? Novel Analysis of Food Frequency Questionnaire Data using Canonical Correspondence Analysis**. **Goffe LA**, Rushton SP, White M. *In: Society for Social Medicine 57th Annual Scientific Meeting*. 2013, Brighton and Sussex Medical School, Brighton and Hove, UK: BMJ Publishing Group.
- **"Takeaways Are Not The Enemy": A Qualitative Study Of Intervention Deliverers' Experience With Out-Of-Home Food Outlets (Transforming The Foodscape Study)**. **Louis Goffe**, Linda Penn, Jean Adams, Ashley Adamson, Vera Araujo-Soares, Martin White, Wendy Wrieden, Amelia Lake. *International Society for Behavioral Nutrition and Physical Activity 2015*, Edinburgh.
- **Prevalence and socio-demographic correlates of cooking skills in UK adults: cross-sectional analysis of data from the UK National Diet and Nutrition Survey**. Adams J, **Goffe L**, Adamson AJ, Halligan J, O'Brien N, Stead M, Stocken D, White M. *International Society for Behavioral Nutrition and Physical Activity 2015*, Edinburgh.
- **Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK National Diet and Nutrition Survey, waves 1-4**. Adams J, **Goffe L**, Brown T, Lake AA, Summerbell C, Wrieden W, White M, Adamson A. *International Society for Behavioral Nutrition and Physical Activity 2015*, Edinburgh.

- **The emerging role of takeaway Online Ordering Platforms: A qualitative study of vendors' and customers' experiences**. **Goffe L**, Obertelli G, Wrieden W. *UKCRC Public Health Research Centres of Excellence Conference*, 2015.
- **Out-of-home fish and chip consumption in the UK population.** Wrieden WL, Mangwende P, **Goffe L**. *Proceedings of the Nutrition Society 2016*, 75 (OCE3), E264

Other presentations

- **Takeaway engagement: Ways to bait the vendor**. **Goffe L**. *North East Obesity Forum meeting, 'Is fast-food the fast track to obesity?'* October 2015, Teesside University.
- **Assessing the feasibility of delivering and evaluating an intervention to improve portion control and increase small portion availability in traditional British fish and chip shops: a natural experiment**. **Goffe L**. *Human Nutrition Research Centre, Research Day & Annual Lecture, Newcastle University*, October 2016.
- **Assessing the feasibility of delivering and evaluating an intervention to improve portion control and increase small portion availability in traditional British fish and chip shops: a natural experiment**. **Goffe L**. *Agriculture, Food and Rural Development seminar series, Newcastle University*, November 2016.

Other notable outputs

- **Organiser**. More than enough on our plates: tackling the takeaway food diet at source. *Fuse Quarterly Research Meeting*, 2015, Gateshead.
- **Invitation to participate.** Expert panel: to help inform the development of new Toolkit to improve the healthiness of the food and drink offer from independent 'out-of-home' businesses. *Public Health England*, 2016.

Abbreviations

BMI – Body mass index

CVD – Cardiovascular disease

DH – Department of Health (UK Government)

EHO – Environmental health officer

GIS – Geographical information system

GLM – Generalized linear models

HCC – Healthier Catering Commitment

HSS – Hole salt shaker

NDNS – National Diet and Nutrition Survey

NCDs – Non-communicable diseases

NHANES – National Health and Nutrition Examination Survey

NIHR SPHR – National Institute for Health Research's School of Public Health Research

OOP – Online ordering platform

PHRD – Public Health Responsibility Deal

SACN – Science Advisory Committee on Nutrition

SDIL – Soft Drinks Industry Levy

SEP – Socio-economic position

SPD – Supplementary Planning Document

WHO – World Health Organisation

Chapter 1. Why is takeaway food a public health problem?

1.1 The burden of diet related disease and obesity

The World Health Organisation (WHO) has highlighted the importance of both diet and nutrition in maintenance of good health across an individual's life course [2]. They are determinants of weight gain and obesity, and numerous chronic non-communicable diseases (NCDs), including diabetes, cardiovascular disease (CVD), cancer, dental disease, and osteoporosis [2]. The results of the 2016 Global Burden of Disease found that all forms of malnutrition, inclusive of poor dietary habit, was the leading risk factor for mortality globally. Poor dietary habits alone accounted for almost one in every five deaths, with an overall burden of 14.8% attributable to dietary risk factors, and key individual risks included diets low in whole grains, low in fruits and high in sodium [3]. Analysis of the burden of disease in England, dietary risks was ranked as the second leading factor contributing to years of life lost, accounting for a population attributable fraction of 14.41% [4]. A global study of 154 countries and 8.69 million participants, estimated that between 1990 and 2015 the prevalence of elevated systolic blood pressure had increased substantially, which was associated to an increase in disability-adjusted life-years and deaths [5].

The 1980s saw a significant increase in the global prevalence of overweight and obesity [6]. The WHO estimated that globally in 2014 more than 1.9 billion adults were overweight (39%), of these more than 600 million (13%) were obese [7]. Corresponding figures for England show a substantially higher prevalence in the same year; the Health Survey for England estimated that 61.7% of adults were overweight or obese and 25.6% were obese [8].

Obesity is a known risk factor for many non-communicable diseases, including type 2 diabetes [9], coronary heart disease [10], some types of cancer [11] and stroke, [12] and is associated with significantly higher all-cause mortality [13]. As a result, its impacts on quality of life and economic consequences are substantial. In 2007, it was estimated that the costs of overweight and obesity in the UK exceeded £20 billion: £4.2 billion directly attributable to the National Health Service and £15.8 billion to wider society and business [14]. These figures are predicted to rise to £9.7 billion and £49.9 billion respectively by 2050 [14]. A separate study by Scarborough et al. for the same time period estimated the cost directly

attributable to the NHS from poor diet at £5.8 billion [15]. A modelling study by Huffman et al. (2013) estimated the impact on mortality of an improvement in six known modifiable risk factors of coronary heart disease in the United States. They modelled a 20% improvement in six cardiovascular health metrics, three of which are closely associated with diet: total cholesterol, systolic blood pressure and obesity. They predicted that each would be responsible for 41,000, 36,000 and 5,000 few deaths respectively in the year 2020 [16].

1.2 Obesogenic Environments

An individual's weight status cannot be attributed to one single factor but it is the result of interactions between their living and working environments [17], their genetics [18] and their behaviours, both diet (energy intake) [19] and physical exercise (energy expenditure) [20]. Recent evidence suggests that individuals with a variant in the FTO gene are more likely to be overweight [21] and there are certain rare congenital anomalies such as leptin deficiency [22] and Prader-Willi syndrome [23], where individuals lack the feeling of satiation and are therefore at high risk of weight gain. However, despite such genetic predisposition, in the vast majority of individuals, obesity is largely environmentally determined and therefore potentially preventable.

To date, in the UK most national policy and other interventions for both prevention and treatment of obesity have focused on the individual. As recently as 2011, the Department of Health (DH) published 'Healthy Lives, Healthy People: A call to action on obesity in England'. This document set out the UK Government's approach to public health regarding obesity. In which, the then UK Secretary of State for health, Andrew Lansley, stated that '*We need to be honest with ourselves and recognise that we need to make some changes to control our weight…*' and that '*Each of us is ultimately responsible for our health*' [24]. For the most part, and particularly for adults, the UK Government's emphasis on the *individual* disregards the growing body of evidence which suggests that the *environments* in which we live play significant roles in determining our health and weight status [25]. The apportioning of blame for obesity may be a philosophical issue [26]. However, effective methods for reducing obesity at a population level are not, and critically it is simply the case that the individually focused approaches have had little impact to date [27].

Personalised treatments may be effective in supporting positive change for an individual with obesity, but there is broad consensus that a whole systems approach is required to address the many inter-relating causes that lead to overweight and obesity at the population level [28]. A key component of this approach should be to understand and identify modifiable factors in our environment for which there are established, evidence-based associations for either side of the energy balance equation that leads to obesity:

Energy in (intake): *increased food energy consumption*

Energy out (expenditure)*: reduced physical activity*

Environmental factors associated with expenditure of energy, are weak, particularly in adults [29, 30]; there is marginally more evidence regarding associations between food environments and obesity [31], but both contribute to what are termed 'obesogenic environments' [32].

In 1997, Egger & Swinburn made a case for an ecological approach to the obesity pandemic, where they presented a model that *'suggests that the driving force for the increasing prevalence of obesity in populations is the increasingly obesogenic environment rather than any 'pathology' in metabolic defects or genetic mutations within individuals'* [33]. With regards to our food environment, there are those that have hypothesised that 'food deserts', populated urban areas where residents do not have access to an affordable and healthy diet [34], could be contributing to the obesogenic environment. However, there is limited evidence that such a phenomena exists in the UK [35], but conversely there is an increasing body of evidence that a high density of access to unhealthy food that surrounds certain, predominantly deprived communities, is associated with increased prevalence of obesity [36]. As a result, there are those that have suggested that the term 'food swamps' better characterises areas where residents are at an increased risk of obesity and other diet related diseases [37].

1.3 UK Government intervention strategies to create a healthier food environment

In March 2011 the DH launched the Public Health Responsibility Deal (PHRD). The stated aim, was to work collaboratively with the commercial sector to create '*the right environment [that] can empower and support people to make informed, balanced choices that will help them lead healthier lives*' [38]. Businesses were asked if they would like to commit to specific

'pledges'. These pledges were split into four categories: alcohol, health at work, physical activity, and food. The food pledges included objectives related to calorie and specific nutrient reduction, nutritional labelling and fruit and vegetable consumption [38]. Independent evaluation of the food pledges, from this public-private partnership, found that it was difficult to establish the quality and extent of implementation. In most cases businesses selected pledges that were either already underway or easily achievable, and critically the PHRD had avoided proposing strategies that were most effective in improving diet [39].

In 2016, George Osborne, UK Government's Chancellor of the Exchequer (finance minister), announced in his March Budget that there would be a levy on sugary drinks to be applied from April 2018, known as the 'Soft Drinks Industry Levy' (SDIL) [40]. The introduction of the SDIL marked a shift from voluntary approaches to statutory legislation designed to improve dietary behaviours and so intake. This greater acknowledgement by the UK Government of the role of the food environment has continued. In September 2016, Jeremy Hunt, UK Secretary of State for Health, told a private meeting with more than 100 food companies that '*Going out to eat is no longer a treat. It's a regular habit for many families and is contributing significantly to the extra calories and sugar that we all consume on a daily basis'* [41]. It was reported that Hunt provided companies with three options: reduce sugar content; reduce portion sizes; or shift citizens to healthier alternatives [41]. However, no details of how or if these proposed options will be enforced have been released.

The SDIL was incorporated as the flagship initiative of the Government's childhood obesity action plan. The plan also included a target to remove 20% of sugar across nine food categories, to be led by Public Health England and applied to all sectors of the industry, including of the out-of-home sector [42].

1.4 The problem of takeaway food

In 2003, an analysis of their nutritional composition found that meals from leading fast-food chains were 65% more energy dense (available dietary energy per unit weight [43]) than the average British diet [44], leading the authors to hypothesize that regular consumers are likely to be consuming excess calories promoting weight gain, and therefore potentially leading to obesity. While the large international chain restaurants have been the target for

much criticism with regards to the nutritional composition of their menus, a US study published in 2013, found that in independent and small-chain restaurants that provided no nutritional information, meal energy content was on average 49% higher than in popular meals from cuisine-comparable national chains [45]. In 2014, a study that analysed multiple samples of 27 different 'takeaway' meals from independent takeaway outlets in the North-West of England, found that the majority of meals were excessive, with regards to UK dietary recommendations for portion size, energy, macronutrients and salt [46]. Furthermore, independent takeaway outlets have proved to be a highly challenging setting to deliver dietary interventions [47]. Evaluation of one such scheme found that some takeaway businesses had difficulty with making simple changes, such as changing the type of oil used in food preparation. The author also found that that any proposed change to a healthier alternative that potentially resulted in a price increase, were particularly resisted by businesses located in deprived communities [48].

1.5 Action required

Whilst the specific details regarding the implementation and enforcement of suggested improvements to out-of-home food environment are currently unclear, there is an acknowledgement by Government ministers [41], Public Health England [49, 50], and the DH [24, 51] that improvements are required. There is a growing body of evidence linking obesity and other diet related conditions with takeaway food [page 22]. Therefore, we need to better understand the frequency and socio-demographic trends in populations that choose to eat takeaway food, as well as the impact of such food on our diet. We need to identify and evaluate existing interventions and their respective components and contextualise the setting in which they are delivered. Such knowledge will support future intervention development, particularly those tailored to the known challenging setting of independent takeaways [47].

1.6 Thesis overview

1.6.1 Research question

> *Based on best practice, to date, what are the most effective, equitable, and sustainable interventions that can be delivered within the independent takeaway sector in the UK?*

1.6.2 Objectives

To answer my research question I have set out the following objectives:

1. Explore the frequency and identify the socio-demographic correlates of eating takeaway food
2. Assess the nutritional impact of eating takeaway food
3. Identify and collate the evidence regarding existing interventions in independent takeaways
4. Identify possible barriers and facilitators to delivering interventions in independent takeaways
5. Assess the effectiveness of salt reduction in UK Fish & Chip Shops;
6. Explore the feasibility and acceptability of novel interventions designed to increase the availability of healthy options in takeaway food outlets in England.

1.6.3 Published papers, manuscripts under review, and chapters

There are six Published Papers (PP) and two Manuscripts Under Review (MUR) that are included in this doctoral statement and it is divided into nine chapters.

Chapter One has provided an introduction to, and the case for, the body of research.

Chapter Two presents the rationale for my research focus on takeaway food.

Chapter Three presents the observational epidemiology that I carried out using National Diet and Nutrition Survey (NDNS) data. This chapter includes: **PP1** [Adams et al. (2015a) page 30] [52]; **PP2** [Goffe et al. (2017) page 42] [53]; and **PP3** [Adams et al. (2015b) page 59] [54].

Chapter Four provides a narrative summary of the evidence regarding existing interventions to improve the nutritional offerings in takeaways.

Chapter Five discusses those factors that might either be facilitators of an intervention or acting as a barrier to delivery, as identified by those who have previously delivered interventions within out-of-home food outlets. This chapter includes **PP4** [Goffe et al. (2018) page 97] [55].

Chapter Six focuses on a particular established salt reduction intervention used in UK Fish & Chip Shops. This chapter provides an overview of the development of the 5-holed Fish & Chip Shop salt shaker caps, its current use in the industry and evidence of its impact. This

chapter includes my two publications that evaluated the effectiveness of this intervention to reduce the amount of salt delivered **PP5** [Goffe et al. (2016a) page 116 [56]; and **PP6** Goffe et al. (2016b) page 116] [57].

Chapter Seven presents the findings of an evaluation with regards to feasibility and acceptability of a specific, local authority led intervention tailored and targeted at takeaways. This chapter includes **MUR1** [Hillier-Brown et al. (in submission) page 137] [58].

Chapter Eight presents the findings of my evaluation with regards to feasibility and acceptability of a specific, wholesale supplier led intervention tailored and targeted at Fish & Chip Shops. This chapter includes **MUR2** [Goffe et al. (Accepted Dec 2018) page 188] [59].

Chapter Nine is my discussion where I state the: principal findings; strengths and limitations of the study; interpretation in relation to other studies; and implication to decision makers and practitioners of my compendium of research; as well as my proposed future work.

1.6.4 Research process

In developing the ideas for this research, it was important to understand the commercial world of the research setting. Across the course of my studies, I had conversations with a range of stakeholders, including: takeaway owners, customers, wholesale suppliers and intervention deliverers. In parts of my doctoral statement, I have occasionally reported points raised in these informal conversations and detail how they contextualised my research process. These conversations did not directly contribute to my research publications, but they were beneficial to build relationships with busy professionals and illustrate my awareness of perspectives and associated issues from a wide range of influential stakeholders.

Chapter 2. What is known about the relationship between takeaway food and health?

In this chapter, I define the setting of my research. I present a brief history of takeaway fast-food and describe the current landscape and context with a particular focus on independently owned takeaways in the UK. I describe the nutritional profile of the meals available from particular takeaway outlet types and detail the associations between consumption of such food and health.

2.1 Out-of-home eating

My area of study (takeaways), falls within the broader field of 'out-of-home eating'. There have been a number of studies, and subsequent systematic reviews [60], that have investigated the influence of out-of-home eating on diet. However, the term 'out-of-home eating' is inherently broad and has been used in studies to relate to both where food is purchased and where food is consumed. Bezerra et al. in their systematic review broadly split studies by those that define 'out-of-home eating' by the location, that is where the food was prepared and purchased and those that define it by the location in which the food was consumed [61]. Furthermore, while most studies that use the term 'out-of-home eating' refer to 'meals', it could equally include snacks purchased from a range of sources, including vending machines. While the term is widely used it does not lend itself well to academic study as it does not rigorously define the subject under study. Therefore, it is critical to understand how the term 'out-of-home eating' and related terms are applied to a given study in order to relate the findings to my area of study.

The most prominent targets for change to improve the nutritional content of out-of-home eating have been the multinational fast-food restaurants. Claims regarding their negative impact on health have resulted not only in innumerable media reports, but a widely viewed documentary film [62]. The rapid global expansion of multinational fast-food restaurants has coincided with increased rates of obesity, but correlations do not equal causation. In 2016, an Australian study based on a natural experiment, using a repeated cross-sectional design with a control site, found that the introduction of a multinational chain restaurant, McDonald's, into Tecoma (a suburb of Melbourne, where personal, family, and household median weekly incomes are all higher than national medians [63]), did not result in an

increased frequency of consumption of the chain restaurant's products over a 12 month period [64]. However, this study was based on the introduction of one outlet, of an already widely available and accessible product. Additionally, the outlet was subjected to a community campaign that opposed the development that continued after it opened for trading [64]. Despite this, the restaurant remains opens, so presumably it is economically viable. Therefore, these findings do not necessarily mean that an increased prevalence of outlets offering ready-to-eat food prepared outside the home, such as takeaways, pubs, cafés and restaurants do not have an influence on our diet and subsequent weight status and health.

2.1.1 Defining takeaway food for academic study

A search of the term "takeaway food" in Google Scholar (accessed November 2017) returned 2,680 results. While it was not possible to screen all of these, I did view many of the most cited papers, none of which provided a detailed definition of what the authors defined to be 'takeaway food'. There is an obvious assumption that the term, a concatenation of 'take' and 'away', refers to food that can be eaten away from the premises from which it was purchased. Such a broad definition would include cold food, such as sandwiches, and it is clear that most studies refer, in this context, to hot and 'complete' meals. In England, there is a legal framework to define business use for a given property. Shops fall within 'Class A', which is divided into 5 sub-categories, A1 to A5. Classes A3 and A5 cover properties where food for consumption is available. A3 businesses are those in which food and drink can be consumed either on or off site, whereas A5 are businesses that sell hot food only for consumption off premises [65]. There is a danger of over-intellectualising a term that is inherently understood widely by the adult population of the UK, but it is of course important to have a working definition for the purpose of scientific study. In my thesis I base my definition on that used to define takeaway consumption in the NDNS [66] and refer to 'takeaway food' as:

> *A complete hot meal (more than a beverage or bag of chips), served quickly, that is primarily packaged to be consumed off the premises where it is purchased*

When I refer to a 'takeaway', I am referring to the outlet where the food is sold. While reference in part will be made to the multinational fast-food chain restaurants (e.g. McDonald's), that provide food that fits the aforementioned description, this will mainly be to contextualise the setting of my research, as the intervention work detailed in my thesis refers to those businesses that are non-franchised and independently owned.

2.2 A brief post-war history of takeaway fast-food in the UK

Following the implementation of rationing during World War II [67] that carried on into peacetime and ended in 1954 [68], there was restricted access to a diverse range of foods. Immigration from the east including Europe, the Middle East, Subcontinental and East Asia, and the Caribbean has brought a diverse range of cuisines that are now firmly established in UK food culture and have been adopted as our own. These include pizza from Italy, kebabs from the Middle East, curry from the Indian Subcontinent and Oriental food from East Asia. One book on Sylheti settlers in the UK reported the growth of Indian restaurants, from an estimated 20 in London in 1946, to 300 across Britain in 1960, to over 3,000 by 1980 [69]. The more subtly flavoured food of Chinese origin saw an even greater rise to prominence. Before 1914 there was only one restaurant in the West End of London, the Cathay, which opened in 1908, along with a limited number of outlets in the dockland areas of Limehouse (London) and Liverpool. This rose to over 4,000 in Britain by 1970 [70]. In an attempt to appeal to changing tastes, J. Lyons and Co., the British food and restaurant company, acquired the UK rights, from its American founder, Edward Gold, for the 'Wimpy Bar' and opened its first outlet at the Coventry Street Corner House in 1953, serving hamburger based fast-food meals [70]. This was a successful move for J. Lyons and Co. as the number of outlets grew to 460 by 1969. This rapid increase happened during the 1960s, a period which Burnett (2004) refers to as *'the democratisation of eating out for pleasure to all classes'* [70]. This period also saw the rise of other affordable outlets such as Spaghetti Houses, Trattorias and French Bistros [70], as well as the establishment of the first Pizza Express outlet in Soho, London in 1965 [71].

Now in the 21st Century the multinational companies: McDonald's; Burger King; KFC; Pizza Hut; and Dominos are found worldwide. KFC, the American fried chicken chain, reported to be the first fast-food restaurant to arrive in the UK, opened their first outlet in the UK in Preston, North-West England, in 1965 [72]. Pizza Hut, also American, arrived in the UK eight

years later in 1973 [70, 71]. McDonald's followed soon after, opening their first outlet in the UK in 1974 [73] and expanded rapidly from the mid-1980s across the country [74]. The company detailed in their 'Form 10-K' (a US Government mandated annual financial performance report), that their global revenue for the year 2016 was $24.6 billion generated from 36,899 outlets [75]. KFC's place on the high street has resulted in many similar outlets on the theme of deep-fried chicken. Such places, particularly in areas of high deprivation, are increasingly having a cultural role within communities in addition to being sources of nourishment [76]. For example, takeaways offer one of the few alcohol-free and affordable locations that are popular social locations for both teenagers, young adults and individuals from cultural groups who do not consume alcohol [77]. The UK's receptiveness and acceptance to new cuisines has seen an ever changing and evolving food culture and with this an expanding and increasingly diverse takeaway marketplace. One of the most recent additions, gaining market share in the UK [78], is the 'piri piri' style grilled chicken chain restaurant, Nando's, which like KFC has led in turn to copycat independent outlets.

2.2.1 The history of Fish & Chips

Fish & Chips is considered the quintessential British contribution to the takeaway market [79]. However, as with all cuisine types, it is the result of the constant changing and merging of food cultures. Fried fish was reportedly first brought to the UK by European Jewish migrants, probably in the 17th Century [80] and was first combined with chips in the 1860s [79]. Despite facing substantial competition from an increasing number of different cuisine types there remains a large number of specialist Fish & Chip Shops throughout the UK, estimated to be in excess of 10,500 [81]. The composition of the offer is simple and universal, though, certain components retain distinct regional identities: fish species; frying medium; and accompaniments [82].

2.3 The size of the fast-food market

In 2017 Just Eat plc, an online food ordering platform [83], commissioned the Centre for Economics and Business Research (Cebr), an independent business management consultancy, to evaluate the economic size and contribution of the takeaway industry to the UK economy. The conflict of interest between the commissioner of the research and the research subject is evident in that the report is written explicitly promoting the value of the

takeaway sector, with each sub-heading delivering a positive message, e.g. “The UK takeaway sector is a thriving engine of growth”, “An industry that is supporting record employment” [84]. Despite the rhetoric, the report included some key statistics relating to the size of the sector. Authors estimated that in 2016 there were 36,855 dedicated takeaways, with a total consumer spend of £9.9 billion in the same year. For the purposes of reporting, they defined ‘takeaway’ as:

> *food that is eaten off premises from restaurants, cafes and other catering establishments. The food can be hot or cold and the orders can be collected or delivered. What is not included as takeaway is food and snack purchased in shops such as supermarkets, newsagents and greengrocers.*

There was limited information regarding Cebr’s methodology. However, they do state that the data used was obtained from Defra and the Office of National Statistics [84]. Further detailed data on the market size was available through the international market research company Euromonitor International. While, they also did not report the method of their market evaluation, it is stated that data were drawn from a wider range of sources, including Defra, Department of Business, Enterprise & Regulatory Reform, National Statistics Office, Office of National Statistics, various trade associations, the trade press, company research, trade interviews and other unspecified trade sources. For the same year, 2016, they estimated there to be a total of 38,479 outlets, of which 27,093 were independent outlets [85]. The larger number of data sources used could potentially account for the higher number of outlets identified. Or alternatively, it could be accounted for by their wider definition of outlet under study, which they termed ‘fast-food’:

> *Fast-food outlets offer limited menus that are prepared quickly. Customers order, pay and pick up their order from a counter. Outlets tend to specialize in one or two main entrees such as hamburgers, pizza, ice cream, or chicken, but they usually also provide salads, drinks, dessert etc. Food preparation is generally simple and involves one or two steps, allowing for kitchen staffs generally consisting of younger, unskilled workers. Other key characteristics include: A standardised and restricted menu; Food for immediate consumption; Tight individual portion control on all ingredients*

> *and on the finished product; Individual packaging of each item; Counter service; A seating area, or close access to a shared seating area, such as in a shopping centre food court. For chained fast-food, chained and franchised operations which operate under a uniform fascia and corporate identity. Take out is generally present, as is drive-through in some markets [85].*

These two figures are potentially an overestimation of those outlets at which my research is targeted, as they are both inclusive of cold food outlet, e.g. ice cream parlours, but do give an indication of the size of this sector. Euromonitor further segregates the sector between chain and independent outlets. They define the two categories as follows:

> *Chained foodservice operations have a minimum of 10 branded outlets.*
>
> *Independent operations have one or more (but fewer than 10) foodservice outlets and are not affiliated with any other business. Mainly relates to family businesses or partnerships [85].*

Their figures show that while there are approximately seven independents for every three chain outlets, the two sectors are approximately equal with regards to market share as estimated by both proportion of transactions and market value. However, there is a trend towards an increasing market share of the chains over the independent outlets, see Table 2-1. These figures show that both the independent and chain outlets serve a substantial amount of food to the UK population.

Table 2-1 Fast-food market share between chain and independent outlets

	2013	2014	2015	2016	2017
Number of outlets (% chain Vs independent)					
Chain	10,006	10,396	10,910	11,386	11,453
	(26.6%)	(27.5%)	(28.6%)	(29.6%)	(29.8%)
Independent	27,661	27,452	27,245	27,093	26,949
	(73.4%)	(72.5%)	(71.4%)	(70.4%)	(70.2%)
Total	**37,667**	**37,848**	**38,155**	**38,479**	**38,402**
'000 transactions (% chain Vs independent)					
Chain	1,218,207.7	1,247,785.5	1,298,929.6	1,384,674.1	1,460,679.0
	(48.5%)	(49.5%)	(50.7%)	(52.5%)	(53.8%)
Independent	1,293,067.0	1,270,851.8	1,263,482.5	1,253,010.2	1,252,534.8
	(51.5%)	(50.5%)	(49.3%)	(47.5%)	(46.2%)
Total	**2,511,274.70**	**2,518,637.30**	**2,562,412.00**	**2,637,684.30**	**2,713,214.00**
Market value GBP million					
Chain	7,436.5	7,738.6	8,223.3	8,676.5	9,053.4
	(49.9%)	(50.8%)	(52.3%)	(53.5%)	(53.8%)
Independent	7,471.2	7,490.7	7,497.2	7,530.9	7,773.7
	(50.1%)	(49.2%)	(47.7%)	(46.5%)	(46.2%)
Total	**14,907.80**	**15,229.40**	**15,720.50**	**16,207.40**	**16,827.10**

Euromonitor International. Passport – Fast-food in the United Kingdom. Euromonitor International, 2018. Available from: https://www.euromonitor.com.

2.4 Takeaway ownership, stability, and prevalence

The opening of an independent takeaway has provided many with an accessible: low cost [86]; and low skill requirement, opportunity to own a business. While there are minimal barriers to entering the market, remaining viable is more difficult. Personal communications that I have had with both business owners and local authority health and trading standards officers have highlighted the highly competitive nature of this sector; this is supported by data on both the density [87] and the 'churn rate' (attrition rate) [page 94]. Frequently, there are clusters of takeaways competing for the same customers [88]. An example of this is offered by the town of Birtley, in the metropolitan borough of Gateshead. There are a total of 19 takeaways, of which, 13 are on the same road within 450 metres of each other [89]. Based on ONS data for 2015, Birtley, has an estimated population of 8,340, this equates to one takeaway per 439 people [90]. Certain owners of established Fish & Chip Shops and

suppliers, have remarked to me that a focus on ‘quality’ is essential to remain competitive. However, they also report that a widely used tactic by many takeaway owners is to respond to a drop in sales by improving ‘value-for-money’, by offering increased volumes of food at a low price. Such strategies have proved successful. As an example, one outlet in a deprived area of Newcastle upon Tyne, 7 Star Pizza, see Figure 2-1, actively promoted itself through value-for-money deals. It had the lowest hygiene rating attainable, ‘0: urgent improvement necessary’ (as of November 2016), in the nationally administered Food Hygiene Rating Scheme (FHRS) [89], and was subsequently reported in the local press [91]. Despite this, it had received positive reviews via ‘Just Eat’ [92], receiving, a user generated, rating of 5.6 out of 6 stars from a total of 296 reviews (when accessed in November 2016). It should be noted that this business is under new management as of March 2017.



Figure 2-1 Takeaway pizza outlet, Newcastle upon Tyne

The expansion of the internet has influenced how we shop generally with many people shopping online; as a result, retailers have adjusted to our changing purchasing behaviours. Many established businesses have left the high street, leaving a large number of properties vacant [93]. This has meant that some local authorities have considered new strategies to encourage businesses to fill these premises [94]. An environmental health officer (EHO) from the North-East of England, who I interviewed, stated that he had observed an increase in

independent takeaway outlets following the financial crisis of 2008, due to the above stated accessible nature to business ownership within this sector.

> *We've had a lot, an awful lot of new food businesses and changing owners of businesses, compared to past years. Because it is fairly easy to set up a food business. It's always been the same historically, you know, I mean harking back to sort of when.., you know, shipyards and indu[stry]…, closed, you know, we saw a lot of people getting burger vans because it was an easy thing to do, you know, they've got to earn money. But those sort of businesses don't necessarily last very long and they change ownership.*
>
> EHO, North-East England, June 2014

While, to my knowledge, there are no published data or reports relating to changes in the numbers of either A3 or A5 premises nationally, Burgoine et al. (2009) studied an area of Northumberland, covering three small rural towns between 1980 to 2000, and observed a 259% increase in the number of outlets for 'foods for consumption away from home' [95]. A further study in Norfolk, a county in the East of England comprising of both urban and rural areas, conducted between 1990 and 2008, found that not only was there a net growth in takeaways across the study area, this growth was particularly pronounced in the most deprived areas, where density increased by almost 2.0 outlets (43%) per 10,000 population over the study period, compared to increases of 1.0 (58%) and 0.5 (30%) outlets per 10,000 population in the middle and least deprived tertiles [87]. Whether it is the UK population's appetite or the increasing number of outlets providing such food that is driving demand is unknown, but our collective spend on 'fast-food, takeaway and home-delivery' increased from £8,925 million in 2008 to £10,540 million in 2012. Furthermore, the percentage of household expenditure on out-of-home food has risen from 13.4% to 14.4% over the same period [96].

2.5 Nutritional profile of takeaway food in the UK

In 2014, Jaworowska et al. published the findings of a Liverpool Primary Care trust and Liverpool City Council funded study to determine the nutritional profile of popular takeaway meals from small, independent outlets across three local authorities in the North-West of

England: Liverpool City Council, Wirral Metropolitan Borough Council, and Knowsley Council. They analysed multiple samples of 27 different types of takeaway meals from a variety of cuisine, these included: Chinese (n=123), Indian (n=95), British (n=119), Italian (n=65) and kebabs (n=87) [46]. Meals were analysed for: energy; protein; carbohydrate; total fat; salt; and total sugar. Despite great variability between meals, the authors found that most meals from these small, independent outlets were high, and well in excess of dietary recommendations, for energy, all macronutrients and salt. This was principally due to the large portion size served, see Table 2-2. Only four meal types delivered a median energy intake of less than 1,000kcal/portion [46]. In comparison to Government recommendations only four of these meals: shish kebab, prawn chow mein, chicken kebab, and chicken chow mein delivered a median energy (kcal/portion) that was less than 50% of energy intake for an adult female (2,000kcal/day). These figures are also high when compared to a well-established meal from the international chain restaurant McDonald's, where a Big Mac® and medium fries estimated energy (kcal/portion, as reported online) is 845kcal [97].

The authors reported that their sampling methodology represented 50%, 20% and 95% of takeaways from Wirral, Liverpool and Knowsley, respectively. While this represents good coverage of their region, it is not representative of the takeaway foodscape of England. The authors claim that the meal types were selected, in part, based on Leung's 2010 publication [98]. However, cross-referencing with Jaworowska et al. 2012 paper on salt content in hot takeaway meals [99], it would appear erroneous as those samples were collected by Liverpool City Council and Wirral Metropolitan Borough Council prior to Leung's publication. Additionally, as the majority of samples from each takeaway consisted of a single meal purchased, it does not account for within takeaway variation. To provide an approximate comparison of the composition of local cuisine types I looked at the ten most popular cuisine tags used by takeaways listed with Just Eat in December 2017 [83] for the principal settlements in England's most populous conurbations, see Table 2-3. While this is not an exhaustive summary of takeaway cuisine type meals available throughout England, it does provide an indication of the trends. With regards to the English regions, the meals analysed in the Jaworowska et al. study broadly match those popular cuisines tags used by takeaways listed with Just Eat. However, there are recurrent meals that are noticeably absent, including burger and chicken meals. There are also clear differences between the London regions and

the rest of England. For example, ‘Fish & Chips’ is listed in six of the English cities, but in none of the London regions, whereas ‘Japanese’ and/or ‘Sushi’ are listed in all London regions, but not in the rest of England. The Just Eat tags may not be representative of all businesses present in each area and there might also be certain cuisines that people are less likely to order online, but as online access is gaining in popularity with regards to how customers purchase their meals, it is an indicator of the level of exposure to a given takeaway cuisine type.

Table 2-2 Energy content of takeaway meals per portion in North-West of England

Meal type	n	Energy (kcal/portion): median	Energy (kcal/portion): interquartile range	Median as a proportion of Government recommendations for adult female energy (kcal/day)
Chinese (all meals)	*123*	*1161*	*932 - 1452*	*58%*
Beef, green peppers in black bean sauce with fried rice	31	1386.2	1170.4 - 1559.3	69%
Sweet and sour chicken with boiled rice	10	1501.0	1415.0 - 1618.5	75%
Prawn chow mein	21	724.6	650.8 - 883.7	36%
Chicken chow mein	10	838.5	697.4 - 1023.7	42%
Char siu chow mein	10	1095.0	805.5 - 1159.0	55%
Chicken satay with fried rice	10	1247.3	1095 - 1726.8	62%
Kung po king prawns with boiled rice	10	1097.7	983.8 - 1318.3	55%
Special fried rice	21	1367.0	1234.5 - 1546.8	68%
Indian (all meals)	*95*	*1391*	*1170 - 1585*	*70%*
Chicken korma with pilau rice	10	1594.5	1458.5 - 1743.8	80%
Chicken tikka masala with keema rice	21	1479.8	1331.2 - 1688.5	74%
King prawn rogan josh with pilau rice	22	1027.2	838.3 - 1154.5	51%
Lamb rogan josh with pilau rice	10	1356.0	1246.3 - 1479.3	68%
Lamb bhuna with chips	22	1521.5	1378.9 - 1765.1	76%
Vegetable biryani	10	1310.6	1102.3 - 1519.2	66%
England (all meals)	*119*	*1606*	*1431 - 1881*	*80%*
Chicken and chips	25	1575.3	1320.0 - 1858.1	79%
Fish & Chips	64	1657.9	1515.3 - 1967.5	83%
Chips and curry sauce	9	1052.7	830.4 - 1123.9	53%
Mushroom omelette and chips	21	1568.1	1376.4 - 1920.3	78%
Pizzas (all meals)	*65*	*1820*	*1469 - 2152*	*91%*
Margherita pizza	12	1985.5	1712.4 - 2270.0	99%
Pepperoni pizza	12	2137.4	1927.8 - 2597.7	107%
Seafood pizza	11	2004.0	1697.4 - 2514.9	100%
Ham and pineapple pizza	10	1468.5	1261.0 - 1526.3	73%
Meat pizza	20	1563.2	1323.1 - 2007.8	78%
Kebabs (all meals)	*87*	*1125*	*690 - 1673*	*56%*
Donner kebab with chips	32	1864.5	1577.4 - 2221.1	93%
Donner kebab	12	1163.5	1121.4 - 1354.5	58%
Chicken kebab	22	725.8	649.5 - 818.9	36%
Shish kebab	21	603.5	508.9 - 709.2	30%

Table 2-3 Most popular Just Eat cuisine tags for major English conurbations in December 2017

	Manchester		Birmingham		Leeds		Liverpool		Southampton	
Rank	Cuisine	n	Cuisine	n	Cuisine	n	Cuisine	n	Cuisine	n
1	Pizza	424	Pizza	455	Indian	195	Pizza	186	Indian	71
2	Indian	291	Indian	377	Pizza	194	Chinese	115	Pizza	64
3	Kebab	238	Chinese	183	Italian	108	Indian	87	Kebab	52
4	Chinese	206	Kebab	155	Chinese	104	Italian	83	Chinese	43
5	Curry	151	Italian	123	Kebab	49	Kebab	79	Oriental	20
6	Chicken	143	Curry	120	Curry	47	Chicken	54	Curry	20
7	Burgers	117	Fish & Chips	111	Burgers	45	Fish & Chips	37	Italian	18
8	Italian	115	Chicken	107	American	45	Breakfast	36	Chicken	16
9	Oriental	87	Bangladeshi	93	Thai	34	Curry	35	Fish & Chips	15
10	American	73	Burgers	88	Desserts	31	Desserts	32	Burgers	14

	Newcastle		Nottingham		Sheffield		Bristol	
Rank	Cuisine	n	Cuisine	n	Cuisine	n	Cuisine	n
1	Pizza	352	Pizza	263	Pizza	300	Pizza	115
2	Indian	154	Indian	176	Kebab	182	Indian	103
3	Kebab	124	Kebab	166	Indian	173	Kebab	77
4	Italian	100	Chinese	134	Chinese	127	Chinese	68
5	Fish & Chips	100	Curry	78	Curry	103	Curry	39
6	Chinese	93	Fish & Chips	54	Italian	78	Italian	38
7	Curry	56	Italian	51	Oriental	55	Oriental	30
8	Oriental	44	Oriental	49	Chicken	50	Burgers	20
9	Grill	42	Chicken	41	Fish & Chips	47	American	20
10	American	35	Burgers	27	Thai	36	*Bristol Loves*	20

	London East		London East (central)		London North		London North-West	
Rank	Cuisine	n	Cuisine	n	Cuisine	n	Cuisine	n
1	Pizza	230	Pizza	66	Pizza	225	Pizza	205
2	Indian	221	Indian	65	Indian	196	Indian	164
3	Chinese	153	Japanese	55	Chinese	160	Italian	130
4	Chicken	116	Sushi	51	Italian	139	Chinese	110
5	Italian	112	Chinese	44	Japanese	103	Chicken	88
6	Grill	94	Italian	43	Kebab	101	Burgers	74
7	Burgers	91	Burgers	31	Chicken	93	Japanese	71
8	Japanese	90	Thai	28	Sushi	92	Kebab	71
9	Sushi	82	Curry	26	Burgers	87	Curry	64
10	Curry	82	Kebab	25	Curry	82	Thai	61

	London South-East		London South-West		London West	
Rank	Cuisine	n	Cuisine	n	Cuisine	n
1	Indian	280	Pizza	242	Pizza	175
2	Pizza	222	Indian	196	Indian	137
3	Chinese	188	Italian	174	Italian	122
4	Italian	123	Chinese	165	Chinese	95
5	Curry	117	Thai	84	Lebanese	63
6	Kebab	114	Japanese	82	Japanese	57
7	Oriental	96	Curry	78	Chicken	54
8	Chicken	91	Burgers	72	Burgers	54
9	Japanese	60	Chicken	67	Thai	52
10	Burgers	60	Sushi	62	Kebab	49

Liverpool City Council is not alone in having concerns about the nutritional content of takeaway foods. Driven by specific concerns over their local food environment and health concerns of their population, Gateshead Council delivered their own meal sampling and nutritional analysis of independent hot food takeaways [100]. Gateshead Council's Health and Public Protection service in 2012 sampled meals for laboratory analysis from 187 shops within their jurisdiction. They collated the nutritional profile of eight different meal types across four different types of cuisine: British, Indian, Chinese and Italian, see Table 2-4. Additional variables assessed during analysis included: protein, carbohydrates, sugars, fat, saturated fat, mono-unsaturated fat, poly-unsaturated fat, fibre (using the American Association of Analytical Chemists (AOAC) method developed to measure all resistant starches and low-weight dietary fibres [101]), salt and sodium. As with the Jaworowska et al. study [46], Gateshead reported a large variation within meal type and identified portion size as a key issue. Only one meal type, 'Chicken Chow Mein', delivered a mean meal total energy of under 1,200kcal.

Local authority led nutritional surveys are inherently limited in geographical scope and resources, i.e. finances. This means that the methodology only reveals a snapshot of the nutritional profile of those meals sampled within that locale. This issue is acknowledged by Jaworowska et al., but is also seen as challenging to rectify through full recipe analysis that would require engagement and cooperation with an outlet's owner and staff [46]. However, the results are useful for building a case for action in the locale, to evidence the nutritional

profile of the food businesses operating within their jurisdiction [102]. In the Gateshead example, the findings from their survey directly contributed to their 'Hot Food Takeaways Supplementary Planning Document', which has been adopted by the local authority and currently restricts the opening of new takeaways within the authority [103].

Table 2-4 Energy content of takeaway meals per portion in Gateshead

		Total energy (kcal)							
Meal type	**n**	**mean**	**sd**	**median**	**min**	**max**	**range**	**se**	**Median as a percent of Government recommendations for adult female energy (kcal/day)**
Chicken Chow Mein	46	802	187	797	445	1389	944	28	40%
Chicken Madras & Plain Naan Bread	41	1222	204	1210	720	1861	1141	32	61%
Chicken Tikka Masala & Pilau Rice	40	1396	218	1395	1004	1948	944	34	70%
Pie & Chips	50	1429	192	1447	808	1892	1084	27	72%
Fish & Chips	50	1571	297	1552	928	2294	1366	42	78%
Pizza Margherita	45	1656	325	1590	1171	2766	1596	48	80%
Chicken in Sweet & Sour Sauce & rice	51	1748	362	1791	1026	2806	1780	51	90%
Pizza Pepperoni	43	1891	313	1843	1269	3035	1767	48	92%

2.6 Associations between takeaway food consumption and adverse health outcomes

Whilst studies have identified associations between consumption of takeaway food and body weight [61] and diet related diseases such as type 2 diabetes [104], there are no clinically controlled studies limiting participants to a diet of exclusively takeaway meals. The film, *Super-Size Me*, followed the filmmaker as he consumed only food from McDonald's for a 30 day period [62]. The reported health outcomes were minimal and poorly reported. However, the film charted the filmmaker as he gained a reported 11kg during filming [62]. It generated $22,233,808 at the box office worldwide [105] garnering substantial public

interest and debate [106] as to how such food may have an impact on our health. Despite highlighting the potential health issues related to such food, this was an n=1 experiment that was not rigorously controlled, and crucially was an unrealistic portrayal of how we consume takeaway food, therefore it does not reflect dietary behaviour, nor the potential usual dose response to consumption of such food. A systematic review by Summerbell et al. (2009) reported that *'The epidemiological evidence that 'fast-foods' as defined in the literature are associated with slightly higher levels of subsequent excess weight gain and obesity is consistent, although limited in terms of the body of evidence reviewed'* [107]. Others have linked an increase in takeaway food consumption to associated health outcomes. Pereira et al. (2005), found a positive association between frequency of visits to 'fast-food restaurants' and not only weight gain but also increased insulin resistance [108]. They found that, over a 15-year period, independent of other potential confounding lifestyle factors, not only did the frequent, compared to the infrequent, users of such outlets experience an average of an extra 4.5kg of weight gain, they also had a two-fold greater increase in insulin resistance. As a result, the authors suggested a putative link between fast-food consumption and the risk of both obesity and type 2 diabetes. Krishnam et al. (2010) took the next logical step to see if there was an association between consumption of various types of restaurant meals and the incidence of type 2 diabetes in African American women [109]. They found that consumption of hamburgers, fried chicken, fried fish, and Chinese meals from restaurants were independently associated with a higher risk of type 2 diabetes [109].

2.7 Salt and takeaway food

The evidence regarding salt consumption and health is consistent. High sodium intake is associated with increased blood pressure and increased risk of cardiovascular disease, and lowering intake has a positive impact on health, by reducing risk of stroke and coronary heart disease in adults [110]. The WHO recommends a maximum daily intake of 5g of salt (2g sodium) [111] and in 2003 the UK the Science Advisory Committee on Nutrition (SACN) recommended a reduction in the population's average daily intake to 6g from the then current 9g [112]. PHE published their assessment of dietary sodium in adults in 2014 using the NDNS. Overall, the mean estimated intake for all adults (19-64 years old) was 8.0g of salt per day, 33% greater than SACN recommendations. For men this figure was 9.1g/day and women it was 6.8g/day [113]. Ni Mhurchu et al. (2011) analysed UK household consumer

panel data to estimate the proportional contribution of major processed food groups to annual UK sodium purchases [114]. Table salt (fine grain for table and cooking) was the largest single contributor of sodium purchases (23%). A further 37% came from five processed food categories: bacon, bread, milk, cheese, and sauces [114]. This led the authors to conclude that a focus on sodium reduction in such foods may have a sizeable impact on salt intake. However, their data did not include food consumed out of the home. Jaworowska et al. (2012) analysed 411 single samples of 23 different types of hot takeaway meals from 215 takeaways, collected between December 2005 and January 2006 across two local authorities Liverpool City Council (n=75) and Wirral Metropolitan Borough Council (n=140). The authors referred to the meal samples' salt content as *'alarmingly high'* [99]. They grouped the meals sampled into five meal categories: Chinese, Indian, English, pizzas and kebabs. The median salt grams per meal value for three of the five categories: Chinese, pizzas and kebabs, were in excess of the 6g daily target set by SACN [112] and promoted by the FSA [99], see Table 2-5.

Table 2-5 Salt content of takeaway meals per portion in North-West England (December 2005 and January 2006)

Meal category	n	Salt (g) per meal: median	Salt (g) per meal: interquartile range	Percent SACN/FSA daily target (6g)
Chinese	92	8.07	5.47 – 10.99	134%
Indian	95	4.73	3.61 – 6.10	79%
English	95	3.01	2.23 – 4.48	50%
Pizzas	54	9.45	6.97 – 12.83	157%
Kebabs	75	6.21	4.01 – 8.35	103%

In Jaworowska et al's 2014 publication (with the expanded analysis of the nutritional composition of takeaway food) this included those meals sampled within Knowsley and detailed salt content for each meal type [46], see Table 2-6. Fourteen of the 27 meals had a median value that is greater the SACN recommended daily target and only three meals had less than 50% (3g) of this target.

Table 2-6 Salt content of takeaway meals per portion in North-West England all meals

Meal type	n	Salt (g/portion): median	Salt (g/portion): interquartile range	Median as percent SACN/FSA daily target (6g)
Chinese (all meals)	*123*	*6.43*	*4.37 - 8.92*	*107%*
Beef, green peppers in black bean sauce with fried rice	31	10.72	8.13 - 13.88	*179%*
Sweet and sour chicken with boiled rice	10	3.13	1.83 - 3.76	*52%*
Prawn chow mein	21	7.88	5.58 - 9.99	*131%*
Chicken chow mein	10	6.23	4.50 - 7.45	*104%*
Char siu chow mein	10	8.07	7.18 - 8.46	*135%*
Chicken satay with fried rice	10	10.30	7.53 - 13.38	*172%*
Kung po king prawns with boiled rice	10	5.54	3.51 - 7.37	*92%*
Special fried rice	21	9.41	7.17 - 12.33	*157%*
Indian (all meals)	*95*	*4.70*	*3.61 - 5.96*	*78%*
Chicken korma with pilau rice	10	3.81	3.18 - 4.35	*64%*
Chicken tikka masala with keema rice	21	6.68	5.64 - 8.18	*111%*
King prawn rogan josh with pilau rice	22	4.20	3.44 - 6.08	*70%*
Lamb rogan josh with pilau rice	10	3.49	2.78 - 5.23	*58%*
Lamb bhuna with chips	22	4.12	3.10 - 5.14	*69%*
Vegetable biryani	10	5.63	4.77 - 6.47	*94%*
England (all meals)	*119*	*2.65*	*1.82 - 3.80*	*44%*
Chicken and chips	25	2.18	1.68 - 3.23	*36%*
Fish & Chips	64	2.90	2.32 - 4.47	*48%*
Chips and curry sauce	9	3.31	1.88 - 4.55	*55%*
Mushroom omelette and chips	21	2.15	3.77 - 5.55	*36%*
Pizzas (all meals)	*65*	*9.12*	*6.78 - 11.96*	*152%*
Margherita pizza	12	8.83	6.63 - 10.81	*147%*
Pepperoni pizza	12	12.87	5.94 - 13.70	*215%*
Seafood pizza	11	11.09	8.66 - 13.62	*185%*
Ham and pineapple pizza	10	7.72	5.37 - 9.75	*129%*
Meat pizza	20	8.20	6.93 - 9.81	*137%*
Kebabs (all meals)	*87*	*6.62*	*4.27 - 8.48*	*110%*
Donner kebab with chips	32	7.50	5.90 - 9.71	*125%*
Donner kebab	12	7.98	6.64 - 9.72	*133%*
Chicken kebab	22	5.94	3.95 - 7.27	*99%*
Shish kebab	21	4.27	3.47 - 5.99	*71%*

As part of their nutritional analysis of independent hot food takeaways, Gateshead Council also measured the salt content, see Table 2-7. Their samples were broadly lower in salt than

those reported by Jaworowska et al. Despite this, four of the eight meal types provided over half of the SACN recommended a daily intake of 6g. While some local authorities have carried out their own nutritional sampling, they do not routinely publish their findings [102]. Public Health England publish standard food tables [115]; however a comparison with the meals from North-West England and Gateshead data is not appropriate, in part, due to the heterogeneity of the sampling methods applied to create the standard food tables, but primarily due to reporting of meal constituent components and not as complete meals, e.g. 'Sauce, sweet and sour, take-away'.

Table 2-7 Salt content of takeaway meals per portion in Gateshead

		Salt (g)							
Meal type	**n**	**mean**	**sd**	**median**	**min**	**max**	**range**	**se**	**Median as percent SACN/FSA daily target (6g)**
Fish & Chips	50	0.87	0.43	0.75	0.33	2.05	1.73	0.06	13%
Pie & Chips	50	1.37	0.45	1.29	0.44	2.26	1.82	0.06	22%
Chicken Tikka Masala & Pilau Rice	40	2.36	0.85	2.24	1.15	4.06	2.91	0.13	37%
Chicken Madras & Plain Naan Bread	41	2.94	0.89	2.71	1.76	6.05	4.29	0.14	45%
Pizza Margherita	45	4.77	1.39	4.29	2.61	8.97	6.36	0.21	72%
Chicken in Sweet & Sour Sauce & rice	51	4.70	1.91	4.34	2.10	11.54	9.44	0.27	72%
Chicken Chow Mein	46	4.93	1.70	4.76	2.02	11.57	9.55	0.25	79%
Pizza Pepperoni	43	6.24	1.60	5.93	3.66	10.96	7.31	0.24	99%

2.8 Exposure to takeaways

It is imperative that we understand the geographical patterning of takeaways in order to estimate their potential population impact by identifying which demographic groups are most exposed. Fraser et al. (2010) carried out a non-language restricted *'semi-systematic'* review to include published studies on the geographical location of 'fast-food' or 'takeaway' outlets [36]. A total of 33 studies met their inclusion criteria and their principal finding was that of the 16 studies that analysed an entire population, 14 studies showed positive

associations between *'fast-food'* access and deprivation. They found conflicting evidence regarding the relationship between fast-food access and obesity and/or overweight and limited evidence regarding fast-food access and lower fruit and vegetable consumption. However, they stipulated that definitions of the fast-food outlets under study were heterogeneous, compounded by potential methodological issues which could have been a factor in some of the conflicting results reported. Burgoine et al. (2014) advanced the pre-existing analytical methods to examine exposure to takeaway food outlets to include home, work and commuting routes [116]. The study included 5,442 working adults in Cambridgeshire, in the South-East of England, from a cross-sectional study using data on individual participants' diet and weight, and objective metrics of food environment exposure. Using a geographical information system (GIS) Burgoine et al. were able to produce objective metrics of environmental exposure to takeaway outlets. They found that increased exposure to takeaways was associated with higher consumption of such food, higher body mass index (BMI) and greater odds of obesity [116]. However, there are methodological limitations with a GIS, as acknowledged by the authors, as inferences were made regarding spatially defining a 'neighbourhood' both around home and work, as well as assumed commuting routes. The study was limited to adults aged 29-62, which crucially misses the adults who are the highest consumers of takeaway meals at home, those aged 19-29 [Adams et al. (2015a) page 30] [52] and does not reflect the changing way we are increasingly exposed to and ordering takeaway meals online [117]. Griffiths et al. (2014) carried out a similar GIS analysis with 13,291 school children aged 11-12 within Leeds City Council (Yorkshire, England), comparing BMI to exposure to food outlets at home, school, and commuting routes [118]. In their study they found no evidence of a positive association between BMI and either all food outlets or takeaway and fast-food outlets as a specific group [118]. Methodologically, Griffiths et al. study differed from Burgoine et al. in that commuting routes were calculated using a 2km buffered straight line between home and school postcode, whereas Burgoine et al. used a more nuanced network analysis method to determine the shortest route through a transport network. Whilst it is not possible to quantify the impact of these two methods, the coarse method to derive commuting route used by Griffiths et al. coupled to the fact they were analysing school data, where most kids are likely to attend from the immediate locale to the same central location, would suggest a

more homogenous dataset differentiated primarily by school attended, with regards to the exposure metrics. Therefore, any trends might have been less pronounced. However, as with Burgoine et al. the critical issue is the age of the study participants. It could be argued that children aged 11-12 will have limited control of their dietary choices, irrespective of exposure. Such analysis would be of greater interest with older teenagers as data shows that it is this group of children that have the highest habitual intake of takeaway meals [Adams et al. (2015a) page 30] [52].

2.9 Health professionals and the public's awareness of the health consequences of excessive takeaway food consumption

While the Government is aware of, and has acknowledged the specific issue of the nutritional composition of out-of-home food provision [50], the views of professionals working within local authorities that were charged with implementing a change were not known [page 97]. As described above, there are both academic publications and locally-led food sampling programmes that have profiled the nutritional quality of takeaway food. The NHS has a dedicated webpage to provide nutritional information and advice to support healthier choices within takeaways [119]. The page states that consumption of takeaway meals "can push you over your recommended daily maximum amount of salt and fat", but does not make explicit either how high in energy content these meals are, or that takeaway meals frequently contain more than the maximum recommended adult daily intake of salt.

A 2016 study from Liverpool, cited a dearth of evidence about consumer knowledge and attitudes towards takeaway food. The authors delivered an online questionnaire to a mix of 462 staff and students from Liverpool John Moores University on this subject, which also covered attitudes towards smaller portion size and recipe reformulation within this sector. Reporting of their study was limited, but they did state that younger takeaway consumers were associated with a higher health score, a metric which was generated from consumers' takeaway nutritional knowledge. Despite this, the younger participants were also the most frequent consumers of takeaway food. They also found that increasing nutritional knowledge of takeaway food was associated with receptiveness to nutritional labelling, smaller portion sizes and a willingness to purchase reformulated meals [120].

2.10 Chapter summary

A diverse range of takeaways are prevalent and increasing in the UK food landscape. Sales of food from independent outlets represent approximately half of the total fast-food out-of-home market. The meals from independent takeaways in the UK generally serve foods and portions that are in excess of dietary recommendations, for energy and salt. Regular consumption has been associated with weight gain and obesity, as well as increased insulin resistance and a higher risk of type 2 diabetes. Geographic distribution of takeaways is socio-economically patterned, with a positive association between access to outlets and deprivation.

Chapter 3. Observational epidemiology using NDNS data

In this chapter, I present the findings of observational epidemiological research based on UK National Diet and Nutrition Survey data. The first two publications explore the relationship between the frequency and socio-demographic correlates of eating meals out and takeaway meals at home; and the relationship between mean daily energy intake and frequency of consumption of out-of-home meals. I identify the motivations behind takeaway food consumption and discuss the potential role of cooking skills as a mechanism to improve our collective diet and present the findings from my third publication on the prevalence and socio-demographic correlates of cooking skills in UK adults.

3.1 Who are the consumers and how frequently do they consume takeaway food?

It is evident that there is a large and increasing market for takeaway food [96], yet to the best of my knowledge, it was not known which sectors of the population are the highest consumers. To increase the potential for future interventions to be successful, through strategic targeting, it is important to know and understand which demographic groups are the high consumers of takeaways and how frequently they eat such meals. It is also critical for those working in policy or developing interventions to understand and account for such trends in consumption to ensure that future interventions are not unwittingly widening socio-economic health inequalities [121]. As my research has focused on the UK population, it was appropriate to investigate UK data. In my first paper, a cross-sectional analysis of the first four years of data from the UK National Diet and Nutrition Survey (NDNS) was used to explore the frequency and socio-demographic correlates of eating meals out and takeaway meals at home.

PP1. Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK national diet and nutrition survey, waves 1-4 (2008-12)

Adams J, Goffe L, Brown T, Lake AA, Summerbell C, White M, Wrieden W, Adamson AJ. *International Journal of Behavioral Nutrition and Physical Activity* 2015, **12**(51).

Adams et al. International Journal of Behavioral Nutrition and Physical Activity
(2015) 12:51
DOI 10.1186/s12966-015-0210-8

International Journal of Behavioral Nutrition and Physical Activity

RESEARCH Open Access

Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK national diet and nutrition survey, waves 1–4 (2008–12)

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Abstract

Background: Food prepared out-of-home tends to be less healthful than food prepared at home, with a positive association between frequency of consumption and both fat intake and body fatness. There is little current data on who eats out-of-home food. We explored frequency and socio-demographic correlates of eating meals out and take-away meals at home, using data from a large, UK, population representative study.

Methods: Data were from waves 1–4 of the UK National Diet and Nutrition Survey (2008–12). Socio-demographic variables of interest were gender, age group, and socio-economic position. Self-reported frequency of consuming meals out and take-away meals at home was categorised as: less than once per week and once per week or more. Analyses were performed separately for adults (aged 18 years or older) and children.

Results: Data from 2001 adults and 1963 children were included. More than one quarter (27.1%) of adults and one fifth (19.0%) of children ate meals out once per week or more. One fifth of adults (21.1%) and children (21.0%) ate take-away meals at home once per week or more. There were no gender differences in consumption of meals out, but more boys than girls ate take-away meals at home at least weekly. The proportion of participants eating both meals out and take-away meals at home at least weekly peaked in young adults aged 19–29 years. Adults living in more affluent households were more likely to eat meals out at least once per week, but children living in less affluent households were more likely to eat take-away meals at home at least once per week. There was no relationship between socio-economic position and consumption of take-away meals at home in adults.

Conclusions: One-fifth to one-quarter of individuals eat meals prepared out-of-home weekly. Interventions seeking to improve dietary intake by reducing consumption of out-of-home food may be more effective if tailored to and targeted at adults aged less than 30 years. It may also be important to develop interventions to help children and adolescents avoid becoming frequent consumers of out-of-home food.

Keywords: Diet, Eating out, Food, Meals, Restaurant, Socioeconomic, Take-away

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Background

Out-of-home sources of ready-to-eat food include vending machines, take-aways, cafes, restaurants, supermarkets and convenience stores [1]. Food prepared out-of-home tends to be less healthful than food prepared at home, particularly in terms of energy and fat content [2]. This likely explains the associations found between frequency of eating out-of-home food and both nutritional quality of total diet and body weight [2,3].

Eating food prepared out-of-home is becoming more common across the world and makes a substantial contribution to individual diets and household spending on food [2,4-6]. For example, in 2012, about 10% of total daily energy intake of UK individuals was accounted for by food prepared and consumed out-of-home, with up to an additional 4% accounted for by take-away food eaten at home [7]. Between 2009 and 2012, expenditure on take-away food eaten at home rose by 11%, in real terms, to an average of £1.79 ($US2.86, €2.28) per person per week [7]. Over the same period, spending on eating out (excluding alcoholic drinks) rose by 7% to £8.95 ($US14.29, €11.40) per person per week, accounting for more than one quarter (26%) of total household spending on food and non-alcoholic drinks [7].

In terms of socio-demographic correlates of out-of-home food consumption, the scant, available data from developed countries suggests that men tend to consume more of their total dietary energy away from home [8,9], and obtain more meals from out-of-home sources [5] than women. Consumption of out-of-home food tends to increase with age in children, peak in late adolescence or early adulthood [10], and then drop with increasing age in adulthood [5,8,9,11-13]. An inconsistent relationship between markers of socio-economic position and out-of-home food consumption in developed countries was found in a systematic review [2].

Interventions to improve the nutritional content of food prepared out-of-home have been attempted in the UK and elsewhere [14,15]. Governmental public health and health education agencies are also increasingly urging individuals to cut down on their consumption of food prepared out-of-home, particularly fast food [16]. As reviewed above, some evidence of differences in consumption of out-of-home food according to socio-demographic characteristics [17,18] is emerging. However, little data from the UK exists. Better understanding of socio-demographic patterns of out-of-home eating is needed to more effectively target and tailor interventions.

Two key problems exist within the literature on out-of-home eating. First, variations in the definition of out-of-home eating make comparisons between studies difficult [2,4]. Some authors focus on food consumed out-of-home, irrespective of where it was prepared; (e.g. [8-10,12]) whilst others focus on food prepared out-of-home, irrespective of where it was consumed (e.g. [5,11,13,19]). Second, international differences in dietary intake [20] and out-of-home eating patterns [8] mean data from one country may not be generalisable to others.

To add to the sparse literature on who eats out-of-home food, we explored frequency and socio-demographic correlates of eating meals out and take-away meals at home, using data from a large, UK, population-representative study. We particularly focused on food prepared, rather than consumed, out-of-home as food prepared out-of-home is the subject of current policy focus [16].

Methods

We performed a cross-sectional analysis of the first four years of data from the UK National Diet and Nutrition Survey (NDNS).

Data source and participants

The NDNS is an annual, cross sectional survey collecting information on the food consumption, nutrient intakes and nutritional status of people aged 1.5 years and older living in private households in the UK. The current programme began in 2008–09 and recruits around 1000 participants per year – 500 children aged 1.5-18 years, and 500 adults aged 19 years or older. As far as possible, sampling, recruitment and data collection methods stay constant from year to year allowing data to be combined across survey years.

Households across the UK are selected to take part in the NDNS using a multi-stage probability design. In each wave, a random sample of primary sampling units is selected for inclusion. These primary sampling units are small geographical areas that allow more efficient data collection by enabling it to be geographically focused. Within these primary sampling units, private addresses are randomly selected for inclusion. If, on visiting, it is found that more than one household lives at a particular address, one is randomly selected for inclusion. Within participating households, up to one adult and one child are randomly selected to take part. Data collection involves a researcher interview covering socio-demographics and shopping, cooking and eating habits; participant completion of a four-day food diary; and a nurse visit. Parents, or carers, provide information on children aged 11 years and younger [21].

Overall, 91% of households eligible for inclusion agreed to take part in the first four waves of NDNS. Usable food diaries (three or four completed days) were collected from at least one household member in 58% of eligible households. At an individual level, 56% of those selected to take part completed usable food diaries: 2083 adults and 2073 children [21].

Anonymised data from the first four waves (2008–09 to 2011–12) of the NDNS were obtained from the UK Data Archive – a data sharing service for the UK research community. These data are available to other eligible researchers directly from the Archive.

Variables of interest

Frequency of eating meals out and take-away meals at home

Whilst the NDNS food diary includes information on where food was consumed, it does not collect information on where food was obtained. However, the researcher interview includes two questions on frequency of eating food prepared out-of-home. These are: "On average, how often do you/does child eat meals out in a restaurant or cafe?"; and "On average, how often do you/does child eat take-away meals at home?". In both questions it is specified that "'meals' means more than a beverage or bag of chips" and participants are asked to "include pizza, fish and chips, Indian, Chinese, burgers, kebab etc.". Response options are: "rarely or never", "1-2 times per month", "1-2 times per week", "3-4 times per week", and "5 or more times per week". We believe these questions were designed specifically for the NDNS. Information is not available on the reliability or validity of these questions, but similar frequency-based questions have been used previously [5].

Responses in the two least frequent categories of the above questions (rarely or never, and 1–2 times per month) were collapsed for analysis as previous research indicates that the health risks associated with fast food occur in those with frequent consumption (more than once per week) [22]. As 5% or fewer participants consumed meals out or take-away meals at home more than 1–2 times per week, responses in the three most frequent categories (1–2 times per week, 3–4 times per week, and 5 or more times per week) were also combined for analysis. This led to dichotomous outcome variables with categories of: less than once per week; and once per week or more.

Socio-demographic variables

Three socio-demographic variables were included: age in years, gender, and socio-economic position. Age was collapsed into approximately 5-year categories for children, and 10-year categories for adults.

Socio-economic position (SEP) was measured using household occupational social class and, in adults only, individual age at completion of full time education. Although net household income (another common measure of SEP) [17,18] is collected in NDNS, around 15% of participants refuse the question and this level of attrition was not considered acceptable.

Occupational social class was categorised using the three-level National Statistics Socio-economic Classification [23] of the household as: higher managerial, administrative and professional occupations; intermediate occupations; and routine and manual occupations. This classification assigns all individuals living in the same household according to the occupation of the householder - the individual responsible for owning or renting the accommodation. Where there is more than one householder, the individual with the highest income takes precedence. Where more than one householder has the same income, the oldest individual takes precedence. Unemployed householders are categorised according to their last main occupation. A small number of households are excluded from this classification where the householder has never worked.

Individual age at completion of full time education was categorised as less than 16 years (equivalent to having obtained less than basic school leaving qualifications), 16–17 (equivalent to basic school leaving qualifications), or more than 18 years (equivalent to advanced school leaving qualifications or more). This variable was not calculated for children aged 18 years or younger as many have not completed full time education. Education was used as an individual, rather than household, marker of SEP. As such we did not use parental education as a proxy for children as it would not be clear which parents' educational status to apply.

Data analysis

Individuals were included in the analysis if they took part in the NDNS in waves 1–4 and information on all of the variables of interest was available.

Logistic regression was used to explore the unadjusted, and mutually adjusted, relationships between likelihood of eating meals out or take-away meals at home once per week or more often across socio-demographic variables. As there was evidence that different patterns in proportion of participants eating these meals once per week or more according to age in adults and children, all analyses were conducted separately for children (18 years or younger) and adults (older than 18 years).

Study weights, prepared by NDNS and provided with the data, were used to account for selective non-response. These weights take account of the fact that whilst sampling for the NDNS is population-representative, response is not. Some population groups are less likely to respond to the invitation to take part in the NDNS than others. Applying study weights corrects for this selective non-response and returns the results to population-representative. The use of study weights mean that percentages (with 95% confidence intervals) are presented rather than raw frequencies.

All analyses were conducted in Stata v13.

Ethics

Ethical approval for collection of NDNS data was provided by Oxfordshire A Research Ethics Committee. Ethical approval for this secondary analyses of anonymised data was not required.

Results

Of 2083 adults and 2073 children who took part in the NDNS in waves 1–4, 2001 (96.1%) adults and 1963 (94.7%) children were included in the analyses. The distribution of participants across socio-demographic variables is shown in the first data column of Table 1.

The proportion of participants who ate meals out once per week or more, overall and by socio-demographic variables, is shown in Table 1. Just over one-quarter of adults (27.1%) and just less than one-fifth of children (19.0%) ate meals out once per week or more. There were no gender differences in proportions eating meals out once per week or more in adults or children. In adults, eating meals out once per week or more was most common in the youngest age groups (19–29 years), with significantly more participants in this group (41.0%) eating meals out once per week or more than in other groups (20.1%-27.6%) in unadjusted and mutually adjusted analyses. However, there was no evidence of an inverse linear association with age. Significantly fewer children aged 10–14 years ate meals out once per week or more than those in the youngest age group (1.5 – 4 years), but there were no other statistically significant differences by age in children.

Adults living in households in the intermediate and most affluent occupational social class were significantly more likely to eat meals out once per week or more than those in the lowest social class in both unadjusted and adjusted analyses. However, there was no difference in the proportion of adults eating meals out once per week

Table 1 Frequency of eating meals out by socio-demographic variables; UK National Diet & Nutrition Survey 2008-12

Variable	Level	Distribution, %[1] (95% CI)	1-2/week or more, % (95% CI)	Unadjusted OR (95% CI)	Mutually adjusted OR (95% CI)
All adults (n = 2001)		100	27.1 (25.0 – 29.4)	–	–
Gender	Male	49.1 (46.7 – 51.6)	28.8 (25.5 – 32.2)	Reference	Reference
	Female	50.9 (48.4 – 53.3)	25.6 (22.8 – 28.6)	0.90 (0.70 – 1.15)	0.89 (0.70 – 1.14)
Age (years)	19-29	18.2 (16.1 – 20.5)	41.0 (34.4 – 47.9)	Reference	Reference
	30-39	17.4 (15.7 – 19.2)	21.9 (17.7 – 26.7)	**0.39 (0.26 – 0.58)**	**0.35 (0.23 – 0.54)**
	40-49	19.2 (17.4 – 21.1)	24.7 (20.5 – 29.4)	**0.47 (0.32 – 0.70)**	**0.43 (0.29 – 0.65)**
	50-59	15.8 (14.2 – 17.6)	25.7 (21.1 – 31.0)	**0.51 (0.34 – 0.77)**	**0.48 (0.32 – 0.73)**
	60-69	14.0 (12.4 – 15.7)	20.1 (15.3 – 25.8)	**0.36 (0.22 – 0.57)**	**0.34 (0.21 – 0.56)**
	>69	15.4 (13.7 – 17.3)	27.6 (22.3 – 33.7)	**0.58 (0.37 – 0.90)**	**0.57 (0.35 – 0.90)**
NS-SEC	Routine & manual	35.4 (33.1 – 37.8)	20.8 (17.7 – 24.3)	Reference	Reference
	Intermediate	20.5 (18.6 – 22.5)	29.7 (24.8 – 35.0)	**1.76 (1.24 – 2.49)**	**1.89 (1.33 – 2.69)**
	Managerial & professional	44.1 (41.7 – 46.6)	31.1 (27.7 – 34.7)	**1.81 (1.37 – 2.41)**	**1.95 (1.43 – 2.65)**
Age left education (years)	<16	24.1 (21.9 – 26.5)	24.2 (19.8 – 29.3)	Reference	Reference
	16-17	35.5 (33.0 – 38.0)	25.7 (22.0 – 29.7)	1.08 (0.78 – 1.50)	0.97 (0.68 – 1.40)
	>17	40.4 (37.8 – 43.0)	29.5 (25.7 – 33.6)	1.31 (0.95 – 1.80)	1.01 (0.69 – 1.48)
All children (n = 1963)		100	19.0 (17.2 – 21.0)	–	–
Gender	Male	52.0 (49.5 – 54.4)	20.0 (17.4 – 22.8)	Reference	Reference
	Female	48.0 (45.6 – 50.5)	18.0 (15.5 – 20.8)	0.88 (0.67 – 1.14)	0.87 (0.66 – 1.13)
Age (years)	0-4	19.6 (17.9 – 21.5)	21.0 (17.4 – 25.1)	Comparator	Comparator
	5-9	28.4 (26.2 – 30.6)	17.3 (14.2 – 21.0)	0.82 (0.57 – 1.16)	0.81 (0.57 – 1.16)
	10-14	28.4 (26.2 – 30.8)	13.5 (10.6 – 17.0)	**0.61 (0.42 – 0.89)**	**0.61 (0.42 – 0.89)**
	15-18	23.5 (21.4 – 25.8)	26.1 (21.8 – 31.0)	1.25 (0.87 – 1.81)	1.27 (0.88 – 1.82)
NS-SEC	Routine & manual	37.0 (34.6 – 39.5)	17.9 (15.0 – 21.3)	Reference	Reference
	Intermediate	20.0 (18.1 – 22.1)	21.4 (17.3 – 26.2)	1.34 (0.93 – 1.94)	1.35 (0.93 – 1.96)
	Managerial & professional	43.0 (40.6 – 45.4)	18.8 (16.2 – 21.7)	1.10 (0.81 – 1.48)	1.12 (0.83 – 1.52)

[1]weighted percentages that correct for selective non-response.
CI: confidence intervals; NS-SEC: National Statistics Socio-economic Classification.
Bold indicates statistically significantly different from reference category at $p < 0.05$.

or more by individual education in adults, or by household occupational social class in children.

Table 2 shows the proportion of participants who ate take-away meals at home once per week or more. More than one fifth of adults (21.1%) and children (21.0%) ate take-away meals at home this frequently.

There were no gender differences in the proportion of participants who ate take-away meals at home once per week or more in adults, but girls were less likely to eat these meals frequently than boys – in unadjusted and mutually adjusted analyses. In adults, the proportion of participants eating take-away meals at home once per week or more tended to decrease with age. Adults in the oldest group (more than 69 years) were one fifth as likely to eat these meals once per week or more than those aged 19–29 years. In children, the proportion eating take-away meals at home once per week or more increased with age. Children aged older than 9 years were significantly more likely to eat these meals at least once per week than those aged less than 5 years in both unadjusted and mutually adjusted analyses. Children aged 15–18 years were more than twice as likely to eat these meals once per week or more than children aged 1.5 – 4 years.

There was no difference in the proportion of adults eating take-away meals at home once per week or more by household occupation social class or individual education in adults after mutual adjustment. However, children living in households of the highest occupational social class were significantly less likely to eat take-away meals at home once per week or more than those living in the least affluent households.

Table 3 shows cross-tabulations of eating meals out and take-away meals at home in adults and children.

Table 2 frequency of eating take away meals at home by socio-demographic variables; UK National Diet & Nutrition Survey 2008-12

Variable	Level	1-2/week or more, % (95% CI)	Unadjusted OR (95% CI)	Mutually adjusted OR (95% CI)
All adults (n = 2001)		21.1 (19.1 – 23.3)	–	–
Gender	Male	23.1 (20.1 – 26.4)	Reference	Reference
	Female	19.2 (16.6 – 22.0)	0.89 (0.68 – 1.17)	0.94 (0.71 – 1.23)
Age (years)	19-29	32.4 (26.3 – 39.1)	Reference	Reference
	30-39	25.8 (21.3 – 30.9)	0.82 (0.54 – 1.26)	0.81 (0.53 – 1.23)
	40-49	26.5 (22.1 – 31.4)	0.96 (0.64 – 1.45)	0.90 (0.59 – 1.36)
	50-59	16.9 (12.9 – 21.8)	**0.50 (0.32 – 0.80)**	**0.49 (0.31 – 0.78)**
	60-69	12.6 (8.6 – 17.9)	**0.38 (0.22 – 0.66)**	**0.36 (0.21 – 0.64)**
	>69	7.9 (4.7 – 12.9)	**0.19 (0.09 – 0.39)**	**0.18 (0.08 – 0.37)**
NS-SEC	Routine & manual	22.1 (18.8 – 25.8)	Reference	Reference
	Intermediate	23.5 (19.0 – 28.8)	1.03 (0.71 – 1.51)	1.09 (0.73 – 1.60)
	Managerial & professional	19.2 (16.4 – 22.3)	0.99 (0.73 – 1.34)	1.03 (0.74 – 1.44)
Age left education (years)	<16	14.5 (10.9 – 19.0)	Comparator	Comparator
	16-17	25.8 (22.0 – 29.9)	**2.04 (1.39 – 3.00)**	1.25 (0.83 – 1.89)
	>17	19.9 (16.8 – 23.5)	1.47 (0.99 – 2.17)	0.83 (0.53 – 1.31)
All children (n = 1963)		21.0 (19.1 – 23.1)	–	–
Gender	Male	23.7 (20.8 – 26.7)	Reference	Reference
	Female	18.2 (15.6 – 21.1)	**0.71 (0.55 – 0.93)**	**0.70 (0.54 – 0.91)**
Age (years)	0-4	14.0 (10.8 – 17.9)	Reference	Reference
	5-9	18.4 (15.1 – 22.1)	1.43 (0.96 – 2.11)	1.44 (0.98 – 2.14)
	10-14	23.1 (19.3 – 27.4)	**1.77 (1.20 – 2.61)**	**1.79 (1.20 – 2.64)**
	15-18	27.7 (23.1 – 32.7)	**2.43 (1.63 – 3.64)**	**2.44 (1.63 – 3.65)**
NS-SEC	Routine & manual	26.0 (22.6 – 29.9)	Reference	Reference
	Intermediate	20.4 (16.1 – 25.4)	0.81 (0.56 – 1.17)	0.82 (0.57 – 1.19)
	Managerial & professional	17.0 (14.4 – 19.9)	**0.59 (0.44 – 0.79)**	**0.60 (0.45 – 0.81)**

[1]weighted percentages that correct for selective non-response.
OR: odds ratio; CI: confidence intervals; NS-SEC: National Statistics Socio-economic Classification.
Bold indicates statistically significantly different from reference category at $p < 0.05$.

Table 3 Cross-tabulation of frequency of eating meals out and take-away meals at home; UK National Diet & Nutrition Survey 2008-12

Meals out	Take-away meals at home			Chi-squared (df), p-value
	<1/week	1-2/week or more	Total	
All adults (n = 2001)	78.9	21.1	100	
<1/week	60.0	12.9	72.9	
1-2/week or more	18.9	8.2	27.1	18.39 (1), <0.001
All children (n = 1963)	79.0	21.0	100	
<1/week	66.9	14.1	81.0	
1-2/week or more	12.1	6.9	19.0	45.66 (1), <0.001

Figures show % of all participants in each cell, weighted for selective non-response.

There was evidence that both adults and children who ate meals out at least once per week were also more likely to eat take-away meals at home at least once per week.

Discussion

Statement of principal findings

As far as we are aware, this is the first description of frequency and socio-demographic correlates of eating food from out-of-home sources in a UK population-representative cohort. In terms of frequency of consumption, around one quarter of adults and one fifth of children ate meals out once per week or more; around one fifth of adults and children ate take-away meals at home once per week or more. In terms of socio-demographic correlates, the only gender differences were that boys were more likely to eat take-away meals at home at least once per week than girls. The proportion of participants who ate both meals out and take-away meals at home at least once per week peaked at age 19–29 years and decreased in older adults. Adults living in households of higher occupational social class were more likely to eat meals out at least once per week, but there was no difference by individual education in adults or household social class in children. Noticeably, there were no socio-economic differences in the proportion of adults eating take-away meals at home at least once per week. But, children living in households of the highest occupation social class were less likely to eat take-away meals at home at least once per week than those in the lowest.

Interpretation and implications of findings

In a number of countries, governments provide advice on how to choose more healthful options when eating meals out and choosing take-away meals, but no guidance on the maximum recommended frequency of consumption is provided [24,25]. Studies have found that the health risks associated with fast food occur in those with consumption more than once per week [22]. If 'fast food' and 'take-away' food can be equated, our findings indicate this level of consumption is particularly common in certain population sub-groups. In particular, almost one-third of adults aged 19–29 years ate take-away meals at home this often. Consumers, particularly aged 19–29 years, may benefit from interventions to decrease frequency of consumption.

Differences in methods also make it hard to compare frequency of consumption reported here with previous work. The most comparable previous data reports on frequency of eating meals prepared in restaurants (either sit-in or take-away) amongst adults in the USA – where 41% of US adults ate such meals three times or more per week in 2000 [5]. As 5% or less of participants in the current study consumed meals out or take-away meals at home more than 1–2 times per week, this suggests that consumption is substantially higher in the USA than the UK. Further consideration of why individuals consume meals out and take-away meals at home, and if this differs between the USA and UK, could inform the development of interventions to prevent further increases in, and even reduce, consumption in both settings, and elsewhere.

Changes in consumption of meals out and take-away meals at home over time may also limit comparisons with previous studies. There is evidence that the prevalence of out-of-home eating establishments increased between 1980 and 2000 [26], suggesting that consumption has also increased over recent decades.

Our finding that boys were more likely than girls to eat take-away meals at home, but not meals out, frequently reflects previous findings. Others have reported that men obtain a greater proportion of their total energy from food consumed out-of-home [8,9], and consume commercially prepared foods more often [5]. The distinctions between meals out and take-away meals at home, and gender differences in children, have not been previously studied. Unlike previous work [5,8,9], we did not find the same gender difference in frequency of consumption of either type of meal in adults. It is possible that patterns of out-of-home eating by gender may have changed in recent years.

Our finding that consumption of both meals out and take-away meals at home peak in early adulthood (19–29 years) is similar to previous reports [5,8,9,11-13]. However, few previous studies have explored the relationship with age in children, and only one has included both adults and children [11]. These trends may reflect true changes in consumption over the lifecourse, secular trends in consumption, or a mixture of both. For example, older people may be less likely to eat meals from out-of-home sources because they tend to have less disposable income

than others [27]; because they did not develop the habit earlier in their life when such options were less common [5]; or for a combination of these, and other, reasons.

We did not study the nutritional quality of the out-of-home meals consumed by participants. It would be inappropriate to assume that all meals from out-of-home sources are nutritionally equal and there may be systematic differences in what is consumed by socio-demographic characteristics. Interventions seeking to improve dietary intake by reducing consumption of out-of-home food may be more effective if tailored to, and perhaps targeting at, adults aged less than 30 years. It may also be important to develop interventions to help children and adolescents avoid becoming frequent out-of-home food consumers.

Eating meals out at least once per week was particularly high in the youngest children (1.5-4 years) (21.0%). This may reflect that these children spend little or no time in formal educational settings meaning they have more opportunity than others to accompany their parents to lunches out, in particular.

Adults of higher SEP, measured by household occupational class, but not individual education, were most likely to eat meals out at least once per week. This may reflect the differences in what different measures of SEP capture. Household occupational social class is more often a measure of current status than educational attainment – which may reflect circumstances many years in the past. [17,18] Differences in eating meals out by occupational class may reflect that such meals can be expensive (although comparative data on the cost of meals out, take-away meals, and home cooked meals is not readily available), as well as cultural differences in leisure activities [28].

No differences in consumption of take-away meals at home were seen in adults according to either measure of SEP. However, children living in households of higher occupational class were less likely to eat take-away meals once per week or more than those living in households of the lowest occupational class. This is perhaps contrary to popular beliefs where high take-away consumption in less affluent groups (across the board, and not just in children) is suggested to contribute to socio-economic inequalities in obesity [29,30]. As noted, previous studies have reported inconsistent associations between SEP and out-of-home eating in adults [2]. Our results suggest this may be due to differences in definition of out-of-home eating, with different relationships seen for meals out and take-away meals at home; or differences in operationalization of SEP, with different relationships seen for occupational social class and education (in adults). It is possible that socio-economic trends in take-away consumption in today's children will carry forward to tomorrow's adults.

We studied meals out and take-away meals separately as there is reason to believe these represent different types of eating [28,31]. Whilst the same food can be bought to take-away or eat in-store in some outlets, many outlets will provide only food to take-away or only food to eat in [1]. Furthermore, the prevalence of these different types of outlets varies with socio-economic markers of local areas. In particularly, restaurants for consuming meals out are most common in more affluent areas in the UK [32].

The fact eating take-away meals at home was more common in less affluent children, but not adults, suggests that socio-economic influences on consumption are not consistent across the lifecourse. Take-away outlet density is higher in more deprived UK neighbourhoods [33], and everyday exposure to take-away outlets across home and work neighbourhoods and commuting routes has been associated with consumption in UK adults [34]. It is possible that children are less mobile in their daily lives and so are more exposed to their home neighbourhood environment than adults. Thus, children who live in deprived neighbourhoods may be particularly exposed to the take-away outlets concentrated there, whereas more mobile adults living in the same neighbourhoods may have more variable take-away outlet exposure as they spend time at home, at work, and commuting.

Strengths and limitations of methods

The NDNS aims to recruit a population-representative sample at each wave and study weights are provided to take account of selective non-response where this exists. Our results are, therefore, likely to be generalisable across the UK. However, given known international differences in eating patterns [8,20], they may not be generalisable to other contexts. Further work, using consistent methods, is required to provide internationally comparable information. The large sample size of both children and adults means that our analyses are unlikely to be underpowered.

The current data were collected in 2008–12, making this the most up-to-date UK dataset on this topic. Whilst it is possible that more recent data may reveal different trends, there was no evidence of differences in frequency of consumption over the four survey years included (data not shown).

Although NDNS does sometimes include one adult and one child per household and it would be possible, in some cases, to explore household congruence of out-of-home eating patterns, this was out with the scope of the current work. Future work could explore household, and other influences, on eating out-of-home.

The validity and reliability of the questions used to assess frequency of consumption have not been explored. One previous study found that frequency of eating out-of-home food in children aged 5–12 years tended to be under-reported in questionnaire compared to food-diary

data [10]. Any systematic differences in interpretations across socio-demographic groups would lead to bias, but the nature of this is difficult to predict. Furthermore, the questions used do not capture the consumption of all food prepared out-of-home. Ideally, the source of all food consumed would be captured alongside food diary data. This could be included in future waves of NDNS.

Out-of-home food outlets are heterogeneous. No information was collected on the specific type of meal out or take-away outlets visited and there may be systematic differences in these across population groups. Similarly, although guidance was given on what a 'meal' is, differences in individual interpretations are likely to introduce error. Future work that disaggregates out-of-home eating using existing tools [32] may reveal further, interesting patterns.

We measured SEP using household occupational social class and, in adults only, age at leaving full time education. These capture two of the three most common measures of individual SEP – occupation, education and income. We were unable to use a marker of individual educational attainment in children as the great majority were still in full time education. Although household income is captured in NDNS, around 15% of the sample refused this particular question – leading to potential non-response bias. We did not include a measure of income for this reason.

It was beyond the scope of the current work to explore the relationships between frequency of eating meals out and take-away meal at home and either dietary quality or adiposity. This has been explored in other (non-UK) cohorts [3,22] and future work could explore these relationships further within NDNS.

Conclusions

We studied frequency and socio-demographic correlates of eating meals out and take-away meals at home, using data from a large, UK population-representative study. Between a fifth and a quarter of people in the UK eat meals out once per week or more, with one fifth eating take-away meals at home this frequently. Boys were more likely than girls to eat take-away meals at home frequently, but no other gender differences were found. At least weekly consumption of both types of meal peaks in early adulthood. Adults from more affluent households are more likely to eat meals out at least weekly, but children from less affluent households are more likely to eat take-away meals at home at least weekly. Interventions seeking to improve dietary intake by reducing consumption of out-of-home food may be more effective if tailored to, or targeting at, adults aged less than 30 years. It may also be important to develop interventions to help children and adolescents avoid becoming frequent consumers of out-of-home food.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
JA conceived the idea for the analysis. All authors contributed to methods development. LG and JA performed the analysis. All authors contributed to data interpretation. JA drafted the manuscript. All authors provided critical comments on the manuscript. All authors read and approved the final manuscript.

Acknowledgements
This paper presents independent research funded by the National Institute for Health Research (NIHR)'s School for Public Health Research (SPHR) with support from Durham and Newcastle Universities, and the NIHR Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.
The School for Public Health Research (SPHR) is funded by the National Institute for Health Research (NIHR). SPHR is a partnership between the Universities of Sheffield, Bristol, Cambridge, UCL; The London School for Hygiene and Tropical Medicine; The Peninsula College of Medicine and Dentistry; the LiLaC collaboration between the Universities of Liverpool and Lancaster and Fuse; The Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities.
AJA is director, CS is a senior investigator and JA and AAL are members of staff in Fuse, the Centre for Translational Research in Public Health, a UKCRC Public Health Research Centre of Excellence. Funding for Fuse from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.

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Received: 6 October 2014 Accepted: 30 March 2015
Published online: 16 April 2015

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3.2 PP1 commentary

This paper looked at habitual behaviour related to two types of out-of-home food consumption. For my thesis, specifically regarding takeaway meal consumption, key findings were:

- One fifth of adults (21.1%) and children (21.0%) ate takeaway meals at home once per week or more
- More boys than girls ate takeaway meals at home at least weekly
- The proportion of participants eating takeaway meals at home at least weekly peaked in young adults aged 19-29
- Children living in less affluent households were more likely to eat takeaway meals at home at least once per week
- There was no relationship between socio-economic position and consumption of takeaway meals at home in adults [Adams et al. (2015a) page 30] [52]

The paper highlights the regular contribution that takeaway food makes to some peoples' diets and the socio-demographic pattering that exists, which should be considered and ideally accounted for by both policy makers and intervention developers.

As detailed in the paper, the NDNS uses a four-day food diary to record detailed dietary intake of participants, but it does not collect information regarding where food purchases were made [66]. Therefore, it is not possible to link foods recorded in the diary to the place where they were purchased. The information relating to out-of-home food consumption, was generated from an interviewer led questionnaire and specifically asks:

> *On average, how often do you / does (child's name) eat takeaway meals at home?*

Interviewees were then presented with a card which displayed the five possible responses:

1. Five or more times per week
2. Three to four times per week
3. One to two times per week
4. One to two times per month
5. Rarely or never [66]

There were additional instructions supplied to the interviewer that specifically defined and constrained the concept the questions were attempting to quantify. These were:

- *'Meals' means more than a beverage or a bag of chips*
- *Include pizza,* Fish & Chip*s, Indian, Chinese, Burgers, Kebabs, etc.*
- *This question is about takeaway meals in the respondent's home only* [66]

The paper highlights potential issues regarding this method of using self-reported estimates of frequency of consumption and states that NDNS makes no mention of attempts to validate this. As a consequence of these caveats, the responses unfortunately did not fully capture the participant's complete habitual takeaway food consumption. Unfortunately, while I can comment on the methods and quality of the data captured, it is not possible to validate the resultant measure. Thus, while the paper provides an insight as to the socio-demographic variation regarding takeaway meal consumption, it does not detail how such habitual consumption patterns influence our diet.

3.3 Evidence for the impact of takeaway food on total energy intake

Despite the growing body of epidemiological evidence suggesting an association between exposure to takeaways and negative impacts on our diet and health, proving a *causal* link is difficult. Prentice and Jebb (2003) attempted to explain the mechanism as to how such consumption can lead to weight gain. They concluded that the high energy densities of such food could lead to the overriding of our appetite control systems resulting in over consumption [44]. Despite this potential causal mechanism, why do some heavy consumers of takeaway food not become overweight? Ebbeling et al. (2004) set up a trial with adolescents to answer this specific question. They explored the impact of consumption in both lean and overweight participants and found that adolescents, regardless of body weight, over-consumed takeaway food, based on a dietary pattern that maintained energy balance. Consumption was greater in the overweight subjects, and in addition, those overweight subjects were less likely to compensate for the additional energy intake throughout the day, by adjusting energy intake across the day, in comparison to lean individuals [122].

Overall, the evidence therefore suggest that takeaway food delivers meals that are excessive with regards to portion size, leading to an over consumption of energy which is unlikely to

be compensated for throughout the day. A US study, by An (2016), of nationally representative data on 18,098 adults 18 years of age and above from the National Health and Nutrition Examination Survey (NHANES) 2003–2010 waves, looked to see if this was the case. They investigated the impact on daily energy intake on both 'fast-food' and 'full-service restaurant' food consumption. They found that consumption of any food and/or beverage on a given day from a fast-food or full-service restaurant was associated with a net increase in daily energy intake respectively of 190kcal and 187kcal and the impact was more pronounced within individuals from lower socio-economic position (SEP) [123]. Due to the differences between the US and UK out-of-home food environments we were interested to investigate if the same relationship was evident in the UK, but not just in adults but also children.

To address this question, using the findings from the paper above [Adams et al. (2015a) page 30] to identify potential interactions between model variables, in my second paper, I analysed NDNS data [66] from the first four waves of data collection to investigate whether individuals who report a higher energy intake had a higher habitual consumption of meals outside the home in a restaurant or café, or takeaway meals consumed at home.

PP2. Relationship between mean daily energy intake and frequency of consumption of out-of-home meals in the UK National Diet and Nutrition Survey

Goffe L, Rushton S, White M, Adamson A, & Adams J. *International Journal of Behavioral Nutrition and Physical Activity* 2017, **14**(131).

Goffe et al. International Journal of Behavioral Nutrition and Physical Activity
(2017) 14:131
DOI 10.1186/s12966-017-0589-5

International Journal of Behavioral Nutrition and Physical Activity

RESEARCH Open Access

Relationship between mean daily energy intake and frequency of consumption of out-of-home meals in the UK National Diet and Nutrition Survey

Louis Goffe[1,2,3*], Stephen Rushton[4], Martin White[1,5], Ashley Adamson[1,2,3] and Jean Adams[5]

Abstract

Background: Out-of-home meals have been characterised as delivering excessively large portions that can lead to high energy intake. Regular consumption is linked to weight gain and diet related diseases. Consumption of out-of-home meals is associated with socio-demographic and anthropometric factors, but the relationship between habitual consumption of such meals and mean daily energy intake has not been studied in both adults and children in the UK.

Methods: We analysed adult and child data from waves 1–4 of the UK National Diet and Nutrition Survey using generalized linear modelling. We investigated whether individuals who report a higher habitual consumption of meals out in a restaurant or café, or takeaway meals at home had a higher mean daily energy intake, as estimated by a four-day food diary, whilst adjusting for key socio-demographic and anthropometric variables.

Results: Adults who ate meals out at least weekly had a higher mean daily energy intake consuming 75–104 kcal more per day than those who ate these meals rarely. The equivalent figures for takeaway meals at home were 63–87 kcal. There was no association between energy intake and frequency of consumption of meals out in children. Children who ate takeaway meals at home at least weekly consumed 55–168 kcal more per day than those who ate these meals rarely. Additionally, in children, there was an interaction with socio-economic position, where greater frequency of consumption of takeaway meals was associated with higher mean daily energy intake in those from less affluent households than those from more affluent households.

Conclusions: Higher habitual consumption of out-of-home meals is associated with greater mean daily energy intake in the UK. More frequent takeaway meal consumption in adults and children is associated with greater daily energy intake and this effect is greater in children from less affluent households. Interventions seeking to reduce energy content through reformulation or reduction of portion sizes in restaurants, cafés and takeaways could potentially lead to reductions in mean daily energy intake, and may reduce inequalities in health in children.

Keywords: Food intake, Eating out, Out-of-home meals, Energy intake, Restaurant, Takeaway, NDNS, Food environment

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Background

Meals purchased out-of-home are considered to be less healthy than homemade meals [1]. Out-of-home fast-food meals tend to be higher in energy, fat, salt and sugar and lower in vitamins and minerals than meals prepared at home [2–9]. In particular, meals from independent takeaway outlets are inconsistent with dietary recommendations, delivering portions that are high in energy, all macronutrients and salt [5, 8]. Whilst the mechanisms that lead to overconsumption are not fully understood [10], experiments in both laboratory and natural settings have shown that large portion sizes, particularly of energy-dense foods, contribute to the overconsumption of energy [11]. Furthermore, consumption of meals from out-of-home sources has been linked to weight gain [12, 13] and an increased risk of insulin resistance [14] and type 2 diabetes [15].

Consumption of ready-to-eat food from out-of-home outlets such as cafés, takeaways, restaurants, and convenience stores is common [16, 17]. Our previous work identified that during 2008 to 2012 in the UK almost one-quarter of adults and one-fifth of children ate a meal out weekly and one-fifth of both adults and children ate a takeaway meal at home at least weekly [18]. A comparable study in the United States, during 2007 to 2010, found that adults consumed on average 11.3% of their energy intake from fast-food [19]. The proportion of household budgets spent on out-of-home meals has increased. In the United States in the 1970s approximately 20% of food expenditure was spent on out-of-home food, [20] rising to 38% by 1992 [17] and 50.1% in 2014 [21]. In the UK, excluding alcohol, the proportion of household food and drink budgets spent out-of-home has risen from 21% in 1995 to 26% in 2014 [22]. This increase in expenditure corresponds to an increase in availability [23], particularly with regards to multinational chain restaurants, which have pursued rapid global expansion since the 1980s [24].

Increased intake of takeaway food is associated with increased exposure to takeaway outlets [25]. A number of epidemiological studies have detailed the association between increased exposure and weight gain, obesity, insulin resistance and type 2 diabetes [12, 14, 15]. The consumption of out-of-home meals is socio-demographically patterned; our analysis of UK data found that boys eat takeaway meals more frequently than girls and peak consumption is found in young adults between the ages of 19 to 29 [18]. We also found that more affluent adults were more likely to eat meals out at least once per week, but children from less affluent households were more likely to eat takeaway meals at least weekly [18]. Additionally, exposure to out-of-home food outlets is strongly socio-demographically patterned, since there is greater takeaway outlet density in more deprived communities [23, 26–28].

As a result of these emerging associations, there have been a number of studies in the US that have attempted to quantify the effect of food from fast-food and full-service restaurants on dietary intake whilst adjusting for socio-demographic variables [29–32]. In adults, consumption of any food from a fast-food outlets or full-service restaurants was respectively associated with a 190 and 187 kcal greater daily energy intake [30]. The equivalent figures for children (aged 2 to 11 years) were an additional 126 and 160 daily kilocalories [29] and adolescents (aged 12 to 19 years) were 310 and 267 kcal [29]. However, to our knowledge, no work has been carried out on UK populations exploring how habitual patterns of out-of-home meal consumption impact on mean daily energy intake across all ages.

We hypothesised that mean daily energy intake is dependent on frequency of consumption of out-of-home meals in both adults and children (hypothesis 1). We also hypothesised that this relationship is dependent on age, gender, socio-economic position and body size (hypothesis 2).

Methods

We undertook secondary analysis of individual-level data from a large, annual UK cross-sectional survey of adults and children to estimate the impact on mean daily energy intake of frequency out-of-home meal consumption, including both meals eaten out and takeaway meals eaten at home, whilst adjusting for a range of socio-demographic and anthropometric factors.

Data source

We combined data from the first four annual waves of the UK National Diet and Nutrition Survey (NDNS) from 2008 to 9 to 2012–13. The NDNS is a rolling programme of cross-sectional surveys carried out across the United Kingdom. NDNS aims to recruit 1000 individuals per year, 500 adults aged 19 years and over, and 500 children aged 1.5 to 18 years, broadly representing the UK population, and collects data on food consumption, nutrient intake and nutritional status of people living in private households. As far as possible sampling, recruitment and data collection methods are constant across years to enable data to be combined across survey years [33]. Individuals in the study completed an estimated four-day food diary and participated in an interview to collect background data that included data on dietary habits, socio-demographic status and lifestyle [33]. Overall, 91% of households eligible for inclusion agreed to take part in the first four waves of NDNS. Usable food diaries (three or four completed days) were collected from at least one household member in 58% of eligible households. At an individual level, 56% of those selected to take part completed usable food diaries: 2083 adults and 2073 children [33].

Variables

Mean daily energy intake

For each individual, mean daily energy intake (kilocalories) was derived from food diary data. The NDNS does not collect data on the source of the food consumed.

Socio-demographic variables

We included three socio-demographic variables to test the second hypothesis: age (years), gender (male/female) and socio-economic position (SEP). SEP was measured using the National Statistics Socio-economic Classification (NS-SeC) [34], where individuals are assigned a class based on the employment of the person in their household with the highest income. Data were collapsed into two levels for analysis – Class 1 (managerial, professional and intermediate occupations) and Class 2 (routine and manual occupations) – as this maximised model fit, as measured by Akaike Information Criterion (AIC). Individuals were excluded where either a response was not provided or the householder had never worked. We anticipated that SEP will impact on behaviour but not necessarily in a monotonic way (e.g. increasing or decreasing with SEP). Therefore, we used SEP as a grouping variable to analyse the differences between classes.

Anthropometric variables

There are many ways of quantifying body size. We considered both body mass index (BMI) and the cubic transformation of height. The cubic transformation of height provides a body mass measure that does not include an estimate of specific tissue mass (e.g. muscle, fat or bone). In full model analysis the cubic transformation of height variable resulted in better model fit than BMI, as measured by AIC.

Frequency of eating meals out and takeaway meals at home

The NDNS does not contain details about where food reported in food diaries was obtained but the interview contained two questions to estimate habitual out-of-home food consumption. These were: "On average, how often do you/does [child's name] eat meals out in a restaurant or café?"; and "On average, how often do you/does [child's name] eat takeaway meals at home?". Individuals were informed by the researcher leading the interview that "'meals means more than a beverage or bag of chips". The responses available to individuals fell on a five point ordinal scale: "Rarely or never?"; "1–2 times per month"; "1–2 times per week"; "3–4 times per week"; or "5 or more times per week". Due to the low number of individuals reporting frequency of consumption in the highest three categories, these were merged to form one category "1 or more times per week".

Data analysis

We used generalized linear modelling (GLM) to investigate the relationships between frequency of consumption of out-of-home meals and individual's mean daily energy intake, with separate models for adults (aged 19 years and over), and children (aged 1.5 to 18 years) (Hypothesis 1). To explore the influence of socio-demographic variables, we included gender, age, height cubed, NS-SeC, frequency of meals out and frequency of takeaway meals as independent predictors (Hypothesis 2). In the adult model, we included potential interactions between: age and both frequency of meals out and takeaways (as consumption peaks in young adults [18]); and NS-SeC and meals out (as adults living in more affluent household are more likely to eat meals out at least once per week [18]). In the child model we included potential interactions between: gender and takeaway meal consumption (as more boys than girls eat takeaway meals [18]); age and both frequency of meals out and takeaways (as consumption peaks in young adults [18]); and NS-SeC and takeaway meal consumption (as children living in less affluent households are more likely to eat takeaways [18]). We used stepwise deletion to identify the significant independent variables ($P < 0.05$). Using the derived regression equations from the GLMs we were able to estimate mean daily energy intake for both adults and children, adjusted for key socio-demographic and anthropometric variables to illustrate the relationship with habitual consumption of out-of-home meals.

In order to illustrate the relationship between mean daily energy intake and the frequency of consumption variables in both adults and children, the derived regression equations from the GLMs were used to generate estimates, which were transformed into kilocalories and plotted with errors bars representing 95% confidence intervals. To calculate the estimates for adults we used the mean height for both females and males in the modelled dataset, 161 cm and 175 cm respectively. To calculate the estimates for the children we used the mean height for both females and males in the modelled dataset, 138 cm and 139 cm respectively.

We carried out data analyses in R [35].

Results

We only included individuals in the analysis where there was a complete set of records for the variables of interest. This resulted in 1889 (90.7%) adults and 1797 (86.7%) children from the first four annual waves of the NDNS (2008–9 to 2012–13). A summary of variables of interest for adults is shown in Table 1 and for children in Table 2. Since the data were not complete for all individuals, some individuals were omitted from the analyses. We assessed the extent to which excluded and included cases differed in their mean daily energy intake,

Table 1 Summary of adult model variables

Variable	Level	N (%)	Mean (SD)
Categorical variables			
All adults		1889	
Gender	Male	829 (43.9)	
	Female	1060 (56.1)	
NS-SeC	Class 1: Higher managerial, administrative, professional and intermediate occupations	1217 (64.4)	
	Class 2: Routine and manual occupations	672 (35.6)	
Frequency of eating meals out	Rarely or never	537 (28.4)	
	1–2 times per month	851 (45.1)	
	1 or more times per week	501 (26.5)	
Frequency of eating takeaway meals at home	Rarely or never	848 (44.9)	
	1–2 times per month	667 (35.3)	
	1 or more times per week	374 (19.8)	
Continuous variables			
Age	Years		49.2 (16.9)
Height	Centimetres		167.5 (9.5)
Mean daily energy intake	Kilocalories		1811.2 (573.1)

socio-demographic, anthropometric characteristics and frequency of consumption of out-of-home meals variables using chi-squared tests and GLMs, as appropriate. Significant differences in the adult model included: mean daily energy intake, where included cases were more likely to have a higher mean daily energy intake; NS-SeC, where included cases were more likely to be in a higher social group; and frequency of meals out consumed, where included cases were more likely to eat meals out more frequently. Significant differences in the child model included: mean daily energy intake, where included cases were more likely to have a higher mean

Table 2 Summary of child model variables

Variable	Level	N (%)	Mean (SD)
Categorical variables			
All children		1797	
Gender	Male	934 (52.0)	
	Female	863 (48.0)	
NS-SeC	Class 1: Higher managerial, administrative, professional and intermediate occupations	1158 (64.4)	
	Class 2: Routine and manual occupations	639 (35.6)	
Frequency of eating meals out	Rarely or never	497 (27.7)	
	1–2 times per month	923 (51.4)	
	1 or more times per week	377 (21.0)	
Frequency of eating takeaway meals at home	Rarely or never	682 (38.0)	
	1–2 times per month	733 (40.8)	
	1 or more times per week	382 (21.3)	
Continuous variables			
Age	Years		9.8 (5.0)
Height	Centimetres		138.4 (27.8)
Mean daily energy intake	Kilocalories		1595.3 (462.1)

daily energy intake; age, where included cases were more likely to be older; frequency of meals out consumed, where included cases were more likely to eat meals out more frequently; and frequency of takeaway meals consumed, where included cases were more likely to eat takeaway meals more frequently.

Adults

Adult mean daily energy intake was dependent on gender, body size, NS-SeC, frequency of eating meals out, and in the highest consumers of takeaway meals (Table 3).

Men consumed more energy per day ($t = 9.20$, $P < 0.01$), as did larger adults ($t = 7.69$, $P < 0.01$) and those living in routine and manual households consumed less ($t = -3.30$, $P < 0.01$). Adults who ate out more frequently consumed more energy, 1–2 times per month ($t = 3.26$, $P < 0.01$), 1 or more times per week ($t = 2.91$, $P < 0.01$). Only adults who ate takeaway meals most frequently (1 or more times per week ($t = 2.48$, $P = 0.01$)), consumed significantly more energy. There was a suggestion of a positive effect of eating takeaway meals at home 1–2 times per month, but this was not significant ($t = 1.72$, $P = 0.08$). There were no significant interaction terms in the adult GLM relating to mean daily energy intake.

Children

Child mean daily energy intake was dependent on gender, body size and NS-SeC (Table 4).

Boys consumed more ($t = 9.56$, $P < 0.01$) as did larger children ($t = 21.33$, $P < 0.01$) and those living in routine and manual households consumed less ($t = -2.21$, $P = 0.03$). There was a suggestion that children who ate takeaway meals more frequently consumed more: 1–2 times per month ($t = 1.65$, $P < 0.10$), 1 or more times per week ($t = 1.91$, $P = 0.06$). Despite this non-significance, the frequency of consumption of takeaway meals at home variables were retained due to a significant interaction between NS-SeC and frequency of eating takeaway meals at home, where the model estimate increased as frequency of consumption increased, 1–2 times per month ($t = 2.01$, $P = 0.04$), 1 or more times per week ($t = 2.10$, $P = 0.04$). This interaction represents a synergistic effect of the two single dependent variables alone. The mean daily energy intake of children living in routine or manual households was more positively related to a greater frequency of consumption of takeaway meals at home than in children living in higher managerial, administrative, professional and intermediate households.

Model residuals

For a GLM with a Gaussian error structure to be an adequate model for the data, the residuals (error) should be normally distributed with zero mean. The distribution of residuals from the adult and child models were normal but there were outliers at the lower end of the body size (height cubed) range where the model appeared to overestimate. Consideration of the records for the individuals concerned showed a level of recorded mean daily energy intake that was lower than the intake required to maintain an estimated basal metabolic rate, indicating poor or inadequate recording.

The estimated mean daily energy intake in adults from the GLMs in relation to the frequency of meals out consumed are shown in Fig. 1. This suggests there is an upward trend between a greater consumption of meals out and mean daily energy intake, which levels off at a consumption of 1–2 meals out per month in all groups modelled. The estimated mean daily energy intake in adults from the GLMs in relation to the frequency of takeaway meals consumed is shown in Fig. 2, which suggests greater consumption of takeaway meals is associated with greater mean daily energy intake in all groups modelled. The estimated mean daily energy intake in children from the GLMs in relation to the frequency of takeaway meals consumed are shown in Fig. 3. Here

Table 3 Significant coefficients from adult GLM

Coefficients	Estimate (Std. Error)	t value	Pr(>|t|)
Intercept	6.9156 (0.0507)	136.4009	< 0.001
Gender: Male	0.1733 (0.0188)	9.2008	< 0.001
Body size	< 0.001 (< 0.001)	7.6875	< 0.001
NS-SeC: Class 2	−0.0457 (0.0139)	−3.2976	< 0.001
Frequency of eating meals out: 1–2 times per month	0.0518 (0.0159)	3.2622	0.0011
Frequency of eating meals out: 1 or more times per week	0.0526 (0.0180)	2.9124	0.0036
Frequency of eating takeaway meals at home: 1–2 times per month	0.0256 (0.0149)	1.7243	0.0848
Frequency of eating takeaway meals at home: 1 or more times per week	0.0442 (0.0179)	2.4754	0.0134

AIC: 586.61
Null deviance: 194.80 on 1888 degrees of freedom
Residual deviance: 149.45 on 1881 degrees of freedom
D-squared: 0.23

Table 4 Significant coefficients from child GLM

Coefficients	Estimate (Std. Error)	t value	Pr(>|t|)
Intercept	7.0228 (0.0156)	449.9743	< 0.001
Male	0.1114 (0.0116)	9.5896	< 0.001
Body size	< 0.001 (< 0.001)	21.3252	< 0.001
NS-SeC Class 2	−0.0449 (0.0203)	−2.2084	0.0273
Eating takeaway meals 1–2 times per month	0.0267 (0.0162)	1.6471	0.0997
Eating takeaway meals 1 or more times per week	0.0392 (0.0205)	1.9083	0.0565
Interaction: NS-SeC Class 2: Eating takeaway meals 1–2 times per month	0.0558 (0.0278)	2.0076	0.0448
Interaction: NS-SeC Class 2: Eating takeaway meals 1 or more times per week	0.0682 (0.0325)	2.1020	0.0357

AIC: 60.33
Null deviance: 148.00 on 1796 degrees of freedom
Residual deviance: 107.72 on 1789 degrees of freedom
D-squared: 0.27

there is also a trend suggesting greater consumption of takeaway meals is associated with greater mean daily energy intake. However, this association is more marked in those individuals from NS-SeC Class 2. There is no figure illustrating the impact of frequency of meals out on mean daily energy intake in children as this variable was non-significant in the child GLM. The estimated difference in mean daily energy intake between the highest and lowest consumers of both meals out and takeaway meals are shown in Table 5.

Discussion

Summary of principal findings

We found a positive relationship between habitual consumption of out-of-home meals and mean daily energy intake. In adults, after adjusting for key socio-

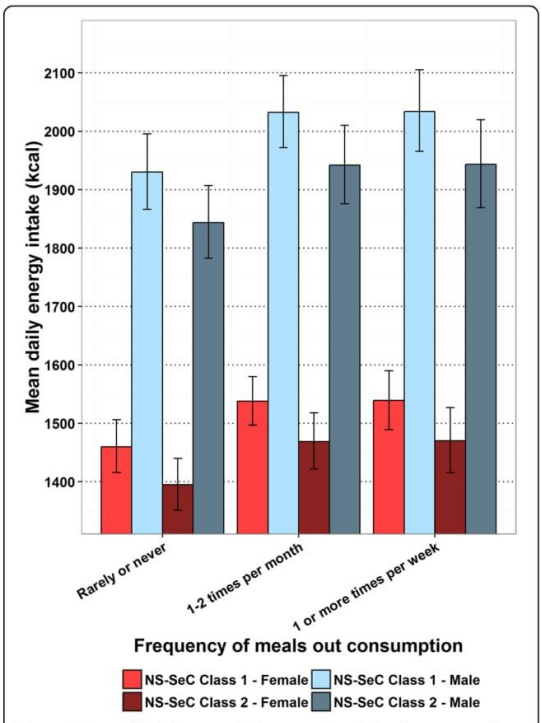

Fig. 1 Estimated adult mean daily energy intake by frequency of meals out consumption with error bars representing 95% confidence intervals

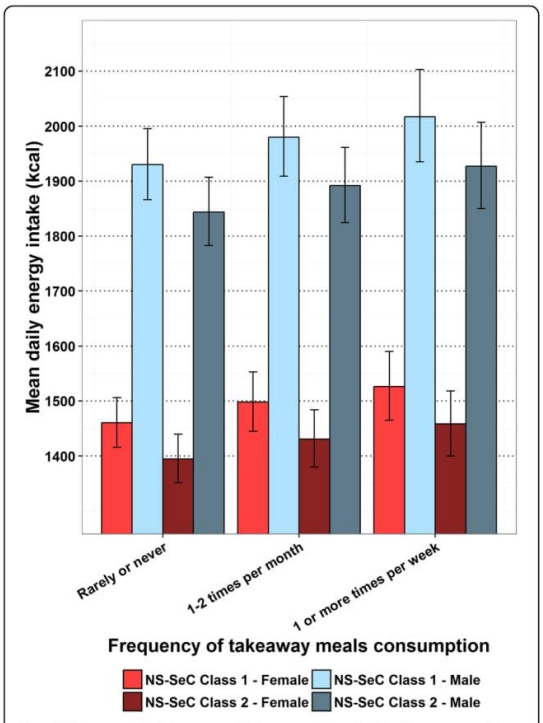

Fig. 2 Estimated adult mean daily energy intake by frequency of takeaway meal consumption with error bars representing 95% confidence intervals

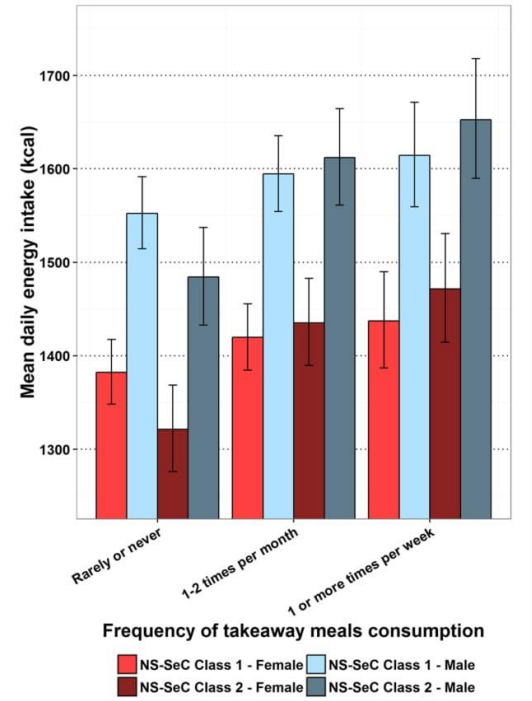

Fig. 3 Estimated child mean daily energy intake by frequency of takeaway meal consumption with error bars representing 95% confidence intervals

demographic and body size variables, we found that greater habitual frequency of consumption of both meals out in a restaurant or café, and takeaway meals was associated with greater mean daily energy intake. Adults who ate meals out at least weekly consumed on average 75–104 kcal more per day than those who ate these meals rarely. Comparable figures for eating takeaway meals at home at least weekly were 63–87 kcal. In children, only habitual consumption of takeaway meals at home had a suggested positive relationship with mean daily energy intake. Children who ate takeaway meals at home at least weekly consumed 55–168 kcal more than those eating these meals rarely. In addition, we found that the impact was amplified by SEP in children, where the larger mean daily energy intake associated with habitual consumption of takeaway meals at home was greater in children from less versus more affluent households.

Table 5 Estimated difference in mean daily energy intake between the highest and lowest consumers

		Difference in consumption between 'Rarely or never' and '1 or more times per week'	
		Meals out (kcal)	Takeaways (kcal)
Adult	NS-SeC Class 1 - Male	104	87
	NS-SeC Class 2 - Male	100	83
	NS-SeC Class 1 - Female	79	66
	NS-SeC Class 2 - Female	75	63
Child	NS-SeC Class 1 - Male		62
	NS-SeC Class 2 - Male		168
	NS-SeC Class 1 - Female		55
	NS-SeC Class 2 - Female		150

Strengths and limitations of study

The modelling method that we applied allowed us to investigate a range of explanatory variables. The range of significant relationships we found indicates that our analyses are unlikely to be underpowered. Although the NDNS attempts to attain a nationally representative sample, because some records were excluded from our analyses due to incomplete data, our results may not be generalisable across the UK. However, it is unclear why the relationships we have identified might vary in other UK groups. As the UK out-of-home food environment is unique [36, 37], our findings may not apply to settings outside the UK. The NDNS does not publish data on participants who did not complete a food diary. Therefore, there is no straightforward method to compare characteristics between those who completed a food diary and those who did not. The NDNS acknowledges that non-response bias exists in their sample and provide survey weights. While there are advantages of using weights for simple population averages, it is not clear how such weights are applied to more complex methods (e.g. regression coefficients). Creating weights requires arbitrary choices regarding inclusion of weighting factors and interactions. We chose not to use these weights in our analysis. However, each of our models were appropriately adjusted for by model covariates in order to take account of potential confounding by socio-demographic variables. While there were some individuals that had recorded mean daily energy intake that was lower than the intake required to maintain an estimated basal metabolic rate, indicating potentially aberrant data, we cannot state conclusively if they were erroneous records. Therefore, no data was excluded from our analysis.

A limitation of the data is that the two self-reported out-of-home consumption variables have not been validated and do not detail what out-of-home food was purchased. If systematic variation exists between what different socio-demographic groups purchase in terms of out-of-home meals and what types of outlets they frequent, this could have led to bias. A related study in Irish children cautioned that assessment of out-of-home food intake using questionnaire data might lead to underreporting, specifically when compared to food diary data [38]. Therefore, the two out-of-home

consumption variables that we used may underestimate actual consumption. Daily energy intake data based on food diary data is also prone to misreporting, particularly underreporting, and there is some evidence this varies by age [39] and BMI [40].

We used a binary variable measure of SEP based on NS-SeC, which produced a better fitting GLM than the original eight class equivalent, as measured by AIC. Other SEP measures are available in NDNS including markers of education and income. We did not use these as the majority of child participants were still in full time education and a large proportion of participants refused to give details regarding their income.

Our data were cross-sectional and as such we cannot conclude that there is a definitive causal relationship between habitual consumption of meals out or takeaway meals at home and mean daily energy intake, nor the direction of causation between these variables.

Comparison with other studies and interpretation of findings

Burgoine et al. (2014) showed that exposure to takeaway food outlets was positively associated with both increased consumption of out-of-home foods and with a higher BMI and obesity in UK adults [25]. Our work provides a potential explanation as to why the increased consumption may lead to an increased BMI and obesity through individuals increasing their overall mean daily energy intake as a result of increased habitual consumption of out-of-home food.

Our results reflect a previous systematic review which found that eating out-of-home was associated with a higher daily energy intake [1]. Six of the ten studies included in this systematic review used data that was both from a Western country and that was either nationally representative or from a large cohort. Of these comparable studies only one found no significant influence of food consumed out-of-home on daily energy intake - in Irish children aged 5–12 [38]. The difference between studies could potentially be explained by contextual differences in out-of-home environments, differences in populations studied (we included participants aged 1.5 years and older, rather than just 5–12 years) or details of data used. Whilst the Irish study used data on where all food eaten over a short period was prepared or obtained, we measured habitual consumption of out-of-home food over the longer term.

Comparable modelling studies that explored the association between fast-food consumption and diet quality in the US [29, 30, 32] also found significant positive associations between frequency of fast-food consumption and energy intake. In US adults, consumption of any fast-food or full-service restaurant meals on a given day was associated with a daily energy intake increase of 190 and 187 kcal respectively [30], in children (aged 2 to 11) an increase of 126 and 160 kcal [29] and adolescents (aged 12 to 19) an increase of 310 and 267 kcal [29]. Our models estimated a mean daily difference of 63–87 kcal in adults and 55–168 kcal in children eating takeaway meals at least weekly compared to rarely, and 75–104 kcal per day in adults eating meals out at least weekly compared to rarely. Although our findings are not directly comparable, both studies found a positive association between greater out-of-home meal consumption and daily energy intake. Our estimates represent a sizeable difference in mean daily energy intake in comparison to government dietary recommendations. The UK government recommends that both adult and 15 to 18 year old females should consume 2000 kcal per day [41]. Therefore, adults and children in our study who ate takeaway meals at least weekly are respectively expected to consume 3.2%–4.4% and 2.8%–8.4% more energy per day than those that consume takeaway meals rarely. Comparable figures for eating meals out at least weekly in adults are 3.8%–5.2%. In adults, the mean daily energy intake estimate for eating meals out was greater than for takeaways. This may be due to cultural practices, such as when eating out is linked to celebrating specific events leading to a combination of consumption of multiple courses and beverages.

Of particular interest in our study is the relationship between takeaway meal consumption and SEP in children, suggesting an amplified impact of takeaway consumption on mean daily energy intake in children from a lower SEP. This combined with the established relationship between deprivation and the density of takeaway outlets [23, 26–28], means that children living in less affluent areas may be both more exposed to and more susceptible to the effects of eating takeaway meals. An also reported that daily energy intake appeared larger among individuals from lower SEP [30], and a UK study that found that greater fast-food consumption, BMI, and odds of obesity were associated with greater fast-food outlet exposure and lower SEP [42], also suggesting amplification of a neighbourhood effect on inequalities in diet and obesity.

Implications for policy and practice

Our results suggest that increased frequency of consumption of meals out in a restaurant or café by adults, and takeaway meals at home by both adults and children is likely to be associated with an increase in mean daily energy intake. With a secular trend towards increasing exposure and ease of access to out-of-home food outlets through online portals [43], and increased expenditure [21, 22], this has potential to have an adverse impact on overall diet quality. Policy makers, local government and caterers should therefore consider options that aim to

limit consumption of such meals, or seek to improve the nutritional quality of out-of-home food, primarily by reformulating, reducing portion size and by providing customers with suitable information to enable them to make informed choices [44]. However, to date there is limited evidence regarding the effectiveness of such interventions [45, 46].

We found the association between habitual consumption of takeaway food and mean daily energy intake to be greater in children from less versus more affluent households. Addressing known socio-economic differences in neighbourhood exposure to takeaway outlets, and possible socio-economic differences in nutritional composition of food chosen, may help reduce known socio-economic differences in diet and obesity in children.

Unanswered questions and future research

The nutritional profile of out-of-home food meals varies greatly [5] and consumption varies by socio-demographic group [18]. But we do not know if there is any socio-demographic patterning in the type of out-of-home food consumed – and this may explain the interaction between SEP and takeaway consumption on mean daily energy intake we found in children. Furthermore, it is not clear if out-of-home food is consumed in total by the purchaser, shared with others, or wasted – or any determinants of this. Future work could explore these points further in order to help tailor and target different interventions to different outlets and socio-demographic groups [18].

This study adds to the substantial body of evidence that suggests that frequent out-of-home food consumption is not conducive to health [1–6, 8, 14, 15, 19, 25, 30, 32, 36]. There remains limited evidence concerning what interventions might be effective in this area [45, 46] but the needs of all stakeholders, including out-of-home food vendors, [47] need to be taken into account in developing intervention strategies. Future work should focus on interventions that aim to reduce the portion size and energy density of meals in cafés, restaurants and takeaways, but also help customers to make healthier choices and incentivise outlet vendors to provide an increased range of healthy options.

Conclusions

Using data from a large UK cross-sectional study we modelled and estimated the impact on mean daily energy intake of habitual consumption of meals eaten out in a restaurant or café and takeaway meals eaten at home in both adults and children, whilst adjusting for socio-demographic and anthropometric measures. In adults, at least weekly consumption of meals out in a restaurant or café was associated with consuming 75–104 kcal more per day compared to rarely eating these meals; and at least weekly consumption of takeaways meals at home was associated with consuming 63–87 kcal more per day. In children, only consumption of takeaway meals at home had a positive association with mean daily energy intake; with at least weekly consumption associated with consuming 55–168 kcal more per day. Additionally, the impact of consumption of takeaway food was amplified in children from less affluent households, suggesting that children of such households are more susceptible to the effects of consumption from takeaway meals than those from more affluent households. Future work should identify interventions that seek to redress the positive association between consumption of out-of-home food and daily energy intake.

Abbreviations

AIC: Akaike information criterion; BMI: Body mass index; GLM: Generalized linear models; kcal: Kilocalories; NS-SeC: National statistics socio-economic classification; SEP: Socio-economic position

Acknowledgements

Not applicable.

Funding

This research was funded by the NIHR School for Public Health Research (SPHR). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health. The SPHR was not involved in the design of the study, analysis, interpretation of data nor writing the manuscript.

This research was part of the SPHR funded project: Transforming the 'foodscape': development and feasibility testing of interventions to promote healthier takeaway, pub or restaurant food. With additional support from Durham and Newcastle Universities, and the NIHR Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). SPHR is funded by the National Institute for Health Research (NIHR). SPHR is a partnership between the Universities of Sheffield, Bristol, Cambridge, Exeter, University College London; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster; and Fuse, the Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. Authors LG and AA are members of Fuse. Funding for Fuse comes from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, and is gratefully acknowledged. AA is funded by the NIHR as a NIHR Research Professor. JA and MW are funded by the Centre for Diet and Activity Research (CEDAR), MRC Epidemiology Unit, University of Cambridge, a UKCRC Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.

Availability of data and materials

The dataset analysed during the current study are available in the UK Data Service repository, https://discover.ukdataservice.ac.uk/series/?sn=2000033.

Authors' contributions

LG, JA and SR conceived the idea for the analysis. All authors contributed to methods development. LG and SR performed the analysis. All authors contributed to data interpretation. LG drafted the manuscript. All authors provided critical comments on the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval for the NDNS was obtained from the Oxfordshire A Research Ethics Committee. We did not require additional ethical approval for this secondary analysis of anonymised data.

Consent for publication
Not applicable.

Competing interests
MW is funded by NIHR as Director of its Public Health Research Funding Programme.

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Received: 2 March 2017 Accepted: 19 September 2017
Published online: 22 September 2017

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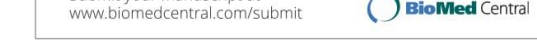

3.4 PP2 commentary

In this paper, I found that adults who ate meals out at least once a week consumed more energy per day than those who ate these meals rarely. This was also the case for those adults that regularly consumed takeaway meals at home. Children who ate takeaway meals at home at least once a week, consumed more energy than those eating these meals rarely. It is not possible to compare my findings directly with An's, (2016) due to the important differences between the out-of-home variables used in each study. An used data from the NHANES, which records from where a given food item was obtained [123], whereas my analysis used NDNS data where participants report their habitual consumption patterns [Goffe et al. (2017) page 42] [53]. However, despite this difference in method, our findings are similar, in that increased consumption of out-of-home food, be it in a restaurant or similar venue or takeaway food at home, was associated with an increase in daily energy intake. In addition, it is worth highlighting that both studies also identified that SEP plays a key role. An reported that the effect of fast-food restaurant consumption on daily energy intake was greater among participants with a lower educational attainment [123]. The GLM I constructed on child consumption identified that a significant interaction representing a synergistic effect between SEP and takeaway consumption, suggesting an amplified effect of takeaway consumption on daily energy intake among children from a lower SEP. This synergistic relationship was not seen in adults. Our findings together with the established literature on area deprivation and takeaway density [36, 87, 124, 125], highlights the increased risk that children in particular are at from the double impact of both higher exposure to such food and the negative consequences of its consumption. Such a conclusion was observed by a recent UK based study by Burgoine et al. (2016) that sought to investigate whether neighbourhood 'fast-food outlet' exposure amplified inequalities in diet and obesity. They used linear and logistic regression models with data from The Fenland Study (a cohort of 5,958 adults aged 29–62 years in Cambridgeshire, collected between 2005 and 2013) combined with measures of fast-food exposure derived from the GIS. They found that *greater fast-food consumption, BMI and odds of obesity were associated both with greater fast-food outlet exposure and a lower educational attainment* [126]. All these studies add further weight and context to the concept of 'food swamps' [page 2] [37]. One potential explanation for this synergistic relationship we found in children from a lower SEP, maybe

related to the type of takeaway that individuals from different socio-economic positions are exposed to and subsequently purchasing meals from. To my knowledge, there is no published data on the relationship between energy per portion of takeaway meals and area deprivation. As the NDNS does not collect data on where food was purchased, it was not possible to investigate this relationship with these data.

3.5 Why do we eat takeaway food?

Research that aims to identify and understand our reasons for consuming such food is limited. As far as I am aware, there is no, in-depth qualitative research exploring individuals' motivations for purchasing and consuming takeaway food. Although I was unable to find any study investigating factors motivating takeaway consumption in the UK, two US studies reported reasons given for consumption of food in fast-food restaurants. In both studies the two key reasons were convenience and taste [127, 128].

The industry's use of marketing to appeal to the customer and drive consumption is usefully summarised through McCarthy's 4Ps classification of the marketing mix: **p**roduct, the item the customer/consumer needs or wants; **p**rice, the cost to the consumer; **p**lace, the access and availability; and **p**romotion, how the product is presented to the customer/consumer [129]. This provides a framework to understand how a given food can appeal to those principal drivers of convenience and taste. For example, in 2012, Just Eat plc's lead campaign was 'Don't Cook, JUST EAT'. Here they promoted, in a comedic style, that cooking was challenging and best left to takeaway professional chefs [130], emphasising issues of *place* in relation to takeaway food ease of accessibility. A review by Boyland & Whalen (2015), found, for example, that food advertising, *promotion*, to children is prevalent, predominantly through online and broadcast media, but also including print media, event sponsorship, outdoor advertising, point of sale in retail environments, and cinema, with the promotion focusing on energy dense and nutrient poor foods. They found that even short-term exposure to such food resulted in increased consumption [131].

In addition to the marketing mix, Higgs & Thomas (2016) contend that there are also pervasive social influences that exert a powerful role on what we eat that may be playing a role in both the development and maintenance of obesity. They hypothesise that our dietary choices converge with those closest in our social connections, so that our dietary norms are

set, in part, by the consumption patterns of those closest to us, as well as by our shared cultural expectations and environmental cues [132].

As part of the Foodscape study, we recruited eight food businesses across Newcastle upon Tyne and Gateshead. Businesses were recruited to take part in qualitative research to develop an understanding of the food preparation and production processes. A variety of recruitment methods were used: Gateshead Council's environmental health team provided us with a list of businesses that they thought would be more likely to engage; my personal contact with businesses; and door-stepping. Takeaway businesses were particularly challenging to recruit, and broadly did not want to engage with the study. Included within the eight businesses were five takeaways: two multi-cuisine takeaways; two Fish & Chip Shops; and one Indian restaurant. The other food businesses included a coffee shop and two sandwich shops. My colleague Dr Linda Penn and I carried out interviews with 10 customers from four of the takeaway businesses. These interviews lasted from one to nine minutes and all, apart from one, took place while customers were waiting for their food, the other interview took place at the customer's home. Due to the brevity and limited number of the interviews, no formal thematic analysis was conducted. However, I did identify certain inductive themes that related to health. There were those that alluded to the fact that, in their opinion, the food was not healthy, but they regarded consumption as a 'treat'. As a consequence customers were equivocal as to whether they would be interested in healthy options, if they were available [133]. Some welcomed the idea, whereas others felt that because the food was regarded as a treat, which implies infrequent occurrence, that health was not an issue and taste was the primary and perhaps only concern [133]. *Shift*, a charitable foundation that builds social businesses that aim to solve social problems [134], developed and prototyped a mobile fast-food business serving hot, tasty, cheap, quick, yet healthy food [76] in East London. The same themes emerged from their engagement with school students. They found that not only did students want tasty and convenient food, it also had to be cheap [76].

3.6 Time scarcity and convenience food

Strazdins et al. (2011) define 'time scarcity' as *'the feeling of not enough time, particularly free or discretionary time'* [135]. While a review of US studies was inconclusive with regards to actual weekly hours worked, there was a clear trend regarding our perception that we are

now living more time pressured lives [136]. Godbey et al. (1998) summarised our behavioural responses to time scarcity: shorten the amount of time we devote to some activities, replace more-time-consuming activities with less-time-consuming substitutes, be more precise with regard to time in our activities, and combine activities so we are doing more than one thing at the same time [137]. Jabs and Devine (2006) observed such behaviours in relation to food as: eating faster, food grazing between activities, limiting meal times, watching TV while eating, and purchasing takeaway food [136].

'Convenience foods', which include not only takeaway foods, but also highly processed, easy to prepare, long-life foods that can be prepared in the home, have been marketed on the basis to be both time and energy saving [138]. Despite the evidence that such food is not good for our health [139], it meets our demand to provide the requisite satisfaction and sustenance while requiring minimal time and little personal effort to prepare. Buckley et al. (2007) analysed responses (n=1,004) to a 2002 questionnaire on 'convenience food lifestyle' from a nationally representative sample of Great British consumers. They divided respondents into four categories: two of which had a preference towards convenience foods, 'kitchen evaders' (representing 16% of the study sample) and 'convenience-seeking grazers' (33%); and two further groups that took a greater interest in what they ate, 'food connoisseurs' (26%), the 'home meal preparers' (25%) [140]. Due to the authors' claims regarding representativeness of the sample, it could be argued at the point of the survey, 2002, that almost half of the population of Great Britain were primarily interested in food that is convenient.

3.6.1 Are cooking skills a barrier to a healthy diet?

Concerns regarding the UK population's poor diet, inclusive of regular takeaway and other convenience food consumption, has resulted in a wider discourse regarding how a perception of time scarcity has influenced our increased reliance on pre-prepared food. This has led some to cite a loss of cooking proficiency as a driver in our increased consumption of convenience food. For example, Baroness Jenkin, a member of the House of Lords, the upper house of the Parliament of the UK, stated in 2014 in an interview that '*If people today had the cooking skills that previous generations had, none of us would be eating so much pre-prepared food*' [141]. However, such unsubstantiated claims regarding a loss in cooking skills are not new. During the post-war period of food rationing, the UK Ministry of Food saw it as

critical to published cooking advice, to support creativity during a time when diversity of basic ingredients were limited [142-144]. While a regular routine of home cooking is associated with a healthier diet, inclusive of a significantly lower consumption of fast-food meals [145], it is not known whether this perceived loss of cooking skills is a causal factor with regards to an increasing consumption of pre-prepared convenience foods and a corresponding reduction in home cooked meals. This hypothesised relationship between cooking skills and health has long been questioned in the academic literature. In 1999, Caraher & Lang posed that the acquisition of cooking skills not only offers the ability to prepare a meal from basic ingredients, but also the knowledge gained helps individuals to make informed decisions regarding processed meals [146]. However, in a subsequent publication by the same authors in 2001, they state that while a lack of cooking skills may contribute to a sense of food insufficiency (latterly referred to as food insecurity), through creating a barrier to full participation, they stress it is primarily financial issues that restrict access to highly valued, nutritious foods [147]. Furthermore, Lang & Caraher argue that cooking skills are not a ridge set of abilities, but are fluid and are continually restructured and fragmented in accordance with our diversifying lifestyles [147].

The literature supports Baroness Jenkin's underlying belief that cooking proficiency can potentially play an important role in maintaining a healthy diet, but this is unlikely to be a panacea. A recent systematic review of interventions to introduce adults to home cooking through the provision of cooking skills and nutritional knowledge concluded that current evidence is inconclusive on the effectiveness and appropriateness of these approaches to facilitate the acquisition of a healthy diet [148]. This indicates that a narrow focus on exclusively on cooking skills is unlikely to result in significant improvements in one's diet. However, despite the numerous interventions cited within this systematic review and the commonly perceived view of the dearth of cooking skills within the general population, the prevalence and socio-demographic correlates of cooking skills within adults in the UK was not known. This information is needed to tailor future cooking skills interventions within the UK towards those found most lacking in cooking ability. This formed the subject of my third paper:

PP3. Prevalence and socio-demographic correlates of cooking skills in UK adults: cross-sectional analysis of data from the UK National Diet and Nutrition Survey

Adams J, Goffe L, Adamson AJ, Halligan J, O'Brien N, Purves R, Stead M, Stocken D, White M. *International Journal of Behavioral Nutrition and Physical Activity* 2015, **12**(99).

Adams et al. International Journal of Behavioral Nutrition and Physical Activity (2015) 12:99
DOI 10.1186/s12966-015-0261-x

International Journal of Behavioral Nutrition and Physical Activity

RESEARCH Open Access

Prevalence and socio-demographic correlates of cooking skills in UK adults: cross-sectional analysis of data from the UK National Diet and Nutrition Survey

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Abstract

Background: Poor cooking skills may be a barrier to healthy eating and a contributor to overweight and obesity. Little population-representative data on adult cooking skills has been published. We explored prevalence and socio-demographic correlates of cooking skills among adult respondents to wave 1 of the UK National Diet and Nutrition Survey (2008–9).

Methods: Socio-demographic variables of interest were sex, age group, occupational socio-economic group and whether or not respondents had the main responsibility for food in their households. Cooking skills were assessed as self-reported confidence in using eight cooking techniques, confidence in cooking ten foods, and ability to prepare four types of dish (convenience foods, a complete meal from ready-made ingredients, a main meal from basic ingredients, and cake or biscuits from basic ingredients). Frequency of preparation of main meals was also reported.

Results: Of 509 respondents, almost two-thirds reported cooking a main meal at least five times per week. Around 90 % reported being able to cook convenience foods, a complete meal from ready-made ingredient, and a main dish from basic ingredients without help. Socio-demographic differences in all markers of cooking skills were scattered and inconsistent. Where these were found, women and main food providers were most likely to report confidence with foods, techniques or dishes, and respondents in the youngest age (19–34 years) and lowest socio-economic group least likely.

Conclusions: This is the only exploration of the prevalence and socio-demographic correlates of adult cooking skills using recent and population-representative UK data and adds to the international literature on cooking skills in developed countries. Reported confidence with using most cooking techniques and preparing most foods was high. There were few socio-demographic differences in reported cooking skills. Adult cooking skills interventions are unlikely to have a large population impact, but may have important individual effects if clearly targeted at: men, younger adults, and those in the least affluent social groups.

Keywords: Food handling, Food preparation, Cookery, Cooking skills, Socioeconomic, Inequalities

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Background

Poor cooking skills may be a barrier to healthy eating and a contributor to overweight and obesity, particularly in low income groups [1–3]. People who lack cooking skills may rely on convenience and pre-prepared foods [4–6]. Similarly, easy access to cheap convenience and pre-prepared foods, may decrease motivation to develop cooking skills or cause existing skills and confidence to atrophy [7].

Poorer cooking skills, less frequent preparation of home-cooked food, and more frequent consumption of pre-prepared foods have been associated with poorer dietary quality and overweight and obesity [4, 8–13]. Growing concern about a perceived lack of cooking skills has led to policy interest in adult cooking skills interventions [14, 15].

Many interventions promoting and teaching cooking skills to adults exist at local level in developed countries [15]. Although some interventions report positive effects on diet [16–18], systematic reviews have found few studies reporting high quality evidence [3, 14]. The current state of the evidence makes it difficult to confirm that cooking skills interventions have a consistent, beneficial impact on diet, or body weight. This could be because: few robust evaluations have been conducted [3], interventions are not adequate to achieve such outcomes [15], good cooking skills are more common than has been assumed, or a combination of these, and other, factors.

Home cooking is a complex phenomenon without an agreed definition [19–21]. For example, preparing spaghetti with Bolognese sauce at home could involve: heating up a pre-prepared 'ready meal' in a microwave; boiling dried spaghetti, frying minced-beef and adding a stir-in sauce; or making spaghetti and Bolognese sauce from the basic ingredients of flour, eggs, tomatoes, minced-beef, and vegetables. Self-reported cooking skills may also be unrelated to everyday use of such skills–with individuals choosing not to cook at home because another household member takes responsibility for this, they eat elsewhere, or they do not prioritise time for cooking [7].

The most recent population-representative data on adults' cooking skills in the UK were collected in 1997. This survey found almost 80 % of women, but only 25 % of men, cooked a main meal on most days of the week–although the definition of 'cooking a main meal' was not clear. Overall, there were very few techniques or foods that 90 % or more of adults were confident using and there were clear gender differences, favouring women, in confidence across all techniques and foods [22]. Other studies have confirmed that women tend to spend more time cooking and report more developed cooking skills than men [8, 12, 23–28]. Recent data from low-income UK households found that over 90 % of women and children, and over 80 % of men, lived in a household where the 'main food provider' (MFP) could prepare a main meal from basic ingredients without help [9]. Indeed recent data from a range of developed countries suggests that most people eat meals prepared at home on most days [8, 11, 13, 22, 23, 29]. UK surveys have found inconsistent trends in cooking skills by age, suggesting that there are not clear cohort effects in self-reported cooking skill, although there may be in how such skills are used [5, 19, 30]. An inverted U-shaped relationship between self-reported cooking skill and age was reported in a Swiss sample peaking at age 50–59 years in women and 40–49 years in men [12]. The reported relationship between markers of socio-economic position and self-reported cooking skills is inconsistent [22, 23, 25, 31, 32].

We are not aware of any recent, population-representative, data on UK adult cooking skills. The aim of this paper is to provide up-to-date information on the prevalence and socio-demographic correlates of cooking skills in UK adults. As food is often purchased and prepared at a household, rather than individual, level, we also explored cooking skills of the MFP (defined below) in respondents' households.

Methods

We conducted a cross-sectional analysis of data from wave 1 of the UK National Diet and Nutrition Survey (NDNS) (2008–9).

Data source

The NDNS is an annual cross-sectional survey assessing the diet, nutrient intake and nutritional status of the general population aged 18 months and upwards living in private households in the UK [33]. Each year, a nationally representative sample is selected using a multi-stage random probability design.

Households across the UK are selected using a multi-stage probability design to take part in the NDNS. In each wave, a random sample of primary sampling units is selected for inclusion. These are small geographical areas that allow more efficient data collection by enabling it to be geographically focused. Within these primary sampling units, private addresses are randomly selected for inclusion. If, on visiting, it is found that more than one household lives at a particular address, one is randomly selected for inclusion. Within participating households, up to one adult and one child are randomly selected to take part as 'respondents'. Data collection involves a researcher interview covering socio-demographics and shopping, cooking and eating habits; participant completion of a 4-day food diary; and a nurse visit [34].

In each household that includes an NDNS respondent, the person with the main responsibility for shopping and preparing food is identified and labelled the MFP. When these tasks were shared equally between more than one person, either one is identified as the MFP. The MFP can, and often is, also a NDNS respondent. Therefore, within each household the NDNS respondent and the MFP may be the same individual. When they are available at the time of data collection, information is collected from MFPs via a structured interview. This interview includes MFP cooking skills and confidence.

The NDNS aims to collect data from a sample of 1000 respondents per year: 500 adults (aged 19 years and older) and 500 children (aged 1.5 to 18 years). Wave 1 of the NDNS was conducted in February 2008–March 2009 and included a series of interview questions on cooking skills. Data from the NDNS were obtained from the UK Data Archive–an online resource that makes research data available to the UK research community.

Inclusion criteria

Respondents were included in the analysis if they: took part in wave 1 of the NDNS; were aged 19 years or older at the time of data collection; and did not report that their ability to cook was limited or prevented due to illness. The MFPs in households of included respondents were included if they also provided an in-person interview. Sixteen MFPs did not provide an in-person interview (during which questions on cooking skills were asked) and were excluded from the analyses.

Variables of interest

Variables of interest fell into two groups: socio-demographic characteristics of respondents and cooking skills of both respondents and MFP.

Socio-demographic variables

Socio-demographic variables of interest were sex, age (collapsed into approximately 15 year age bands for analysis), socio-economic position and MFP status.

Socio-economic position was measured using the National-Statistics Socio-economic Classification (NS-SEC) [35]. This is an occupational classification that we collapsed into three groups (higher and managerial, intermediate, and routine and manual occupations) for analysis, with those not currently in employment classified according to their last main occupation. As per normal procedure, those who had never been employed ($n = 9$) or were unclassifiable ($n = 10$) were included in the routine and manual group (the least affluent group).

Cooking skills

Cooking skills were assessed in three ways–confidence in using eight cooking techniques, confidence in cooking ten foods, and ability to prepare four types of dish. The same questions were used to assess skills in respondents and MFPs.

Confidence in using eight cooking techniques was established using the question: "Which, if any, of the following cooking techniques do you feel confident about using?: boiling; steaming or poaching; frying; stir frying; grilling; oven-baking or roasting; stewing, braising, or casseroling; and microwaving." Questions reported here were read verbatim to respondents by researchers.

Confidence in cooking ten foods was determined using the question: "Which, if any, of the following foods do you feel confident about cooking?: red meat, chicken, white fish (cod, haddock, plaice), oily fish (herring mackerel, salmon), pulses (such as split peas and lentils), dry pasta, rice (savoury), potatoes (not chips), fresh green vegetables (cabbage, spinach, broccoli), and root vegetables (carrots, parsnips)."

For both confidence with cooking techniques and cooking specific foods, techniques and foods were listed on a show-card and respondents and MFPs identified those they felt confident with. Those who spontaneously answered that they were confident with all, or none, were coded as such. It was assumed that if a respondent or MFP did not report feeling confident with a technique or food, then they were not confident with that technique or food.

Ability to prepare four different types of dish was determined using the question "Would you be able to make the following foods and dishes from beginning to end?: convenience foods and ready meals (e.g. frozen pizza, pre-packaged curry & rice); a complete meal from ready-made ingredients (e.g. ready-made sauces and pasta to make spaghetti Bolognese); a main dish from basic ingredients (raw potatoes, raw meat, onions etc.), possibly following a recipe (e.g. shepherd's pie, curry); and a cake or biscuits from basic ingredients (flour, milk, eggs, etc.), possibly following a recipe." Response options for each type of dish were: "No, not at all", "Yes, with a lot of help", "Yes, with a little help", and "Yes, with no help at all". As 89 % of respondents answered "Yes, with no help at all" to the first three of types of dish, leading to small frequencies in some cells, we dichotomised responses into "Yes, with no help at all" and other responses.

Respondents and MFPs were also asked how frequently they prepared a main meal for themselves, or themselves and others in their household. No further information was provided on what constitutes preparing a main meal. Seven response options were available: never, only for special occasions, less than once a week, one or two days a week, some days (3–4 a week), most days (5–6 a week), and every day. To maintain comparability with previous data [22], we

dichotomised answers into most days (5 days of the week or more) and less often.

Statistical analysis

Study weights, provided with NDNS data, were used throughout and all analyses were conducted on weighted data. These weights remove any bias imposed by the method of selecting households and individuals to take part; and reduce any non-response bias at the individual (but not question) level [33]. The use of study weights means that all frequencies are presented as percentages (with 95 % confidence intervals) rather than raw frequencies. There was no missing data for individual respondents.

Logistic regression was used to explore simple differences in frequency and confidence of cooking across socio-demographic variables. In these analyses male, the youngest age group, the most affluent social class and not being an MFP were the reference categories against which other categories were compared. All analyses were conducted in Stata v11.

Ethics

Ethical approval for wave 1 of the NDNS was obtained from Oxfordshire A Research Ethics Committee. We did not require additional ethical approval for this secondary analysis of anonymised data.

Results

In total, 509 respondents, and 493 MFPs, from 509 households were included in the analysis. Table 1 shows the distribution of socio-demographic variables of interest. There was an even split of respondents by gender (49.0 %, 95 % confidence intervals: 44.2–53.9 male); median age was 46 years (inter-quartile range: 33–62 years); just over one third of respondents (36.1 %, 95 % CI: 31.4–40.9) were in the routine & manual socio-economic group and around one-fifth (20.1 %, 95 % CI: 16.5–24.3) were in the intermediate socio-economic group; and over two-thirds (67.5 %, 95 % CI: 62.5–72.1) were classified as the MFP in their household.

Table 1 also shows the proportion of respondents who reported preparing a main meal at least five times per week, and the proportion who lived in a household where the MFP did this. Almost two thirds of respondents (63.1 %, 95 % CI: 58.1–67.8) said they prepared a main meal on most days of the week, whilst more than four-fifths (83.9 %, 95 % CI: 80.0–87.2) lived in a household where the MFP said they did so. Women, those aged 35–49 years, and respondents who were MFPs were more likely to report cooking a main meal on most days. Individuals aged 50–64 years were more likely to live in a household where the MFP cooked on most days of the week than those aged 19–34 years.

Table 1 Frequency and odds of main meal preparation, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Distribution, % (95 % confidence intervals)	Respondent prepares main meal for self ± others 5+ days per week		Main food provider prepares main meal for self ± others 5+ days per week	
		% (95 % confidence intervals)	Odds ratio (95 % confidence intervals)	% (95 % confidence intervals)	Odds ratio (95 % confidence intervals)
All	100	63.1 (58.1–67.8)	–	83.9 (80.0–87.2)	–
Gender					
Men	49.0 (44.2–53.9)	43.5 (36.5–50.8)	Reference	84.5 (79.0–88.8)	Reference
Women	51.0 (46.1–55.8)	81.9 (76.0–86.6)	5.85 (3.69–9.28)	83.4 (77.4–88.0)	0.92 (0.54–1.56)
Age (years)					
19–34	28.0 (23.6–32.8)	53.3 (43.1–63.2)	Reference	76.9 (67.1–84.5)	Reference
35–49	27.6 (23.5–32.0)	67.8 (59.0–75.4)	1.85 (1.06–3.22)	85.6 (79.1–90.3)	1.78 (0.91–3.48)
50–64	24.4 (20.5–28.6)	66.3 (56.4–75.0)	1.73 (0.96–3.10)	87.8 (81.0–92.3)	2.15 (1.05–4.42)
> 64	20.1 (16.5–24.3)	66.3 (55.5–75.6)	1.73 (0.94–3.18)	86.7 (77.2–92.7)	1.96 (0.86–4.47)
NS-SEC					
Managerial & prof.	41.7 (37.0–46.7)	60.2 (52.3–67.5)	Reference	84.0 (77.2–89.1)	Reference
Intermediate	22.2 (18.3–26.8)	72.7 (61.3–81.7)	1.76 (0.96–3.24)	88.4 (79.7–93.7)	1.46 (0.65–3.24)
Routine & manual	36.1 (31.4–40.9)	60.5 (52.2–68.2)	1.01 (0.64–1.61)	81.7 (75.0–86.9)	0.85 (0.47–1.53)
Respondent is main food provider					
No	32.6 (27.9–37.5)	16.9 (11.0–25.1)	Reference	–	–
Yes	67.5 (62.5–72.1)	85.3 (80.8–88.9)	28.48 (15.77–51.44)	–	–

NS-SEC National Statistics socio-economic classification, – not applicable

The percentages of respondents reporting confidence in using the eight cooking techniques are shown in Table 2. Three-quarters, or more, of respondents reported confidence with using each of the techniques, except stir-frying (where just less than three-quarters–74.4 %, 95 % CI: 70.0–78.4–reported confidence). At least 90 % of respondents reported confidence with boiling (93.1 %, 95 % CI: 90.0–95.2), grilling (90.6 %, 95 % CI: 87.3–93.1), and oven-baking or roasting (90.0 %, 95 % CI: 86.4–92.7).

Odds of reporting confidence with cooking techniques by socio-demographic variables are shown in Table 3. There were some, scattered, differences in confidence with techniques by socio-demographic variables. Where these were present, women, respondents who were older than 19–34 years, and respondents who were MFPs tended to be most likely to report confidence with cooking techniques. No socio-demographic differences were seen in confidence with frying, or microwaving.

Table 4 shows confidence with cooking 10 different foods. More than three-quarters of respondents reported confidence cooking each food, except oily fish (69.9 %, 95 % CI: 65.3–74.1) and pulses (60.4 %, 95 % CI: 55.5–65.1). More than 90 % of respondents reported confidence with cooking chicken (91.3 %, 95 % CI: 88.1–93.8), potatoes (94.3 %, 95 % CI: 91.2–95.1), and fresh green vegetables (92.7 %, 95 % CI: 89.4–95.1).

Odds ratios of confidence with different foods are shown in Table 5. As before, women, those who were older than 34 years, and those who were the MFP tended to be most likely to report confidence. Those in the lowest socio-economic group tended to be least likely to report confidence with cooking specific foods.

The reported ability of respondents to prepare four types of dishes without help, and odds of these by socio-demographic group, is shown in Table 6. More than 90 % of respondents reported being able to prepare ready meals (97.6 %, 95 % CI: 95.3–98.7) and a meal from ready-made ingredients (93.1 %, 95 % CI: 90.1–95.3) without help, with 89.2 % (95 % CI: 85.5–92.1) reporting being able to do the same for a main dish from basic ingredients. Just over two thirds of respondents (69.0 %, 95 % CI: 64.2–73.4) said they could bake a cake or biscuits without help. There were few statistically significant differences in ability to prepare these dishes by socio-demographic groups. Where these were found, women and those who were MFPs were most likely to be able to prepare dishes without help.

Data in Additional file 1: Table S1, S2, S3, S4 and S5 show that more than 75 % of respondents lived in

Table 2 Confidence in using eight cooking techniques, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Boiling, % (95 % CI)	Steaming, poaching, % (95 % CI)	Frying, % (95 % CI)	Stir frying, % (95 % CI)	Grilling, % (95 % CI)	Oven-baking, roasting, % (95 % CI)	Stewing, braising, casseroling, % (95 % CI)	Microwaving, % (95 % CI)
All respondents	93.1 (90.0–95.2)	75.0 (70.4–79.0)	88.2 (84.8–90.9)	74.4 (70.0–78.4)	90.6 (87.3–93.1)	90.0 (86.4–92.7)	76.0 (71.4–80.1)	83.1 (79.3–86.4)
Gender								
Men	89.7 (84.2–93.4)	67.3 (60.0–73.9)	90.0 (84.2–93.2)	69.7 (62.6–75.9)	87.7 (82.1–91.8)	81.9 (75.3–87.0)	81.9 (75.8–86.8)	81.9 (75.8–86.8)
Women	96.3 (92.6–98.2)	82.3 (76.9–86.7)	86.8 (82.1–90.4)	79.0 (73.4–83.7)	93.4 (89.4–96.0)	97.7 (95.1–98.9)	84.2 (79.2–88.2)	84.2 (79.2–88.2)
Age (years)								
19–34	92.2 (85.7–95.9)	59.6 (49.3–69.0)	89.0 (82.1–93.4)	72.5 (63.1–80.3)	87.1 (79.1–92.3)	88.8 (80.5–93.8)	59.8 (49.6–69.3)	89.4 (82.0–94.0)
35–49	94.5 (99.1–97.5)	86.5 (79.0–91.6)	88.3 (81.5–92.8)	83.3 (75.5–88.9)	94.8 (88.9–97.6)	96.7 (92.1–98.7)	82.0 (73.9–88.0)	81.3 (73.8–87.0)
50–64	93.0 (84.2–97.0)	78.2 (69.2–85.2)	86.6 (78.5–91.9)	74.5 (65.2–82.0)	92.5 (84.8–96.5)	88.7 (79.8–94.0)	84.1 (75.5–90.1)	82.2 (73.7–88.5)
> 64	92.4 (84.1–96.5)	76.6 (66.7–84.3)	88.7 (80.1–93.9)	64.8 (54.1–74.2)	87.6 (78.9–93.0)	83.8 (74.0–90.4)	80.6 (70.7–87.7)	77.8 (68.0–85.3)
NS-SEC								
Managerial & prof.	93.3 (88.3–96.3)	78.6 (71.4–84.3)	90.4 (85.3–93.8)	81.0 (74.4–86.3)	93.8 (89.2–96.6)	92.0 (86.3–95.5)	76.4 (69.0–82.4)	86.9 (81.3–90.9)
Intermediate	96.0 (88.3–98.7)	86.1 (76.2–92.3)	91.5 (84.1–95.6)	82.1 (72.9–88.7)	94.6 (87.7–97.7)	94.9 (86.8–98.1)	89.9 (80.5–95.1)	84.6 (76.1–90.4)
Routine & manual	91.1 (85.0–94.9)	64.9 (57.1–72.0)	84.0 (77.4–88.9)	63.1 (55.3–70.3)	85.1 (78.2–90.0)	85.0 (78.1–90.0)	67.9 (59.9–74.9)	78.3 (71.1–84.2)
Respondent is main food provider								
No	85.7 (77.9–91.1)	63.2 (53.7–71.9)	89.7 (82.4–94.1)	69.8 (70.6–77.6)	88.2 (80.3–93.2)	79.2 (70.4–85.9)	58.7 (49.1–67.6)	87.5 (79.9–92.5)
Yes	96.6 (93.7–98.2)	80.6 (75.8–84.6)	87.4 (83.4–90.6)	76.7 (71.6–81.1)	91.8 (88.3–94.3)	95.1 (92.1–97.0)	84.4 (79.9–88.1)	81.0 (76.3–84.9)

CI confidence intervals, *NS-SEC* National Statistics socio-economic classification

Table 3 Odds of having confidence using eight cooking techniques, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Boiling, odds ratio (95 % CI)	Steaming, poaching, odds ratio (95 % CI)	Frying, odds ratio (95 % CI)	Stir frying, odds ratio (95 % CI)	Grilling, odds ratio (95 % CI)	Oven-baking, roasting, odds ratio (95 % CI)	Stewing, braising, casseroling, odds ratio (95 % CI)	Microwaving, odds ratio (95 % CI)
Gender								
Men	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Women	2.97 (1.24–7.08)	2.26 (1.43–2.60)	0.77 (0.42–1.39)	1.64 (1.05–2.55)	1.99 (1.00–3.96)	9.46 (3.94–22.71)	2.61 (1.61–4.25)	1.18 (0.71–1.94)
Age (years)								
19–34	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
35–49	1.43 (0.49–4.20)	4.34 (2.22–8.51)	0.94 (0.43–2.04)	1.89 (0.99–3.61)	2.69 (0.99–7.33)	3.72 (1.20–11.48)	3.06 (1.63–5.74)	0.51 (0.24–1.10)
50–64	1.11 (0.36–3.45)	2.44 (1.31–4.57)	0.80 (0.36–1.78)	1.11 (0.60–2.06)	1.83 (0.68–4.89)	0.99 (0.38–2.56)	3.56 (1.80–7.04)	0.55 (0.25–1.22)
> 64	1.02 (0.35–3.00)	2.22 (1.17–4.22)	0.98 (0.41–2.35)	0.70 (0.37–1.30)	1.05 (0.44–2.47)	0.65 (0.27–1.58)	2.79 (1.41–5.53)	0.42 (0.19–0.92)
NS-SEC								
Managerial & prof.	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Intermediate	1.74 (0.46–6.54)	1.69 (0.79–3.62)	1.15 (0.49–2.71)	1.07 (0.56–2.08)	1.15 (0.39–3.38)	1.62 (0.49–5.39)	2.76 (1.18–6.48)	0.83 (0.42–1.65)
Routine & manual	0.73 (0.30–1.77)	0.48 (0.29–0.80)	0.54 (0.28–1.04)	0.39 (0.24–0.66)	0.37 (0.17–0.82)	0.49 (0.23–1.06)	0.67 (0.40–1.12)	0.57 (0.32–1.02)
Respondent is main food provider								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	4.73 (2.06–10.89)	2.42 (1.49–3.93)	0.80 (0.40–1.61)	1.42 (0.88–2.31)	1.50 (0.72–3.09)	5.11 (2.53–10.32)	3.81 (2.33–6.26)	0.61 (0.32–1.14)

CI confidence intervals, *NS-SEC* National Statistics socio-economic classification

Table 4 Confidence in cooking 10 foods, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Red meat, % (95 % CI)	Chicken, % (95 % CI)	White fish, % (95 % CI)	Oily fish, % (95 % CI)	Pulses, % (95 % CI)	Dry pasta, % (95 % CI)	Rice (savoury), % (95 % CI)	Potatoes (not chips), % (95 % CI)	Fresh green veg, % (95 % CI)	Root veg, % (95 % CI)
All	87.7 (84.2–90.5)	91.3 (88.1–93.8)	79.7 (75.4–83.5)	69.9 (65.2–74.1)	60.4 (55.5–65.1)	84.9 (80.9–88.1)	87.8 (84.1–90.7)	94.3 (91.2–96.4)	92.7 (89.4–95.1)	89.6 (86.1–92.3)
Gender										
Men	87.8 (82.3–91.7)	88.4 (82.7–92.3)	74.9 (67.8–80.9)	63.8 (56.5–70.5)	55.1 (47.7–62.2)	78.8 (72.3–84.2)	83.2 (76.9–88.1)	92.4 (87.0–95.7)	87.9 (81.9–92.1)	85.5 (79.5–90.0)
Women	87.6 (82.6–91.3)	94.2 (90.3–96.6)	84.3 (79.1–88.4)	75.7 (70.0–80.7)	65.4 (58.9–71.4)	90.7 (86.0–93.9)	92.1 (87.9–95.0)	96.2 (92.1–98.2)	97.3 (93.7–98.9)	93.5 (89.2–96.1)
Age (years)										
19–34	82.0 (73.8–88.0)	88.9 (82.0–93.4)	70.5 (60.7–78.7)	56.5 (46.4–65.6)	46.4 (36.6–56.4)	92.3 (85.7–96.0)	91.7 (84.8–95.6)	93.4 (85.8–97.1)	90.4 (82.5–95.0)	85.7 (77.7–91.2)
35–49	91.0 (84.1–95.1)	93.6 (87.2–96.9)	78.7 (70.3–85.3)	78.0 (69.9–84.4)	67.1 (58.4–74.8)	92.0 (84.6–96.0)	93.4 (86.0–97.0)	94.9 (87.6–98.0)	93.1 (85.7–96.8)	92.7 (86.0–96.3)
50–64	91.1 (83.1–95.5)	92.1 (83.3–96.4)	86.2 (77.5–91.9)	74.4 (65.2–81.9)	65.2 (55.6–73.7)	81.9 (72.6–88.5)	84.9 (75.7–91.0)	94.6 (86.4–98.0)	93.1 (84.4–97.1)	90.3 (81.6–95.1)
> 64	87.0 (78.4–92.5)	90.6 (82.1–95.3)	86.0 (76.8–92.0)	71.9 (61.3–80.5)	64.7 (53.9–74.1)	68.3 (57.7–77.4)	78.2 (68.2–85.7)	94.6 (87.3–97.8)	94.9 (87.9–98.0)	90.0 (80.9–95.0)
NS-SEC										
Managerial	88.0 (81.9–92.2)	91.8 (86.3–95.2)	82.4 (75.8–87.5)	76.4 (69.4–82.2)	69.2 (61.7–75.9)	90.2 (84.5–94.0)	91.0 (84.9–94.8)	95.1 (90.3–97.5)	92.9 (87.4–96.1)	90.5 (84.7–94.3)
Intermediate	93.9 (87.3–97.1)	96.0 (88.6–98.7)	85.4 (75.5–91.7)	79.6 (69.4–87.0)	69.3 (58.2–78.5)	85.2 (75.6–91.5)	93.2 (86.5–96.7)	97.5 (84.5–99.6)	99.6 (96.9–99.9)	97.6 (90.9–99.4)
Routine	84.0 (77.4–88.9)	88.2 (82.0–92.5)	73.7 (66.0–80.2)	57.6 (49.8–65.1)	46.0 (38.5–53.7)	79.0 (71.8–84.8)	81.3 (74.2–86.8)	91.8 (85.6–95.5)	88.7 (81.8–93.2)	84.1 (77.2–89.2)
Respondent is main food provider										
No	81.7 (73.5–87.8)	84.3 (76.2–90.0)	67.4 (58.0–75.6)	56.2 (46.8–65.3)	49.5 (40.2–58.8)	81.6 (73.3–87.7)	84.2 (76.0–89.9)	90.0 (82.6–94.4)	83.9 (75.6–89.7)	81.1 (72.7–87.3)
Yes	90.6 (86.9–93.3)	94.7 (91.7–96.7)	85.7 (81.3–89.2)	76.4 (71.5–80.7)	65.6 (59.9–70.8)	86.5 (81.9–90.0)	89.5 (85.4–92.6)	96.5 (92.9–98.3)	97.0 (93.7–98.6)	93.7 (90.2–96.0)

CI confidence intervals, *NS-SEC* National Statistics socio-economic classification

Table 5 Odds of having confidence in cooking 10 foods, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Red meat, odds ratio (95 % CI)	Chicken, odds ratio (95 % CI)	White fish, odds ratio (95 % CI)	Oily fish, odds ratio (95 % CI)	Pulses, odds ratio (95 % CI)	Dry pasta, odds ratio (95 % CI)	Rice (savoury), odds ratio (95 % CI)	Potatoes (not chips), odds ratio (95 % CI)	Fresh green veg, odds ratio (95 % CI)	Root veg, odds ratio (95 % CI)
Gender										
Men	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Women	0.99 (0.55–1.78)	2.12 (1.03–4.36)	1.80 (1.10–2.94)	1.77 (1.16–2.70)	1.54 (1.03–2.32)	2.62 (1.46–4.68)	2.36 (1.27–4.41)	2.06 (0.78–5.46)	4.99 (1.80–13.81)	2.43 (1.21–4.87)
Age (years)										
19–34	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
35–49	2.23 (1.00–5.00)	1.83 (0.71–4.76)	1.55 (0.83–2.90)	2.73 (1.52–4.90)	2.36 (1.36–4.09)	0.96 (0.35–2.65)	1.28 (0.44–3.75)	1.33 (0.36–4.82)	1.44 (0.50–4.20)	2.11 (0.86–5.20)
50–64	2.25 (0.94–5.41)	1.44 (0.52–4.00)	2.63 (1.25–5.50)	2.24 (1.23–4.07)	2.17 (1.23–3.83)	0.38 (0.16–0.91)	0.51 (0.21–1.25)	1.24 (0.33–4.65)	1.44 (0.46–4.53)	1.55 (0.62–3.88)
> 64	1.47 (0.68–3.21)	1.20 (0.47–3.07)	2.58 (1.21–5.52)	1.97 (1.06–3.69)	2.12 (1.16–3.87)	0.18 (0.08–0.41)	0.33 (0.14–0.77)	1.24 (0.35–4.37)	1.98 (0.61–6.40)	1.50 (0.59–3.79)
NS-SEC										
Managerial	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Intermediate	2.09 (0.82–5.31)	2.17 (0.61–7.73)	1.25 (0.59–2.65)	1.20 (0.63–2.30)	1.00 (0.56–1.80)	0.63 (0.28–1.41)	1.35 (0.52–3.52)	2.04 (0.25–16.82)	17.51 (2.9–140.23)	4.31 (0.95–19.57)
Routine	0.72 (0.38–1.40)	0.65 (0.30–1.41)	0.60 (0.34–1.05)	0.43 (0.26–0.70)	0.37 (0.23–0.59)	0.37 (0.18–0.71)	0.40 (0.19–0.83)	0.54 (0.20–1.43)	0.61 (0.26–1.47)	0.56 (0.27–1.14)
Respondent is main food provider										
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	2.15 (1.18–3.93)	3.36 (1.66–6.82)	2.89 (1.72–4.83)	2.52 (1.60–3.99)	1.94 (1.24–3.04)	1.44 (0.80–2.60)	1.61 (0.85–3.06)	3.04 (1.16–7.99)	6.19 (2.45–15.60)	3.48 (1.77–6.86)

CI confidence intervals, *NS-SEC* National Statistics socio-economic classification

Table 6 Ability, and odds of having ability, to prepare four dish types without help, National Diet & Nutrition Survey, 2008–09, $n = 509$

Variable & level	Convenience foods & ready meals		Complete meal from ready-made ingredients		Main dish from basic ingredients		Cake or biscuits from basic ingredients	
	% (95 % CI)	Odds ratio (95 % CI)	% (95 % CI)	Odds ratio (95 % CI)	% (95 % CI)	Odds ratio (95 % CI)	% (95 % CI)	Odds ratio (95 % CI)
All respondents	97.6 (95.3–98.7)	–	93.1 (90.1–95.3)	–	89.2 (85.5–92.1)	–	69.0 (64.2–73.4)	–
Gender								
Men	95.7 (91.3–97.9)	Reference	89.2 (83.6–93.0)	Reference	82.8 (76.1–87.9)	Reference	47.6 (40.0–54.9)	Reference
Women	99.4 (97.1–99.9)	6.91 (1.28–37.33)	97.0 (94.0–98.5)	3.90 (1.65–9.17)	95.5 (92.1–97.4)	1.10 (0.40–3.03)	89.5 (85.1–92.7)	9.44 (5.77–15.45)
Age (years)								
19–34	98.9 (95.6–99.7)	Reference	95.6 (89.8–98.2)	Reference	86.0 (77.5–91.6)	Reference	64.8 (54.7–73.8)	Reference
35–49	99.2 (94.5–99.9)	1.44 (0.13–16.23)	97.4 (93.0–99.1)	1.71 (0.43–6.80)	91.6 (84.1–95.8)	1.79 (0.71–4.51)	79.1 (70.9–85.4)	2.05 (1.11–3.77)
50–64	94.5 (85.9–98.0)	0.20 (0.03–1.12)	90.4 (81.6–95.3)	0.43 (0.13–1.41)	89.9 (81.0–95.0)	1.46 (0.57–3.73)	67.8 (57.8–76.4)	1.14 (0.63–2.09)
> 64	97.2 (91.1–99.2)	0.39 (0.06–2.53)	87.1 (78.1–92.8)	0.31 (0.10–0.94)	89.5 (80.8–94.6)	1.39 (0.56–3.49)	62.4 (51.5–72.1)	0.87 (0.47–1.61)
NS-SEC								
Managerial & prof.	97.9 (94.5–99.2)	Reference	94.2 (89.4–96.9)	Reference	92.3 (87.0–95.6)	Reference	73.5 (66.1–79.7)	Reference
Intermediate	98.1 (92.6–99.5)	1.12 (0.19–6.43)	94.2 (85.1–97.8)	0.98 (0.29–3.37)	88.5 (77.9–94.4)	0.64 (0.24–1.70)	66.9 (55.4–76.7)	0.73 (0.40–1.33)
Routine & manual	96.9 (91.2–98.9)	0.69 (0.14–3.45)	91.4 (85.8–94.9)	0.62 (0.25–1.50)	86.4 (79.6–91.1)	0.51 (0.24–1.12)	65.5 (57.7–72.5)	0.66 (0.41–1.08)
Respondent is main food provider								
No	94.7 (88.0–97.8)	Reference	85.3 (77.3–90.8)	Reference	74.0 (64.8–81.5)	Reference	48.7 (39.4–58.0)	Reference
Yes	98.9 (97.3–99.6)	5.15 (1.40–18.89)	96.9 (94.6–98.3)	5.46 (2.46–12.09)	96.6 (93.4–98.1)	9.86 (4.67–20.83)	78.6 (73.6–82.9)	3.87 (2.42–6.18)

CI confidence intervals, *NS-SEC* National Statistics socio-economic classification, – not applicable

households where the MFP reported confidence with each cooking technique and food, except oily fish (72.7 %, 95 % CI: 68.2–76.7) and pulses (63.0 %; 58.1–67.6). The MFP in more than 90 % of respondent households reported being able to prepare convenience foods (94.7 %, 95 % CI: 91.8–96.5), a complete meal from ready-made ingredients (93.3 %, 95 % CI: 90.4–95.4), and a main dish from basic ingredients (93.2 %, 95 % CI: 90.2–95.4) without help. Very few differences in MFP confidence and ability were seen by respondent socio-demographic characteristics. Where these were seen, those in the youngest age group (19–34 years) and lowest socio-economic group were least likely to live in a household where the MFP reported confidence.

Discussion

Summary of results

As far as we are aware, this is the only exploration of the prevalence and socio-demographic correlates of adult cooking skills using recent and population-representative UK data. Our results also contribute to the limited international evidence on this topic. With a few notable exceptions, we found high prevalence of self-reported confidence with using a range of cooking techniques and cooking a range of foods and dishes in both respondents and household MFPs. Almost two-thirds of respondents said they cooked a main meal at least five times per week and more than four-fifths lived in a household where the MFP did so (the MFP was the person with the main responsibility for shopping and preparing food within a household). Almost 90 % of respondents reported being able to cook a main dish from basic ingredients without help, and more than 90 % of respondents lived in a household where the MFP could do so.

Differences in reported cooking confidence across socio-demographic variables were scattered and inconsistent. Where these were found, in general women and respondents who were also MFPs were most likely, and those in the youngest age group (19–34 years) and lowest socio-economic group were least likely, to report confidence. These differences suggest a number of social inequalities in cooking skills according to gender, socio-economic position and age.

Strengths and limitations of methods

The NDNS aims to recruit a population-representative sample at each wave. We used the study weights provided to reduce biases related to the sampling method and non-response at the respondent level, where this exists. Thus, we are confident that this is the most population-representative data on cooking skills currently available in the UK. Previous quantitative studies have either been restricted to those living in low-income households [9], small convenience samples [30], or were conducted more than 15 years ago [7].

It is possible that self-reported data on cooking skills is subject to social desirability bias [7]. However, it is not clear that this would be stable across socio-demographic groups. For instance, whilst women may feel pressure to report more confidence than they feel with cooking [21], men may not. Thus, our results may over-state gender differences in cooking skills. Although there is evidence of gender differences in the social desirability bias in dietary self-report [36], we are not aware of any studies of social desirability bias in cooking skills specifically. The directions of effect of any other socio-demographic differences in social desirability bias are harder to predict.

The validity and reliability of the questions used to assess cooking skills have not been explored. Differences in individual interpretations of the meaning of 'confidence' with cooking techniques and foods are likely to introduce error. Systematic differences in interpretations across socio-economic groups may also exist, leading to bias. Again, it is difficult to predict the directions of any effects.

The complexity of the phenomenon of 'cooking' has been noted [19, 20]. It is unlikely that the simple questions used here adequately capture this complex construct. A short questionnaire, with good test-retest reliability and internal consistency has been recently developed [12]. Whilst this shares some similarities with some of the questions used here, it too is simplistic and unlikely to capture the full complexity of cooking skills. Another questionnaire has been developed to assess the impact of cooking skills interventions [37]. However, this focuses on the wider potential outcomes of cooking skills interventions, rather than just the skills themselves–covering issues such as confidence in using a recipe; and frequency of purchasing convenience food and experimenting with new foods. A simple, but comprehensive, measure of cooking skills is required for population monitoring.

Data from wave 1 of the NDNS are now around 5 years old. It is possible, although unlikely, that prevalence of cooking skills has changed substantially over these years. Although more recent waves of the NDNS have been conducted, they did not include questions on cooking skills. Ongoing monitoring of population cooking skills would be valuable.

At just over 500 adults, wave 1 of the NDNS is relatively small. The NDNS is currently conceived as a 'rolling programme' with each new wave being combined with previous waves to increase sample size. As indicated above, we were not able to take advantage of more recent waves of data. Nor did we include the approximately 50 % of wave 1 respondents who were children.

Although children were asked some questions about cooking in wave 1 of NDNS, these did not cover skills and confidence as in adults. This means data from children could not be combined with that from adults to increase the sample size.

As only 10 % of the NDNS were non-white, we were not able to reliably study ethnic variations in cooking skills. Nor did we study where respondents and MFPs obtained their cooking skills from.

We originally intended to model the relationships between markers of cooking skill and markers of dietary quality and body composition, using multivariate methods. However, as cooking skills were so highly prevalent, and little variability was present, these measures were not effective at differentiating respondents within the population. Future work should explore these relationships further.

Interpretation and implications of results

Our results suggest very high prevalence of reporting confidence with cooking. Compared to similar data collected in the UK in 1997, reported confidence in cooking all ten food items has increased in both men and women [22]. For example, whilst more than 75 % of respondents were confident with all techniques except stir-frying in the current work, confidence was only this high for boiling, grilling, frying and oven-baking in 1997. Furthermore, gender differences seen in cooking confidence for all ten foods in 1997 were much less evident in the current work [22]. Possible explanations for these improvements include the proliferation of local cooking skills initiatives across the UK [15], increased media coverage of food and cooking topics, and changes in individuals' perceptions of their own skills.

Our results suggest that most UK adults do not perceive themselves to be lacking cooking skills–or, at least, are not willing to acknowledge this to a researcher. This suggests that most UK adults are unlikely to think (or, perhaps, admit) they would benefit from a basic cooking skills course and so volunteer for such an intervention. Indeed, previous studies have struggled to recruit to evaluations of cooking skills interventions [16]. This is not to say that few individuals would benefit, but any intervention would have to be well-targeted and carefully consider how best to reach and recruit those most likely to benefit.

Despite high prevalence of reported cooking skills, we found that these skills are not necessarily being frequently used. For example, whilst almost 90 % of respondents reported being able to prepare a meal from basic ingredients without help, only two-thirds did so five times a week or more. This confirms that possessing cooking skills is not the same as making frequent use of these skills [7, 16]. One reason why people may not make regular use of their cooking skills is that other members of their household are responsible for cooking. This is reflected in the high frequency of meal preparation amongst MFPs–with over 80 % preparing main meals on five or more days per week.

It seems logical that having cooking skills is a prerequisite for being able to prepare nutritious meals, and associations between cooking skills and dietary quality have been reported [10–13]. As described above, the high prevalence of reported cooking skills meant we were unable to study any relationships between cooking skills and either dietary quality or adiposity. However, it should not be assumed that possessing cooking skills means that food cooked, or eaten, will necessarily be nutritious. Fresh green vegetables were one of the foods that respondents were most confident with preparing (92.7 % reporting confidence), yet less than 40 % of respondents in wave 1 of NDNS consumed five or more 80 g portions of fruit and vegetables per day [33]. Providing individuals with the skills to cook nutritious meals may be necessary, but not sufficient, to ensure that they do so regularly [38, 39]. In order to have a substantial positive impact on the population's dietary intake, interventions should also take account of the many social and environmental determinants of diet [19, 40].

Whilst we found few socio-demographic differences in self-reported cooking skills, those that were present tended to indicate that women and respondents who were MFPs were most likely to be confident with cooking, whilst those aged 19–34 years and those in the lowest socio-economic group were least likely to be confident. These findings suggest that any attempt to recruit adults to cooking skills interventions may find it useful to focus on recruiting men, those younger than 35 years, and those in the least affluent socio-economic groups.

Many others have confirmed that women continue to spend more time cooking than men [8, 23–28], so the finding that they report more developed cooking skills is not surprising. As the MFP is the person with the main responsibility for shopping and preparing food in a households, it makes some intuitive sense that this person might also have the most skill and confidence with food preparation.

Age-related differences in cooking skill may reflect differences in frequency of cooking–with the youngest adults being least likely to have, or have had, children at home and so be preparing food frequently and therefore developing their skills. The results give some credence to the popular belief that younger generations have 'forgotten' how to cook due to increased exposure to convenience foods [41]. However, it also possible that young adults only develop cooking skills when they perceive these to be required–for example, when they become responsible for their own children. Previous work with

small sample sizes has found that older and younger UK women report similar levels of cooking skills–although use these differently [19, 30]. Further work is required to explore how and when individuals develop cooking skills and if there are any particular 'windows of opportunity' for intervention.

Where differences were present by socio-economic position, those in the lowest socio-economic group had the lowest cooking confidence. Qualitative research has described a number of barriers to developing cooking skills through experimentation in more deprived groups, including: lack of time, fear of waste, difficulties with following written recipes (perhaps compounded by limited literacy and numeracy), and uncertainties over food safety and labelling [19, 42]. The proportion of adults living in a household where the MFP could cook a meal from basic ingredients (93 % overall) was higher in the current general population sample than in a UK low-income sample (90 % of women and 80 % of men) [9]. This suggests socio-economic inequalities in household cooking skills exist in the UK.

Conclusions

In this population-representative sample of UK adults, self-reported confidence with using most cooking techniques and preparing most foods was high in respondents and those in their households responsible for food preparation. The great majority of respondents said they were able to prepare a main meal from basic ingredients without help. There were few socio-demographic differences in reported cooking skills, but where these did occur women and those who had primary household responsibility for food tended to be most likely, and those in the lowest age (19–34 years) and socio-economic group least likely, to report confidence. Adult cooking skills interventions should be clearly targeted at those most at risk of reporting low levels of cooking confidence and poorer cooking skills. Careful consideration of how best to reach and recruit those most likely to benefit is required.

Additional file

Additional file 1: Table S1. Confidence of main food provider in using eight cooking techniques, National Diet & Nutrition Survey, 2008–09, $n = 490$. **Table S2.** Odds of main food provider having confidence in using eight cooking techniques, National Diet & Nutrition Survey, 2008–09, $n = 490$. **Table S3.** Confidence of main food in cooking 10 foods, National Diet & Nutrition Survey, 2008–09, $n = 490$. **Table S4.** Odds of main food provider having confidence in cooking 10 foods, National Diet & Nutrition Survey, 2008–09, $n = 490$. **Table S5.** Ability of main food provider to prepare four dish types without help, National Diet & Nutrition Survey, 2008–09, $n = 490$. (DOC 110 kb)

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
JA conceived the idea for the analysis. LG prepared the data. JA & LG conducted the analysis. JA drafted the manuscript. All authors contributed to design of the methods, data interpretation and provided critical comments on drafts of the manuscript.

Acknowledgements
The research was funded by a grant from the UK Department of Health Policy Research Programme to the Public Health Research Consortium. Further details can be found here: http://phrc.lshtm.ac.uk/.
When this work was conducted, MW was director and JA a staff member of Fuse: the Centre for Translational Research in Public Health, a UKCRC Public Health Research Centre of Excellence. AJA is now director of Fuse. JA and MW are now funded by the Centre for Diet and Activity Research (CEDAR). Funding for Fuse and CEDAR from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. AJA is funded by the National Institute of Health Research as an NIHR Research Professor. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The views expressed herein are those of the authors and not necessarily those of the above named funders.

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Received: 5 February 2015 Accepted: 27 July 2015
Published online: 05 August 2015

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3.7 PP3 commentary

The analysis presented in my paper, shows that there was a high prevalence of self-reported confidence with regards to both the use of the cooking techniques and foods specifically questioned within the NDNS. Almost 9 in 10 respondents (89.2%) reported being able to prepare a main dish from basic ingredients. The socio-demographic differences identified were few and inconsistent. Women were more likely to report higher confidence and those in the youngest age group (19-34 years) and from the lowest socio-economic group were least likely to report confidence in cooking. This suggests that there may be gender, socio-economic position and age differences in relation to cooking skills, and that young men of low SEP were least likely to report confidence in cooking.

There are issues with the data that we used in this analysis (detailed in the paper), specifically regarding the robustness of the self-reported measures to accurately reflect cooking ability. Such issues are likely to relate all such methods that attempt to quantify cooking skills based on a self-reported questionnaire. A 2013 Swiss study claimed to have developed a self-reported metric on cooking skills [149], which was a 'reliable and consistent instrument'. However, as the authors admit this is likely to be culturally specific and therefore not widely applicable, as the only socio-demographic data collected was age, gender and whether participants had children. Others have gone further to critique the singular focus on a specific culinary technique, regardless of the validity of the evaluation. Short (2003) reported on a qualitative study with 30 domestic cooks living in England to investigate their beliefs, values and opinions with regards to their cooking skills and broad practices. Short's purpose was to provide a more nuanced understanding of the complexity of the processes that exists within the kitchen for the purposes of meal preparation. A simple description of the mechanical skills was insufficient to detail the wide range of processes involved in meal preparation, which additionally included perceptual, conceptual, organisational skill as well as academic knowledge. Critically, Short found that there was no clear relationship between participants' skills and knowledge, and their domestic cooking practices [150]. Such considerations were accounted for by Lavelle et al. (2017) in their development and validation of measures to, not only assess cooking skills, but also *'food*

skills', which they define as the ability to select and prepare healthy food within the available resources [151].

Lavelle et al. evidenced that improvements can be made with regards to effective measurement of ability to prepare a healthy meal [151]. Such tools will have their use in identifying and targeting those most in need of food and cooking skills to support a desired improvement in diet quality. However, any intervention requires willing participants that acknowledge that their existing skills are insufficient to deliver healthy home cooked food. The vast majority of the participants in the NDNS, deemed themselves to be proficient and that their cooking ability was not a barrier to meal preparation. Therefore, even if future interventions are tailored and targeted to those adults most likely lacking in cooking skills, it is unlikely that such interventions will have a significant impact, at a population level, in improving diet quality. Furthermore, interventions that focus solely on cooking skills, for some, will be diametrically opposed to their resultant food choice behaviours (based on issues of time scarcity: eating faster, food grazing between activities, limiting meal times, watching TV while eating, and purchasing takeaway food [136]). Future interventions might also need to incorporate the role of technologies. Such factors were identified by Caraher & Lang in 1999, where they observed that *'young people's food skills rise the more there is a technological input in the preparation of food; using the microwave scores higher than preparing food from basics.'*

While, cooking skills do play a role in what has been termed 'food literacy', what Vidgen & Gallegos term 'the everyday practicalities associated with healthy eating' [152]. Through knowledge and understanding of the role of food and health, individuals, households, and communities can be empowered to improve their diet quality [152], but it also must be combined with structural environmental factors that facilitate access and availability of healthy options and negate time scarcity which is a factor of our modern lives [136].

3.8 Chapter summary

One fifth of adults and children eat takeaway meals at home at least once per week, with consumption peaking in teenagers and young adults. Habitual consumption is associated with a greater mean daily energy intake and the impact of consumption on total energy intake is amplified in children from less affluent households. Consumption of takeaway food

is driven largely by convenience and taste. While cooking skills may play a role in food literacy, training to provide such skills in isolation is likely to have a limited impact on the population's overall diet as around 90% of people in the UK do not view their cooking ability as a barrier to cooking "a main dish from basic ingredients without help".

Chapter 4. What has been done about takeaway food?

In this chapter, I provide an overview of the characteristics of public health interventions targeted at a dietary improvement in order to understand which interventions have an impact. As sugar sweetened beverages are a regular component of takeaway meals, I briefly discuss the potential impact of taxes, including the UK Soft Drinks Industry Levy on health improvement. However, I focus on those initiatives specifically targeted at the takeaway sector and summarise the impact of interventions to promote healthier food in such outlets that were identified by a systematic mapping and evidence synthesis by Hillier-Brown et al. (2017) [47]. Finally, in this chapter, I take an ecological approach to intervention development including identifying the range of stakeholders associated with the food offering in independent takeaways.

4.1 What interventions have an impact?

Frieden (2010) proposed the five-tiered 'Health Impact Pyramid' as a framework for public health action to estimate the impact of public health interventions, see Figure 4-1. Interventions that aim to address issues at the base of the pyramid, 'socio-economic factors', will likely have the greatest population impact while this potential will diminish as interventions ascend the pyramid. This ascension corresponds to need for the increasing level of individual agency required by the intervention [153].

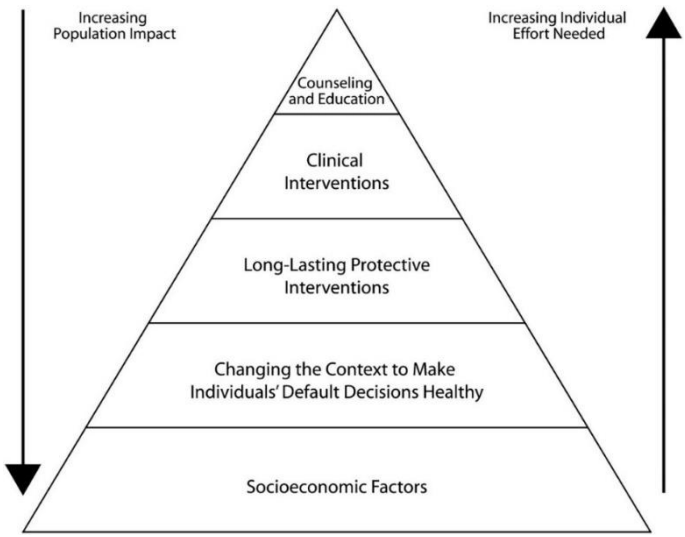

Figure 4-1 Frieden (2010): The Health Impact Pyramid

McLaren et al. (2010) considered the continuing relevance of Rose's (1985) seminal publication, Sick individuals and sick populations [154], on population strategies of prevention [155]. They responded to Frohlich & Potvin (2008) criticism that such approaches may unintentionally widen social inequalities in health [156], stating the likely impact will be dependent on where the intervention is situated on a continuum from agency to structure. They contend that:

> *Population strategies that are more superficial in nature rely on individual agency and aptitude, and as such are potentially more likely to increase (worsen) social inequalities in health [155].*

Capewell & Graham (2010) applied the agency-structure continuum to review the evidence of different cardiovascular disease prevention strategies in relation to health inequalities [157]. Primary prevention of CVD is reliant on addressing the major risk factors of smoking and poor diet. Certain high-income countries, including the UK, have taken a 'high-risk approach', seeking to identify those high-risk susceptible individuals and provide individual protection [154], through screening, lifestyle advice and medication to reduce blood pressure and cholesterol [157]. Such strategies they found were 'agentic', contingent on active engagement and participation of the target individual. As a result, this disproportionately favour those with greater resources, therefore widening health inequalities [157].

Adams et al. (2016) looked at the role of individual agency in relation to diet and obesity interventions. They plotted and described interventions across two axes: agency; and population and high-risk, see Figure 4-2. The latter defining an intervention where it targets a small change across a population or a large change in high-risk individuals [158].

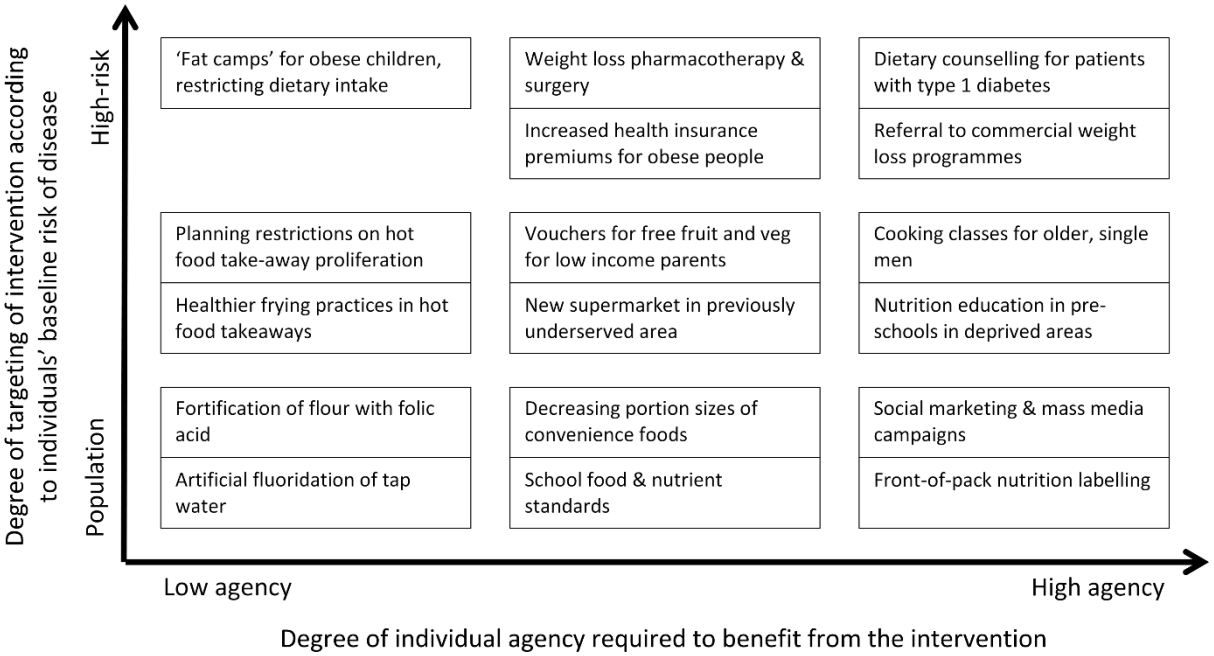

Figure 4-2 Adams et al. (2016): Two continuums to describe public health interventions

Adams et al. found a paradox, in that while population interventions that require a low level of individual agency are most likely to be both effective and equitable, they are not currently favoured by governments around the world [158].

A European wide study interviewed 71 senior policy makers, public health nutrition policy experts and academics from 14 different countries (Belgium, Czech Republic, England, Estonia, Finland, Germany, Greece, Iceland, Italy, Ireland, Malta, Poland, Portugal and Slovenia) aiming to map existing public health nutritional policies and detail their perceived effectiveness [159]. The study guaranteed anonymity to the participants allowing the study to reveal the differences between the official policies and their implementation. The authors of the study described a *diverse, dynamic, complex and bewildering* range of policies and proposed the use of McCarthy's 4Ps classification of the marketing mix to categorise policies: product, price, promotion, and place [129]. 'Product' refers to policies linked to reformulation, elimination of industrial trans-fats and the introduction of healthier products. 'Price' refers to policies linked to taxes, subsidies or other economic incentives. 'Promotion' refers to policies linked to health education, public information campaigns, advertising

control or food labelling. 'Place' refers to policies that aim to modify food (quality or availability) in a specific setting, such as schools or workplaces [159]. The key findings from this study were that participants stated that mandatory and regulatory interventions were more effective in bringing about change than voluntary strategies such as optional reformulation and information provision. However, critically they reported that such strategies were challenging politically [159]. The authors followed-up this work with a systematic review that aimed to identify whether the impacts of interventions to promote healthy eating differed by SEP. Their search returned 31,887 articles, that following screening identified 36 studies that were mapped on to an expanded '6Ps' that additionally included: prescriptive, '*restrictions on advertising/marketing through controls or bans, labelling, recommendations or guidelines*'; and person, '*Individual-based information and education (e.g. cooking lessons, tailored nutritional education/counselling, or nutrition education in the school curriculum)*'. As with their qualitative study, 'price' interventions, that included taxes and subsidies, were found to be most effective in groups with lower SEP and therefore likely to reduce health inequalities, whereas, the individual-focused 'person' interventions were most likely to increase inequalities [160].

4.2 Sugar sweetened beverage taxes

Whilst not specific to takeaways, in recent years, the most prominent regulatory nutritional intervention has been the proposal and introduction of various sugar sweetened beverage taxes around the world [161]. Sugar sweetened beverages are found in most takeaways and frequently sold as part of 'meal deal' offers. Analysis of NDNS data found a relationship between salt intake and sugar sweetened beverage consumption in children and adolescents. He et al. (2008) found that, after adjusting for potential confounding factors, an increase of 1g of salt per day was associated with an increased consumption of 27g of sugar sweetened beverage per day [162]. Therefore, due to the high salt content of takeaway food [page 23] it is possible that any reductions in salt content, or total volume of takeaway food, might also lead to reductions in sugar sweetened beverage consumption. Additionally, an understanding of the mechanism of such interventions may provide an insight as to how future regulatory interventions within takeaways may be developed and delivered. The most notable example is Mexico, where the legislative branch of the Government implemented an excise tax of 1 peso per litre (approximately 10% price increase) on sugar sweetened

beverages, that came into effect on 1 January 2014 [163]. Sánchez-Romero et al. (2016) used epidemiological modelling to predict the impact of the implementation of the tax. Their methodology estimated that a 10% reduction in such beverages would result in 189,300 fewer incidents of type 2 diabetes cases, 20,400 fewer incident strokes and myocardial infarctions, and 18,900 fewer deaths from 2013 to 2022, potentially saving Mexico $983 million USD [164]. What is known from one observational study is that the tax has resulted in a reduction in purchasing of the taxed beverages and an increase in purchasing of untaxed beverages [163]. Additionally, while reductions in purchases were observed across all three SEP groups within the study, the greatest reduction was found in those of the lowest SEP, suggesting that the intervention could have a positive impact on health inequalities. Therefore, such taxes would be classified as an intervention that acts on socio-economic factors and social determinants of health, that is the bottom tier on Frieden's Health Impact Pyramid and those with the greatest potential for a population health impact [153].

4.2.1 UK Soft Drinks Industry Levy

In the UK, the Chancellor of the Exchequer announced in the 2016 budget, that a levy (tax) would be applied to soft drinks that contain added sugar, Soft Drinks Industry Levy (SDIL) [40], to be implemented in 2018. This followed a sustained campaign by a collection of organisations and individuals motivated to improve population health and create a more equitable food system. The Campaign included Sustain, Food Active, the Children's Health Fund, the Children's Food Campaign, Action on Sugar, the Obesity Health Alliance, various Royal Colleges, Members of Parliament and celebrities, most notably, celebrity chef and restauranteur, Jamie Oliver [165]. In 2011, when the concept was first debated in Parliament, it was disregarded by the Government in favour of the Public Health Responsibility Deal. Despite this set-back, in 2013, Sustain, gained the support of 60 public bodies [166] in their call for a 20p per litre 'sin tax' on sugary drinks. Then following a programme of work commissioned by the North West Directors of Public Health, in their public health manifesto, "Top Ten for Number 10" they put their support behind this 'sin tax' [167]. The evidence base for the 20% tax was strengthened through the publication of two studies commissioned by Food Active. One epidemiological study that found that the incidents of related diseases could be significantly reduced [168]. A qualitative study found that half the respondents would accept a 20% price increase [169]. In 2015, in an effort to

raise awareness of the adverse health consequences of high consumption of sugary drinks, Food Active launched the Give Up Loving Pop (GULP) campaign. This was targeted primarily at teenagers and families. Food Active reported that while GULP was broadly well received, they were challenged robustly by individuals and groups associated with sugary drinks industry [165]. Despite both the growing evidence and public support for a tax, in 2015 the Government were still unresponsive to such a measure. This same year, Jamie Oliver, became the most prominent exponent of the tax, launching a documentary on the UK terrestrial television broadcaster, Channel 4 [170], which highlighted the health impacts and increased the pressure on the Government through the subsequent petition coordinated by the Children's Food Campaign which attracted over 150,000 signatories [165]. Details regarding the levy were published in November 2017, where businesses that either produces, packages or brings soft drinks with added sugar into the UK will be liable to pay: 18p per litre if the drink has 5g of sugar or more per 100ml; or 24p per litre if the drink has 8g of sugar or more per 100ml [171]. The levy explicitly aimed to stimulate changes in industry behaviour, leading to reformulation of soft drinks towards lower sugar content [40]. The levy was originally presented as an independent policy decision by HM Treasury, announced in the March 2016 Budget Statement [40]. However, it was subsequently adopted to form the key component of the Government's Childhood obesity action plan [172]. Prior to the Chancellor's announcement there had been a UK modelling study by Collins et al. (2015) that had investigated the potential health impacts of a 20% duty on sugary drinks in England. They estimated that this duty could result in approximately 2,400 fewer diabetes cases, 1,700 fewer stroke and coronary heart disease cases, 400 fewer cancer cases, and gain some 41,000 Quality Adjusted Life Years per year across England between 2010 and 2030 [168]. However, while this study gave estimates with regards to health outcomes associated to a price increase at the point of purchase, it did not reflect the full range of potential consequences of the Soft Drinks Industry Levy that was announced in 2016, which has a rather different mechanism of action. A further comparative risk assessment modelling study by Briggs et al. (2017) was published following the announcement of the SDIL. They modelled and estimated the best and worse-case scenarios on the prevalence of obesity, incidence of dental caries and type 2 diabetes in the UK, from three potential industry responses to the SDIL. These three responses were: reformulation

to reduce sugar content, increase price, and a shift in the market share of high, mid, and low-sugar beverages. Reformulation resulted in the best health outcomes, where the best-case scenario estimated a reduction of 144,383 adults and children with obesity, 19,094 fewer cases of type 2 diabetes per year, and 269,375 fewer decayed, missing, or filled teeth annually. The authors identified that those under 18 years old would benefit most with regards to obesity and oral health, whereas those aged over 65 years would see the largest absolute decrease in type 2 diabetes incidence [173].

4.3 Targeted UK Government led interventions

Prior to the announcement of the soft drinks levy, in the UK, the Coalition Government of 2010 to 2015 launched in 2011 the 'Public Health Responsibility Deal' (PHRD) [38]. This was the Government's flagship initiative to deliver behaviour change with regards to public health in the four areas of: food; alcohol; health at work; and physical activity. The aim was to improve public health through public-private partnerships where businesses and other influential organisations signed up to voluntary pledges. This voluntary approach followed the Coalition Government's preference for non-regulatory measures that focused on asking '*the public to work with us by taking responsibility for their own lifestyle choices*' [24]. The PHRD pledges linked to diet improvement included voluntary action with regards to: nutritional labelling; salt, trans-fats, saturated fat and calorie reduction; and promotion of fruit and vegetable consumption [38]. The UK Government's Department of Health (DH) published progress reports, where signatories were asked to provide initial plans and details of their annual progress towards their intended goal. Knai et al. (2015) published their evaluation of the effectiveness and added value of these voluntary food pledges, which was highly critical [39]. Their evaluation stated that these progress reports were heterogeneous across signatory organisations and limited in both the number of reports available and the details contained within them. Overall the progress reports were of poor quality [39], therefore making it difficult to evaluate whether nutritional improvement targets were being met [39]. Knai et al. concluded that the pledges did not push signatories beyond actions that they were already carrying out, and fundamentally the pledges do not reflect the most effective strategies to improve the public's diet [39].

4.4 Localising the Public Health Responsibility Deal

Regardless of effectiveness, the PHRD engaged only large organisations, and it did not seek to work with small and medium sized independent businesses. In 2011, the UK Government's Secretary of State for Health, Andrew Lansley, placed the responsibility of delivering a nutritional change in independently owned outlets into local authority control, stating that '*We will therefore put local government in the lead in developing and implementing strategies which are locally led and locally focused*' [24]. In 2013, the DH launched a toolkit to localise the PHRD [51]. It was targeted at local authorities with the purpose of helping them to encourage small and medium sized businesses to adopt changes that would support customers to make healthier choices [51]. As with the PHRD, adoption of the advice was voluntary. The toolkit provided five points concerning how the material could be used by local authorities and additional advice as to how to engage with businesses, but there was no offer or advice on how to access resource that could support delivery [51]. As part of the PHRD the DH created a specific pledge to accompany the toolkit, S1 Local engagement on the PHRD agenda [174], and '*asked*' partners to report on their progress by the end of April each year [175]. Only three annual updates on initiatives related to this pledge are listed [174]. As with other pledge reports, due to the heterogeneity and paucity of the reports it is not possible to ascertain how the toolkit has been implemented and its potential impact on small or medium sized businesses generally or specifically with regards to takeaways. One of these reports only refers to 'health at work' actions, the other two reports detail healthy catering awards, but no details are supplied as to work specifically relating to takeaways.

4.5 The role of planning

Caraher et al. (2013) stipulated the limitations of existing national policy focusing on behaviour change and voluntary agreements, particularly with regard to its incompatibility with equitable health promotion.

> *Health promotion in respect of such a complex system must ensure that the focus goes beyond an emphasis on behaviour to one which helps create supportive and health enhancing environments. [176]*

The authors posited that planners, public health professionals, and the public should all be involved in decisions regarding shaping local food environments, which is subsequently backed-up by regulatory mandates at supra-local levels [176]. Using Tower Hamlets (a London borough) as a case study, they detailed the importance of localising the issue to decision makers within the authority. They found that providing data on the citizens within the local authority's jurisdiction was effective at raising awareness on the issue. Contextualising the issue to the locale resulted in the restriction on the opening of new takeaways in certain areas under specific conditions. In PHE's published guidance on encouraging healthier 'out-of-home' food provision, they reaffirmed the use of planning measures to create healthier environments, but critically commented that such tools are unable to differentiate between healthy and unhealthy foods [50]. Additionally, PHE detailed the increasing prevalence of supplementary planning documents (SPDs) that have been developed and subsequently adopted by local authorities to restrict the opening of new hot food takeaways (Class A5). Such planning policies restrict the conversion of commercial premises to 'Class A5', hot food takeaways, based on defined criteria, e.g. proximity to a school. Both Newcastle City Council [177] and Gateshead Council [103] have recently adopted such planning policy, with the latter successfully defending their SPDs following an appeal [178]. While SPDs are effective in their specific aim, they do not address the food offerings of existing premises and potentially consolidate the position of those existing businesses.

4.6 The impact of interventions to promote healthier ready-to-eat meals in existing out-of-home outlets

As part of the Foodscape study [1] Hillier-Brown et al. undertook a systematic review that looked specifically at previous research on the impact of interventions aiming to promote healthier meals in out-of-home outlets. Hillier-Brown et al. identified studies of any design and duration that included either consumer or outlet level before-and-after data that aimed to change the practices of food outlets in order to promote healthier menu offerings [179]. They found 30 studies detailing 34 interventions, predominantly from the US, aimed at 'fast-food chain' restaurants. They categorised interventions as follows: restricting choice, guiding choice, enabling choice, and providing information. They concluded that those interventions that were 'intrusive', such as restricting or guiding choice had a positive impact at either

consumer or outlet level, whereas the more passive interventions which either enabled choice or provided information had little or no impact [179]. These findings corroborate with those of Adams et al. (2016), as by implication these 'intrusive' inventions, aim to reduce the individual agency required for an individual to benefit from the intervention [158].

4.7 What takeaway targeted interventions have been delivered in England?

Following Hillier-Brown's systematic review [179], in a further publication of the Foodscape study [1] Hillier-Brown et al. applied a systematic mapping and evidence synthesis approach to identify and describe interventions that aimed to promote healthier ready-to-eat meals in out-of-home food outlets in England [47]. This thorough approach included searches of academic databases and grey literature, as well as contacting of local authorities, topic experts and health professionals to obtain details of relevant interventions targeted specifically at publically accessible food outlets. The evidence synthesis was divided into two tiers: content and delivery; and a narrative synthesis of those interventions that had been evaluated. A total of 75 interventions were identified, with 43 being award-style schemes, defined as those interventions '*that involved an assessment of food outlet practice(s) targeted by the intervention using pre-defined criteria, together with some sort of accreditation if the food outlet met the criteria*' [47]. The authors concluded that covert interventions, those that delivered changes that were imperceptible to customers (i.e. requiring low levels of individual agency [158]), and were cost neutral were more likely to be adopted by businesses. There were few upstream interventions that engaged with suppliers or harnessed customer demand. Broadly, evaluation was poor, limited in scope and in most cases only measured acceptability [47].

Of the 43 interventions identified in the systematic mapping and evidence synthesis study that were award-style, 14 of these were based on the Healthier Catering Commitment (HCC), developed the Chartered Institute of Environmental Health [47]. The HCC was designed around a belief that multiple small changes can make a big difference [180] and fitted with the UK Government's preference for voluntary agreements. It was designed as a generalist catering award, open to all types of catering businesses, including takeaways, to be delivered primarily by the network of EHOs. It is multicomponent and consists of 22 criteria, of which a business needs to achieve adherence in a minimum of eight, some of which are mandatory,

in order to receive the award [48]. The criteria cover the use of: fats and oils; milk, spreads and sandwich fillings; salt; sugar; fruit and vegetables; carbohydrates; portion size; and healthier option promotions [181]. In 2013, Bagwell published an evaluation of a pilot of the HCC across 12 London boroughs that recruited over 80 independent catering businesses [48]. This study generated useable data from 77 businesses, of which 20 were takeaways [182]. Bagwell defined the nature of each criterion as either: eliminating choice (n=8); enabling choice (n=11); guiding choice by changing default policy (n=2); or providing information (n=1). She found that the less intrusive interventions that enabled choice of healthier alternatives or provision of information, resulted in the greater availability of healthy options. However, acceptability was greater in businesses in the more affluent areas, and the businesses in the more deprived areas, where competition was higher, were more resistant. This led Bagwell to conclude that such a scheme is 'possibly unwittingly widening the gap in health inequalities' [48]. Bagwell's finding aligned with the general consensus of experts in the field of nutritional interventions that legislative action restricting or eliminating choice are likely to be the most effective [159].

> *In less affluent communities, the extra costs of such healthier varieties cannot be passed on to the customer and thus present a real threat to the viability of the business. In these areas, the cheapest products will be bought unless legislation is introduced to prevent their use.* [48].

4.8 Who are the stakeholders involved in delivering an intervention in this setting?

Hillier-Brown et al's systematic mapping and evidence synthesis identified that the majority (54 of 75) of interventions designed to promote healthier ready-to-eat meals sold by specific food outlets in England were led by local authority project teams [47]. Interventions were delivered by staff either employed or contracted by the authority including environmental health and trading standards officers, public health professionals, dietitians and community nutritionists [47]. Such interventions are dependent on the active involvement of a given takeaway's 'food business operator' (FBO), in most instances this is either the owner or the manager of the takeaway.

Story et al. (2008) advocated for an ecological framework that 'emphasises connections between people and their environment; views behaviour as affecting and being affected by

multiple levels of interacting influences' as the most effective strategies for creating population-level improvements to dietary behaviour [183]. As such, it is important to identify the full range of possible stakeholders associated with the resultant food offering within the takeaway food environment and not simply those delivering the interventions and an outlet's FBO.

4.8.1 Intervention deliverers

Interventions in this setting have principally been led by EHOs, consistent with their level of contact with FBOs, but in some authorities this has been supported by trading standards staff, public health professionals, dietitians and community nutritionists [47]. As part of her evaluation of the HCC, Bagwell conducted interviews with intervention deliverers [48]. However, it is difficult to isolate the specific findings from the interviews that were conducted with those administering the intervention from others, as Bagwell used a mixed method study primarily reporting on the elements of the intervention scheme, but it is presumed that they supported the paper's main findings regarding the HCC, that is the less intrusive interventions resulted in the greater availability of healthy options [page 85]. While there are no details regarding the broader role of the intervention deliverers and their specific issues there is mention of their struggle to implement changes linked to reformulation.

4.8.2 Food business operator

The FBO is the individual that is ultimately responsible for the food delivered in a given premises. As defined by the Food Standards Agency, the independent Government department responsible for protecting public health with regards to food, as *'the natural (human being) or legal person responsible for ensuring that the requirements of food laws are met within the food business under their control'* [184]. There is only one study of the views of FBOs of takeaways within the UK, conducted by Estrade et al. in 2014 [185]. This qualitative study sought the views of 'independent fast-food vendors' working in food outlets near secondary schools in deprived areas of Scotland in order to identify and understand the barriers to offering healthier menu options [185]. The study recruited ten participants, five of which were FBOs of takeaways (kebab n=2, Fish & Chips n=2, Indian n=1). From the emergent themes reported in the paper, it was clear that the FBOs did not

see themselves as playing an active role in improving the diet of their customers. They took pride in the product that they delivered, and while they acknowledged that their sector, as a whole, did not offer the healthiest food, they did not see this as applying specifically to their business. FBOs also stated that they operated in a financially challenging environment, where it was difficult to remain competitive with increasing resource costs, therefore paying the premium costs for healthier ingredients did not make good business sense. When asked about certification of a healthy catering award, FBOs reported that these added no value to their business as they were responding to customer demand, and what their customers demanded was not healthy. They saw it as the responsibility of the customer to make healthy choices, and that it was not their role to direct or dictate their customers' choice. Such points illustrate FBOs' financial conflict of interest. Their primary motive is related to profit and not the health of their customers. Interestingly, the FBOs also detailed the area effect that is generally overlooked by policy makers. The setting or location of their business meant that FBOs perceived their customers as being price sensitive, and unlikely to be willing to pay a premium for healthier options. While regulatory measures were opposed by most in the study, the authors concluded that such measures, for example restricting promotional strategies to attract school students at lunchtime, could 'level the playing field' and reduce the pressure felt by FBOs to compete [185]. If implemented, it would be classed as a 'price' based intervention, which based on McGill et al's (2015) '6Ps' categorisation of policy interventions relating to health eating, are the most effective category in reducing health inequalities [160].

Bagwell's evaluation of the HCC included interviews with 10 businesses that revealed that operational issues, cultural practices, and either actual or perceived impacts on profit were factors that influenced the FBO's willingness to engage and implement healthier practices in their business [48]. The sourcing of healthier alternatives had to be easy, that is, available from mainstream suppliers. Simple choice architecture measures [186] such as rearranging drinks in their drinks cabinet were acceptable, but the FBOs interviewed felt that they had no impact on their customers' established preferences. For the FBO, ultimately any change made had to be profitable. Bagwell found even when a FBO was enthusiastic and committed to delivering a healthier option, there also had to be the demand from their customers, balanced with the necessity to keep meal prices affordable. Examples of delivering healthier

options which were unpopular with customers included providing fresh fruit, salads, and salt reductions in meals. Bagwell found that while FBOs were accepting of provision of smaller portions, they were less willing to actively promote these, due to concerns that the lower price of such meals would lead to a decrease in overall profits. Furthermore, Bagwell found that there was greater resistance from FBOs to making healthier changes in those businesses operating in less affluent areas [48].

4.8.3 Suppliers

Suppliers to takeaways are a largely neglected with regards to interventions in this setting. Only six interventions were identified by Hillier-Brown et al. that involved the project team working upstream with suppliers [47]. The number of suppliers that a given business uses is dependent on the cuisine type. While some ethnic cuisines such as Indian and Chinese, have a diverse local network of suppliers, Fish & Chip Shops have a more restricted number of suppliers, which in turn have a large customer base covering wide geographical areas. Fish & Chip Shops across the UK are broadly catered for by two suppliers. T. Quality is one business with ten depos across the country, and the other is the Q Partnerships, an association of three suppliers, also with a total of ten depos across the country. These suppliers operate across wide areas and without geographical restrictions, resulting in a sphere of influence that is potentially greater than that of a local authority. As a business their motivation is primarily profit and not health [page 94]. Regardless of the cuisine type, FBOs are loyal to their suppliers and have established methods of purchasing supplies. In conversation with one FBO, he informed me that his business had only used two suppliers in the past 15 years. This does not mean FBOs do not change suppliers and are particularly open to switching if an identical product can be purchased at a lower price from a rival. Bagwell listed specific action that could be taken by suppliers, suggesting that they could be encourage to stock healthier products and decrease the price differential between such products and the unhealthy equivalent [48]. An example of a current barrier to delivering healthier food, detailed to me by a Fish & Chip Shop owner, was that he wanted to offer his customers the low salt and sugar variety of baked beans, but due to the low quantity required of this product, neither of the two national supplier networks were willing to stock the small, one portion servings, therefore his only option was to source from a local supermarket.

4.8.4 Customers

The evidence from both FBOs and intervention deliverers is that businesses are built around satisfying customer demand and not imposing food choices upon the customers. As part of the Foodscape project, we conducted 12 short interviews with customers, with ten of these from takeaways and a further two from a sandwich shop. From our limited sample in the customers' view, taste and convenience were paramount, and their food choice was not a simple issue of sustenance. Some positioned such food in their wider diet, which they regarded as healthy, and saw consumption of takeaway food as a *'treat'*:

> *… we eat healthy inside the house anyway, so it's a bit of a treat, chips or takeaway*
>
> User of a multi-cuisine takeaway, Newcastle-upon-Tyne, August 2014

There were divergent views as to whether customers would welcome the opportunity to purchase healthier options. This was likely to be connected with the labelling of such food as a '*treat*'. It was food that they desired and therefore they bought without consideration of the potential health implications. This, in part, validates the claim made to me in conversation with a director of a wholesale supplier that is that, for many customers, the meal choice has been made before they have entered the takeaway. Specifically, in Fish & Chip Shops, whilst some stated that they would welcome the opportunity to buy a healthier fish-based meal, their main reason for visiting the shop was to purchase the traditional meal of battered fish with deep fried potato chips.

This cultural attachment is not just limited to Fish & Chips, but to all cuisine types within the takeaway sector. The Mile End Community Project, a community initiative based in East London [187], produced a short film speaking with customers who describe their personal feelings and attraction to fried chicken based meals [188]. This is not a robust, peer-reviewed study, but it does provide an example of the depth of feeling towards takeaway food. The opening speaker states that this food is '*part of the scenery, part of the culture*', this highlights how difficult it can be to work with existing premises where the food offerings are well established, for example in the video one customer expressed her preferences:

> *I always buy the chicken burger yeah, and that's because of the mayo. Like, when I bite it's so yummy that I can't, resist but to eat that, and I always ask for extra mayo… When I used to drench my box [in sauce] it was so bad that the sauce would fall out of the box that I drenched it with, I don't think you would see the chips anymore [188]*
>
> User of a fried chicken shop, London, circa 2015

In addition, specifically in independent outlets, customers have detailed the cultural link to the physical space. Takeaways are not just a supplier of food, but a safe gathering place for like-minded friends, family and peers to meet [188]. As well as providing an accepted social space for the Muslim community that provides halal food in an alcohol-free environment [77].

Shift Design [134] undertook a pilot trial of 'Box Chicken' working in collaboration with Tower Hamlets, Newham, Hackney, Camden and Islington local authorities. The trial involved mobile food outlets with the aim of selling healthy and affordable takeaway food [76, 189], targeted at young people as the main consumers of takeaway food [Adams et al. (2015a) page 30] [52]. Their evaluation highlighted the need for food to be '*familiar*' to the target demographic, by this they meant that offerings had to be directly comparable to established popular and equivalent takeaway meals such as chicken burgers. Customers were less accepting of non-traditional offerings such as plantain chips and items that were explicitly '*healthy*' such as salad boxes [189].

The barriers with regards to the customer are significant and important, as it is ultimately customers' diets which are the target for change. The evidence from Bagwell's evaluation of the HCC showed that many businesses were unwilling to implement interventions that 'enabled choice' through the promotion of healthier options, for example 'fresh fruit is prominently displayed', 'healthier starch alternative to chips', and 'wholegrain varieties of carbohydrates are available' [48]. The reasons for the resistance to such changes can be inferred from Estrade et al. study where FBOs stated that they provided what customers *want* and not what they *should* eat [185] as well as those FBOs interviewed in Bagwell's study who felt that their customers' established food preferences could not be influenced by such promotions [48]. Therefore, it is possible that a focus on changes that are unlikely to be

perceived by the customer, that are covert, particularly if they can be applied to known popular meals, may be more successful, as they will reduce individual agency [158].

4.8.5 Communities

Most customers of a given takeaway will come from the local community, but as a stakeholder group they are considered separately from the aforementioned 'customers' as stakeholders. There is a substantial number of epidemiological studies detailing the geographical patterning of takeaways and their impact on different demographic groups [page 26]. However, such studies are abstracted from the views of those communities upon which takeaways serve and furthermore, fundamental rules of ecology dictate that this relationship is not unidirectional. Community-based participatory research has shown potential to address specific barriers and challenges to improving health inequalities, such as: providing context to a given intervention's setting, integrating cultural values and democratising science by placing equal value on a community's contribution [190]. Currently, there is limited published on how communities can shape their local foodscape, but as was shown in the campaigning prior to the announcement of the SDIL [page 79], public support plays a critical role in creating the conditions necessary to enact structural obesity prevention policies [191].

While members of the local community may not choose to patronise a given takeaway, the takeaway will still influence their local foodscape. Customer demand demonstrates that there is a desire for takeaway food within many communities, but it does not fully represent the entirety of the local population. Townshend (2016) refers to the clustering of takeaways alongside betting shops and sub-prime money lenders as the 'toxic high street' and calls for urban planning to work with communities to address those issues that communities themselves see as problematic [192]. While spatial exposure has been well studied [page 26] the existing literature largely disregards the views of the members of the communities beyond the takeaway customers. The UK Coalition Government (2010 – 2015) commissioned retail consultant, Mary Portas, to deliver a review of high streets and town centres. Part of her recommendations was that communities should have a greater say with regard to neighbourhood plans [94]. She stated:

> *Town centres exist to serve their communities' needs. So local people should have more say in what they want from them. [94]*

The report also emphasises a desire to have all voices within the community heard and not just the vocal minority. However, the report is a confusing read and it is unclear for whom the report was intended - policy makers or the communities themselves? It states that '*Communities need the tools, knowledge and opportunity to have a say*' but there are sparse examples and evidence as to how this might be realised. Despite the UK Government commissioning this report, there is no cited evidence regarding progress in creating an improved platform for communities to contribute outside of the traditional local planning consultation format. In my own experience, I have found the consulting on planning policy to be a one-way conversation. Along with Professor Ashley Adamson we drafted a response to Newcastle Council's original hot food takeaway Supplementary Planning Document [177]. Not only did we present evidence and detail our consideration of the evidence, but offered to open a dialog, and our expertise, on the subject. In response, we received only a confirmation of receipt of our letter and a brief response as to why a certain aspects of the issues we had highlighted could not be accounted for [193]. There was no further interest from the planning department within Newcastle Council to continue the conversation with our academic unit.

I have not completed a systematic search of available literature of community views on local takeaway foodscape, but I have drawn on my experience of specific communities within Newcastle upon Tyne. In 2014, a residents' group in the Elswick ward of the West End of Newcastle upon Tyne, launched their 'People's Charter for Health and Wellbeing' supported by a local charity, HealthWORKS, with funding from the Cabinet Office [194]. In the charter, community members identified what they considered to be the issues relating to poor health and wellbeing within their community and what they thought could be done about them. They specifically highlighted that they were unhappy about '*the number of takeaways selling cheap unhealthy food*' and felt that they should have a say with regards to licencing of such outlets, as they do with alcohol [194]. This ward-level, community consultation resulted in two further residents' charters from two neighbouring wards in the West End of Newcastle upon Tyne, Fenham [195] and Wingrove [196], which also identified takeaways

and their lack of healthy food offerings as a health issue of concern to their respective communities.

Shift Design's evaluation report of the Box Chicken scheme also highlighted the importance of building community partnerships as a facilitator of good promotion practice [189]. They focused on engagement with local councillors and most importantly, schools, as well as distribution of flyers (promotional material) locally. While some schools were keen to get involved, they did find others, which due to a variety of school specific policies, were not able to actively engage with the project [189].

4.9 Profit motive and business attrition

A recurring claim made by those either working in, or regulating this sector, is that takeaways operate in a highly competitive market. This finding is reaffirmed in Public Health England's 'Strategies for encouraging healthier out-of-home food provision' published in 2017 [50]. Customers want low-cost, value-for-money meals, and businesses seek the cheapest way deliver these dual aims. While defining and evidencing 'competitive market' is not straight forward there are various sources of data that validate this claim. Maguire et al. (2015) found that from 1990 to 2008, within the county of Norfolk, East England, the number of takeaways increased by 45% [87]. Not only were total numbers increasing, but they were largely clustering in deprived areas [87], where consumers are likely to be more price sensitive [197]. As stated in Chapter 2 [page 14] the barriers to takeaway ownership are low, but, from my personal conversations with those in the industry, businesses need to aim for a 60% to 70% gross profit margin to stay viable. This competitive pressure is further exacerbated by the increasing popularity of online ordering platforms [198], as such tools likely increase that traditional customer catchment area for a given takeaway. While national figures regarding business attrition are not published, data supplied to me from environmental health at Gateshead Council suggest that takeaway business turnover is high. Gateshead Council has been recording data since 2012, therefore it is possible to estimate 'churn' within the authority from 2013 onwards. Figure 4-3 shows the temporal change in takeaway businesses within Gateshead Council's jurisdiction. On average 24.5 new takeaways have opened each year, and 22.8 have closed during this period. Overall, 157

(71.7%) of the 219 takeaway businesses open in 2012 were still open in 2016, a total of 69 new businesses opened and 62, almost one in three closed during this four year period.

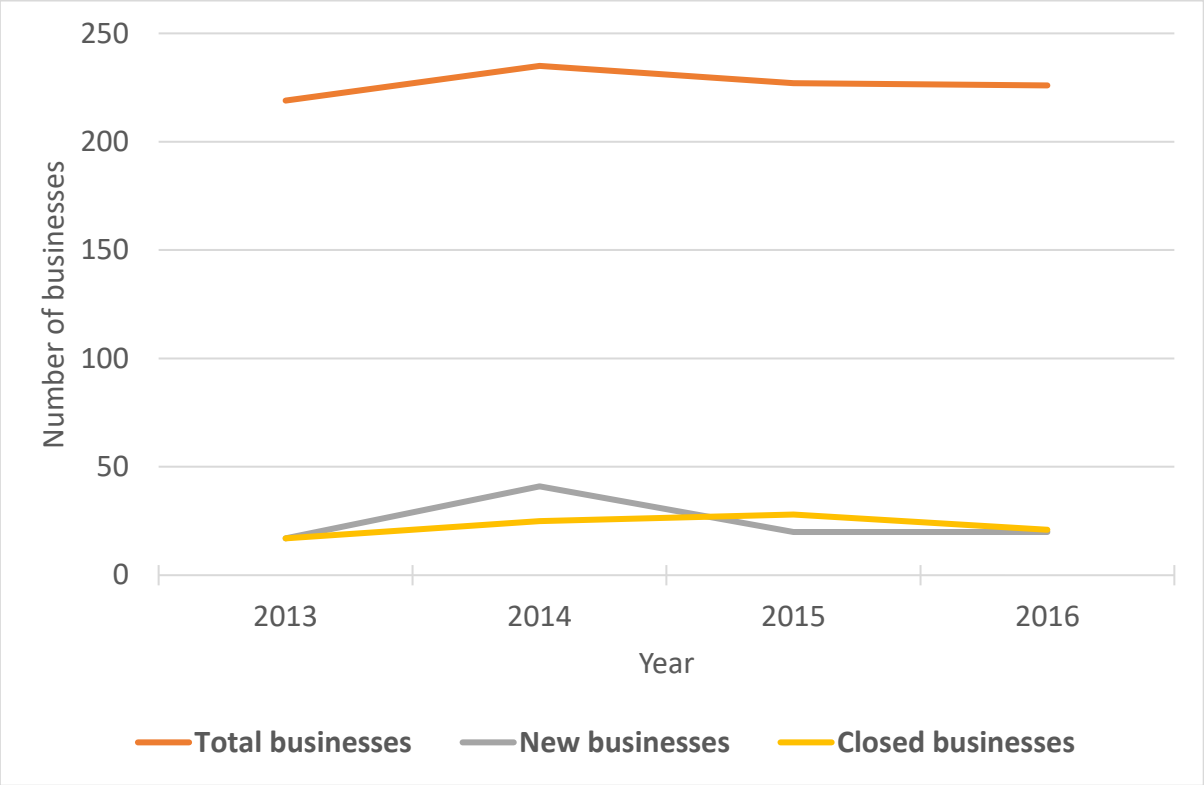

Figure 4-3 Takeaway business churn in Gateshead

Competition on price is therefore the main barrier to delivering an intervention to improve the quality of food offered by takeaways. If the cost to a business of implementation of a given intervention is not considered, as is often the case [47], there is little or no chance that the intervention will be successful.

4.10 Chapter summary

Dietary interventions that target whole populations and require a low level of individual agency have the greatest potential to be both effective and equitable. These are mostly likely to be delivered through price based interventions, such as taxes and subsidies. The excise tax on sugar sweetened beverages in Mexico has been effective in reducing purchasing of such beverages and the UK Soft Drinks Industry Levy has been predicted to potentially lead to a reduction of 144,383 cases of obesity.

The 2011 Public Health Responsibility Deal, promoted by the Coalition Government, was a public-private partnership inviting businesses to sign up to voluntary pledges linked to health improvement. Evaluation of the food pledges concluded that reporting was poor and signatories were not pushed to deliver actions beyond those they were already carrying out, nor did the pledges reflect the most effective mechanism to improve diet. Despite this, the Coalition Government initiated the 'localising' of this scheme, with the presumption that delivery would be taken on by local authorities to target small and medium sized businesses. Insufficient reporting meant that it is not possible evaluate any potential impact.

Planning restrictions, in the form of 'supplementary planning documents', have been effective in restricting the opening of new hot-food takeaway outlets, but they do not account for existing outlets. Within an outlet, it is intrusive interventions that either guide or restrict choice that have the greatest impact on health. However, in the UK, the most commonly applied intervention in this setting are award-style schemes. One such evaluated example is the Healthier Catering Commitment, which found that the less intrusive intervention components, which enabled choice of healthier alternatives or provision of information, resulted in the greater availability of healthy options. Though these were socio-economically patterned, with take-up greatest in more affluent areas.

A number of stakeholders have the potential to influence food offerings in independent takeaways, including: intervention deliverers, food business operators, suppliers, customers, and the wider community. Critically, the most important stakeholder is the FBO, as they are legally responsible for the food provision in any given outlet and it must be noted that they have a conflict of interest as the primary goal for their business to generate a profit.

Chapter 5. What are the challenges for intervening in takeaway outlets?

In this chapter, I present the findings from my study for which we interviewed intervention deliverers to gain their views on the challenges of interventions to promote healthier food in independent takeaways.

Hillier-Brown et al.'s Foodscape project publication provides a detailed summary of interventions to promote healthier ready-to-eat-food sold by specific food outlets in England [47]. However, their conclusions were limited by the quality of reporting of individual interventions and the limited scope and low methodological quality of evaluations. They attribute the general low quality of evaluations, in part, to the consideration that those tasked with delivering interventions were also often evaluating them, therefore introducing considerable risk of bias. Moreover, fundamentally evaluation was structured, understandably, to align with performance indicators of their work of service delivery, and not academic research [47].

As such, due to the limited details attainable on such interventions, an increased understanding, from the perspective of those delivering the interventions, is needed to provide a broader context regarding the setting in which interventions take place. This information could support future interventions by both identifying and understanding the challenges to effective development and delivery. Thus, my fourth paper addresses this gap in knowledge by directly soliciting the views of those delivering such interventions in a qualitative study.

PP4. The challenges of interventions to promote healthier food in independent takeaways in England: qualitative study of intervention deliverers' views

Goffe L, Penn L, Adams J, Araujo-Soares V, Summerbell CD, Abraham C, White M, Adamson A & Lake AA. *BMC Public Health* 2018, **18**(184).

Goffe et al. BMC Public Health (2018) 18:184
DOI 10.1186/s12889-018-5096-3

BMC Public Health

RESEARCH ARTICLE Open Access

The challenges of interventions to promote healthier food in independent takeaways in England: qualitative study of intervention deliverers' views

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Abstract

Background: Much of the food available from takeaways, pubs and restaurants particularly that sold by independent outlets, is unhealthy and its consumption is increasing. These food outlets are therefore important potential targets for interventions to improve diet and thus prevent diet related chronic diseases. Local authorities in England have been charged with delivering interventions to increase the provision of healthy food choices in independent outlets, but prior research shows that few such interventions have been rigorously developed or evaluated. We aimed to learn from the experiences of professionals delivering interventions in independent food outlets in England to identify the operational challenges and their suggestions for best practice.

Methods: We used one-to-one semi-structured qualitative interviews to explore the views and experiences of professionals who were either employees of, or contracted by, a local authority to deliver interventions to increase the provision of healthier food choices in independent food outlets. Purposive sampling was used to recruit a sample which included men and women, from a range of professional roles, across different areas of England. Interviews were informed by a topic guide, and proceeded until no new themes emerged. Interviews were recorded, transcribed verbatim and analysed using the Framework method.

Results: We conducted 11 individual interviews. Participants focussed on independent takeaways and their unhealthy food offerings, and highlighted the advantages and disadvantages of intervention delivery methods, their evaluation and impact.

The main barriers to implementation of interventions in independent takeaways were identified as limited funding and the difficulties of engaging the food outlet owner/manager. Engagement was thought to be facilitated by delivering intensive, interactive and tailored interventions, clear and specific information, and incentives, whilst accounting for practical, primarily financial, constraints of food businesses. Alternative intervention approaches, targeting suppliers or customers, were suggested.

(Continued on next page)

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Conclusions: Participants emphasised independent takeaways as particularly challenging, but worthwhile intervention targets. Participants perceived that interventions need to take account of the potentially challenging operating environment, particularly the primacy of the profit motive. Upstream interventions, engaging suppliers, as well as those that drive consumer demand, may be worth exploring. Rigorous, evidence-informed development and evaluation of such interventions is needed.

Keywords: Public health nutrition, Intervention, Qualitative methods, Food outlets, Diet, Takeaways, Food environments, Health promotion

Background

In the UK, the proportion of income spent on "eating out" increased gradually between the 1950s and mid-1980s [1]. Since the 1980s multinational fast-food restaurant and takeaway chains have expanded rapidly [2] and helped to create a culture of fast-food consumption [3]. In the UK these multinational chains share the market with a vibrant independent sector. The total UK spend on out-of-home eating was estimated as £73.05 billion in 2012, with £10.54 billion specifically on fast-food, takeaway and home-delivery products [4].

Meals from independent UK takeaways are high in total energy and salt when compared to UK Department of Health's Dietary Reference Values [5]. A systematic review by Lachat et al. reported an association between 'eating out-of-home' and higher total energy intake [6]. Similarly, Summerbell et al., identified four prospective cohort studies in adults that found consumption of 'fast-food' was associated with higher levels of subsequent excess weight gain and obesity [7].

Proliferation of takeaway outlets, in the UK, is broadly concentrated in more deprived areas [8–10] and people living or commuting in close proximity to takeaways are more likely to be overweight or obese [11]. Therefore, takeaways are likely contributors to the obesogenic environment [12], specifically areas with a high density of unhealthy food outlets that have been termed 'food swamps' [13, 14].

In 2011 the UK government introduced the 'Public Health Responsibility Deal' which aimed to support and work with food businesses to develop and promote healthier food through voluntary pledges [15]. Whilst many chain restaurants committed to specific pledges, the Responsibility Deal did not extend to independently owned food outlets. Local authorities have been charged with the responsibility of working with independently owned food outlets to increase the provision of healthy food choices [16]. In 2013, the UK Department of Health indicated that further work was required at a local level to encourage small and medium sized enterprises to make changes that would support staff and help customers to make healthier choices [17]. Resources for owners and or managers of food outlets and local authorities have been provided to support this intention [17–19].

Multi-component voluntary schemes, such as healthy catering award schemes run by local authorities to increase the provision of healthy food choices [20], have been delivered across England [21]. The implementation of such schemes has principally been the responsibility of environmental health officers (EHO), with support from nutrition experts and public health improvement staff [21]. Our formative research that systematically identified and described interventions to promote healthier food in independent outlets in England has shown that, apart from Bagwell's work [20], there is little evidence with regards to feasibility, acceptability or effectiveness [21]. Previous work has explored the reasons behind the difficulties and reluctance of food outlet vendors to offer healthier food [22], particularly in more deprived areas [20]. However, there is limited research on the experiences of those delivering interventions in their engagement with the food outlets and implementation of the intervention [20]. We therefore aimed to elicit the views of people with experience of delivering these types of interventions in independent food outlets to identify the operational challenges and their suggestions for best practice.

Methods

We undertook individual, one-to-one, semi-structured qualitative interviews with employees of, or professionals contracted by, a local authority, who had experience of working with independent food outlets, including takeaways, to improve the healthiness of their food offering. We asked participants for their views on food available from takeaways, pubs, cafes, and restaurants, and their experience of delivering interventions in these settings.

Participants and recruitment

We used purposive sampling [23] to recruit men and women, from a range of professional roles (public health, local authority enforcement officers and people with specific remits related to nutrition) from across different areas of England. Participants were professionals who had experience of working with owners and managers of independent takeaways, pubs, cafes, or restaurants to improve the healthiness of food on sale. Initial contacts were identified from prior work to map and synthesise evidence on interventions in out-of-home food outlets [21], with additional

contacts recruited through snowball sampling [24]. We contacted people either by telephone or email to invite their participation in this study.

Interviews

We used the findings of our recent systematic review on interventions in out-of-home food outlets [25] along with provisional discussions with intervention deliverers to develop an initial topic guide (see Appendix A), which was developed as the interviews progressed to allow for detailed comment on specific subjects. The topic guide covered: participants' perceptions of takeaway food from independent out-of-home food outlets; participants' experience of intervention deliverer; issues to consider for intervention design; and views on existing interventions. Interviews focussed on participants' perceptions of the nutritional value of food from independent takeaways, pubs and restaurants, and their experience of intervention development and delivery. We planned to continue interviews until no new themes emerged [26]. Each participant was interviewed individually by one researcher (either LG or LP) either: face-to-face at the participant's place of work; or by telephone and were digitally audio recorded.

Analysis

Interviews were transcribed verbatim, read and checked against audio recordings for accuracy, and then anonymised. Framework analysis with constant comparison guided thematic data analysis [27] and was facilitated by the use of NVivo version 10 software [28, 29]. LG, LP and AAL read all interview transcripts. A coding framework was based on a priori themes from the topic guide and emergent themes that arose from the data. Coding of transcripts was conducted by LG, with independent coding of a subset of transcripts by LP. In regular meetings LG, LP and AAL discussed and agreed on the coding framework, identifying and further developing the themes and sub-themes. The coding framework was applied to all transcripts and the resulting themes and sub-themes were reviewed and agreed upon by all team members. Anonymised quotes are provided to illustrate themes.

Results

We had a sample of 16 potential participants. Eleven interviews were conducted with no new themes emerging in later interviews. Interviews lasted 30 to 90 min. Eight participants were local authority enforcement officers working across environmental health (environmental health officers), trading standards or public protection (participants B-E, G-J), two had specific remits related to nutrition (A & F) and one was a health and wellbeing coordinator (K). All of the participants were either employees of, or contracted by, a local authority for the duration of their intervention work. Participants worked across ten different local authorities in England. Details regarding participants' occupations and intervention experience can be found in Table 1. The topic guide developed as the interviews progressed to reflect the emergent themes. These included an increased focus on independent takeaways, the specific nutritional issues of concern, greater detail regarding intervention evaluation, and their consideration of different intervention methods.

Food business operator

During initial interviews, intervention deliverers used a specific technical term, 'food business operator' (FBO). This person is defined as the natural or legal person responsible for ensuring that the requirements of food law are met within the food business under their control [30]. In most cases this person refers to either the owner or manager of the food outlet. We adopt this term throughout.

Key findings

Our analysis identified a number themes and sub themes. These included: the perceived nature of unhealthy food offerings from independent takeaways; approaches to intervention; barriers and facilitators to interventions, including resourcing and legislation, authority and motivation of intervention deliverers, suppliers of ingredients and packaging, FBO characteristics and their local competition, and customers and community; and evaluation and impact of interventions. These are presented in detail below.

The perceived nature of unhealthy food offerings from independent takeaways

Participants universally expressed condemnation of the nutritional quality, or lack of 'healthiness' of the food provided by independent takeaways where particular problems included excessive portion size, and high levels of saturated fat and salt.

> *You've just got to look at the size of portions you get from a takeaway and they're just ridiculous.* [D]

> *One meal would give a woman three and a half days' supply of her saturated fat allowance* [B]

Salt, in particular, was seen as a concern, specifically, high levels of salt in food from fish and chips shops was identified as a challenge. Sugar was seen as less of a concern, with the exception of sugar sweetened beverages available within all takeaways. However, certain cuisines were regarded as having higher levels of sugar, for example Chinese sweet and sour sauces. Fruit and vegetable content was perceived as low in most independent takeaway food, apart from in Chinese cuisine.

Table 1 Participant details

Participant ID	English region	Gender	Occupation	Intervention experience
A	London	Male	Public health commissioning manager & registered nutritionist	Healthy catering award, targeted interventions
B	North-East England	Male	Environmental health and trading standards manager	Food sampling, healthy catering award, targeted interventions
C	North-East England	Male	Environmental health team leader	Takeaway food sampling
D	North-East England	Female	Senior environmental health officer	Healthy catering award
E	North-West England	Male	Environmental health officer	Chef, school meals area manager, cooking skills trainer, healthy catering awards, targeted interventions
F	South-West England	Female	Independent nutrition consultant	Worked with a range of independent catering businesses and schools
G	North-East England	Male	Principal environmental health officer	Food sampling, healthy catering award
H	North-East England	Male	Senior environmental health officer	Food sampling, healthy catering award
I	West Midlands	Male	Public protection officer	Healthy eating awards, targeted interventions
J	North-West England	Female	Trading standards officer	Healthy eating awards, targeted interventions
K	Yorkshire & The Humber	Female	Local authority project lead on nutrition training	Healthy eating awards, targeted interventions

Approaches to intervention

Within England, Northern Ireland and Wales a Food Hygiene Rating Scheme run by local authorities provides guidance to customers on the standard of food hygiene within all food businesses. Every business receives a rating from zero to five following an inspection by a food safety officer [31], with zero indicating 'Urgent improvement necessary' and five indicating 'Very good'. Choosing independent takeaway outlets that had achieved a minimum rating of three, 'Generally satisfactory', was used as a benchmark for attempting intervention delivery with a business as it was perceived that independent takeaways that did not meet satisfactory hygiene requirements were unlikely to improve the nutritional quality of their food.

One participant suggested that, they perceived there was an underlying assumption on the part of the FBO, that working with the local authority environmental health team would be advantageous due to the EHO's regulatory role.

> *They generally know that if we're supportive of their efforts then we will either (a) give them less of a hard time and (b) perhaps give them some degree of publicity and additional support.* [C]

Interventions identified by participants fell into three binary categories: covert or overt (to the consumer); single-target or multi-component; intensive or light-touch. Covert interventions, were those that were *not obvious* to the customer, which included, for example, cooking or recipe changes, such as skimming the fat off a dish during cooking or using less of a stronger tasting cheese. Covert (to the consumer) interventions were perceived to be more feasible by the participants because they did not rely on customer choice.

> *We've been doing... sort of health by stealth, you know... talk about invisible changes that you're making* [I]

Overt (to the consumer) interventions included providing information to customers to support healthier choices, such as menu labelling (e.g. identifying an item as lower in fat).

Single-target interventions, with one nutritional focus, were rare. However, there was one widely cited example that involved replacing the 17-hole cap of a counter-top salt shaker with a 5-hole cap to reduce the amount of salt dispensed [32, 33]. Multi-component interventions were more common, especially healthy catering award schemes. Such schemes required a food outlet to meet a range of criteria in order to receive an award. Some considered that achieving these multiple targets to obtain an award was a barrier to success.

> *It [the award] was lots of criteria... which is the limiting factor in [name of local authority] because an award that maybe awarded you for having no salt, and low sugar might be more effective than saying "we want you to meet all these criteria."* [D]

Resource intensive interventions, such as FBO engagement workshops, were thought to be more successful than light-touch approaches, such as advice leaflets.

We could have maybe gone down the route of leaflets and one-off stuff which I think would have been a waste. [G]

Participants reported that they believed healthy catering award schemes did not offer valued incentives to independent takeaways and therefore were not sufficiently motivational to FBOs in order to achieve change. By contrast, the 5-hole salt shaker was promoted to FBOs by detailing the minimal impact on business practices and potential financial savings that could be made from delivering less salt. Interventions that sought to support businesses through advertising and contributions to specific business costs of offering healthier foods, such as updating menus, were perceived as feasible options to support FBOs in implementing a change towards provision of healthier food.

If somebody had said, "Well, I've just had 2000 menus printed and I wouldn't be due to do them again for another year or two and you want me to highlight the healthy options." Well, I would have said to them, "How much does it cost and we'll pay, we'll give 50% towards it." [K]

Participants expressed a strong belief that any intervention must take account of the competitive business environment and constraints in which the FBO worked.

…a businessman would say "well what's in it for me?" [E]

This included delivering the intervention at a time that was acceptable to the FBO.

We offered them three different [branded workshop] dates and we set each one at a different time [K]

Participants detailed effective strategies for intervention delivery such as simple, clear, step-by-step instructions, tailored to the specific cuisine type that could be easy to implement. Interventions that included practical engagement, such as interactive tasting sessions, were seen as particularly engaging.

…what really went down well is we actually did a taste test as part of our [branded workshop]. [K]

Participants stated that, regardless of the intervention method, it was important to develop a strong working relationship with the FBO and their business.

…if you build the relationship up, you know, I'll literally go in the kitchen and show them how to do something that they've said they can't do, I'd say "you can, I'll show you." And you'll go and do that and they'll think "oh right, I can, that's cheaper to do it that way." [E]

Participants also emphasised how important it was to acknowledge FBOs for the efforts they had made to change.

We're about saying "look, let's build on the positive things that you're doing and perhaps introduce some healthier options, and in the meantime we might just increase the reputation of your business and your profits" [E]

Barriers and facilitators to interventions

Participants identified barriers and facilitators to intervention delivery across five operational levels. Additionally, each has been mapped to an adapted version of Story et al.'s ecological framework which describes the multiple influences on food availability [34]. This adapted framework depicts factors that are barriers and facilitators to delivering interventions to promote healthier food. They include macro-level barriers (e.g. limited funding) and facilitators (e.g. EHO jurisdiction) through to individual barriers (e.g. language and culture) as well as individual facilitators (e.g. passionate intervention deliverers) (Fig. 1).

Resourcing and legislation

Most participants were employed directly by a local authority. They spoke about changes to their work structure that brought about a closer working relationship with public health officials who had an interest in targeting independent takeaways.

…public health very much want me to target takeaways and that's what their big thing is, you know the takeaway outlets. [E]

Limited funding, compounded by recent cuts in local authority budgets, was the main barrier to intervention delivery.

We try and do what we can but when your resources are dwindling constantly and you've got other pressures on your time, it's not easy. [J]

With regard to legislation that could facilitate improvements, participants suggested a statutory training requirement for FBOs and their staff, including nutritional education.

If you even run a pub you have to have a licence to run a pub. The situation at the moment is that anybody can open a food business, they don't

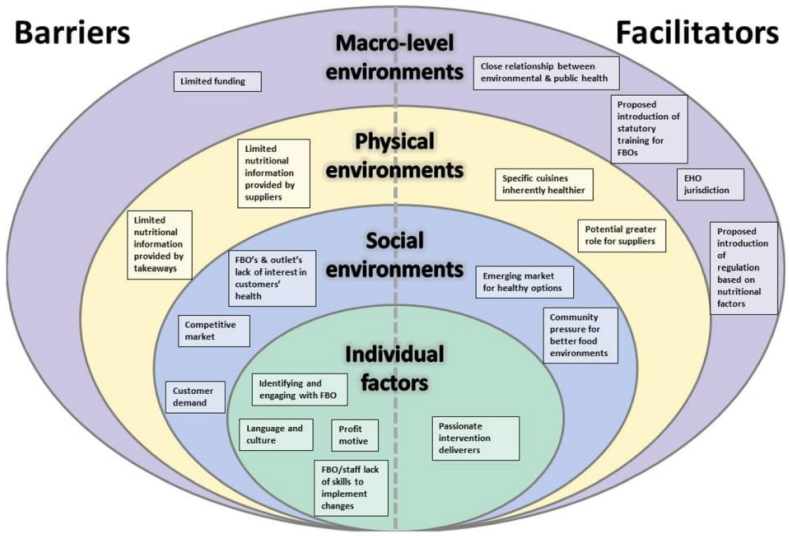

Fig. 1 Barriers and facilitators to delivering interventions to promote healthier food mapped to Story et al.'s [34] ecological framework

have to have any qualification when they open that business, they don't have to have a licence, they don't have to have a cooking qualification for instance. [E]

Others proposed a tax on fat or regulation of portion size. Participants felt there was legislative scope to restrict the opening of new independent takeaways, but emphasised that such changes would have no impact on existing establishments.

We've just had our supplementary planning document ratified and so we are going to be able to [restrict] the proliferation of these types of outlets, but the issue is that only stops the new ones, it doesn't do anything about the existing businesses. [J]

Authority and motivation of intervention deliverers

For some participants nutrition related intervention work was additional to their statutory duties, while others were contracted specifically to conduct this work. Many participants expressed their passion for public health improvement particularly within their local area and community as a personal motivation to facilitate intervention delivery.

I would love to get more involved, it's my passion. Food's my passion. And then I see unhealthy kids all the time and you just think "oh we should be doing, this shouldn't be happening" [E]

Those participants who were employed directly by a local authority identified the authority of an EHO as important in gaining initial access to certain independent takeaways.

…you're going in there with the badge of an EHO in the hope that, you know, the staff or the owner will be engaging because, because of that EHO relationship. [K]

Suppliers of ingredients and packaging

All of the approaches to interventions discussed in interviews were targeted at changes within individual independent takeaways. However, some participants identified the role played by independent takeaway suppliers (wholesalers) as important and felt that there was potential to engage with them to deliver changes, such as provision of *'healthier'* alternatives, which would provide individual independent takeaways with the option to purchase such products.

…they [the suppliers] could more clearly show businesses that there are other options, you know the sort of [healthy] varieties which are the same price… that would be useful. [A]

It was suggested that by limiting the types, cost and size of products and packaging, suppliers could directly influence food and portion sizes offered to customers.

One participant took issue with the way suppliers labelled their products, implying customers were deliberately misled.

The national suppliers are very good at obfuscation of the nutritional value of their food. [B]

The few participants who had tried to engage with suppliers about provision of *'healthier alternatives'* had received mixed responses, but there was broad agreement that consideration should be given to the suppliers' role in independent takeaway food provisions.

FBO characteristics and their local competition

All participants identified the need to engage with FBOs, as they were of the view that FBOs have the greatest influence over menus at their establishments.

…even if the people actually doing the cooking are really into [healthier food], if the manager hasn't bought into it, then it's quite difficult for them to actually do it [F]

However, establishing contact with FBOs was often reported as difficult. Participants reported that FBOs were frequently evasive and might try to avoid having their name on official documentation.

…sometimes it is actually very difficult to identify who the actual business owner is… because nobody seems to take ownership. [J]

Language or culture was also stated as a barrier to engagement. Participants reported that English was often not the first language of the FBO or their staff.

You could speak to the owner and they would say that "my staff don't speak English very well, it's too much work for me to explain it all to them" and you know there was a lot of resistance. [J]

Participants also recognised that profit was the top priority for FBOs.

…a business's bottom line is to make profit [K]

Independent takeaways were perceived by participants to operate in a highly competitive market with high business turnover and low profit margins. This focus on profit and consequently customer numbers meant that issues regarding the '*healthiness*' of food were not seen as a key concern. As a result of intense competition, participants reported that one of the main marketing strategies used by independent takeaway outlets was to offer larger portions at a lower prices, focussing on '*value-for-money*'.

They were very fixated with people wanting value-for-money, and that's why they pile the food on. [F]

This was coupled with a perception by participants that FBOs were disinterested in the health of their customers.

They're not really thinking about what the customers actually could need in terms of health [G]

This did not mean that there were no healthy options within the independent takeaway sector. Some participants were keen to point out what they thought of as healthier examples.

The Cantonese style food, they tend to be much more aware [of healthiness of their product] mainly because of the upbringing they've have and the food they've had when growing up they tend to be more aware [J]

There's big improvements with the charcoal based cuisine places at the moment because that's to do with the big surge in popularity of say the [national grilled chicken restaurant chain] type products, so piri-piri chicken, grilled chicken, barbecue chicken [E]

Where FBOs were willing to participate in an intervention, participants sometimes reported a lack of knowledge or skills to promote their healthier options. However, some participants reported positive experiences such as working with engaged FBOs to identify methods to advertise positive changes to their customers.

Some of them were so up for it. We actually had to produce a poster saying we are now giving less salt on your food [B]

But such enthusiasm was not universal.

We do provide them with a poster about the reduced salt [and] the salt shaker, which some of them put up, some of them didn't. [I]

Customers and community

Participants universally reported that, in their view, customers chose takeaway food because it provided a cheap, convenient and filling meal. One expressed a view that '*price discounting*' encouraged customers to consume

takeaway food multiple times throughout the week. However, some participants perceived there was an emerging market for healthier food options.

> *So you've got that age group of males, who are more frequently asking for lean products, grilled products, chicken predominantly… you know they've all got apps on their phone now to tell them how many calories are in things.* [E]

It was widely acknowledged that independent takeaway outlets did not make it easy for customers to identify the healthier options. There was little calorie or nutrient information provided in independent takeaway outlets.

There was a strong feeling of customer demand driving the takeaway market.

> *The fact that they've [the FBOs] got customers coming through the door is their main problem. If they saw a reduction in customers, they would need to think about how to diversify.* [A]

Participants also suggested that interventions needed to take account of customers' taste preferences. For example, salt reduction was considered problematic because of its direct link to taste.

> *The difficult thing on salt is people will associate it with flavour of course and if they think you are offering food with less flavour, that's the barrier.* [H]

Community pressure was considered a potential driver of change.

> *I think we need to approach this in a more community-based way to involve communities and community-leaders, and you know schools, churches, anything like that to try to create a community ownership if you will, rather than the government saying "you cannot do this."* [E]

Therefore, identifying and targeting the right people and institutions, with the greatest influence within communities, was seen as critical to create a feeling of *'community ownership'*.

> *I've built up a lot of relationships, a lot of them managers with independent businesses, private traders, all the Sure Start centres… All those people ring up for advice. They'll ask me to go and speak to parent groups about healthy food. I'm very involved with schools… we need… to involve communities and community-leaders, and you know schools, churches, anything like that to try to get some community, to create a community ownership.* [E]

Evaluation and impact of interventions

Participants saw their work as service delivery – evaluation was not considered essential within the local authority setting.

> *We're more, go in and do the work, what we've not been great at or not had the capacity to do [is evaluation]* [K]

Factors contributing to the lack of evaluation included limited resources, the constraints and demands of the local authority working environment and a lack of knowledge and skills regarding how to conduct evaluation. Some participants suggested evaluation should be carried out independently.

> *I always think evaluation, where possible, should be independent anyway so that you, you're less likely to have skewed reporting* [K]

All participants acknowledged that independent takeaways, in particular, represented a challenging setting and some were sceptical regarding intervention impact.

> *You can get them to do small things but whether they [the changes made] have a massive impact is debateable.* [J]

However, participants appeared united that work to improve the healthiness of independent takeaway food was important and further efforts should be made.

> *People have been doing this kind of health promotion work for a long time now, and [local authority] health stats are still appalling. So can you make a massive difference to a landscape? I'm not sure. But can you get some wins? …I think you've got to try haven't you? You can't just let it go on as it is* [H]

Discussion

Summary of principal findings

To our knowledge, this is the first study to explore the views of people with experience of delivering interventions to promote healthier independent takeaway food via a range of interventions across England. The results highlight the challenging nature of delivering such interventions. Participants identified independent takeaways as offering predominantly unhealthy food, with large portion size and high levels of saturated fat and salt.

They described a range of approaches to intervention delivery that they perceived as influencing intervention effectiveness and acceptability to FBOs. We categorised these as: covert or overt (to the consumer), single-target or multi-component, intensive or light-touch. Healthy catering award schemes (overt and multi-component) were perceived by participants as largely ineffective. Factors facilitating effective intervention delivery were perceived to be: intensive and interactive programmes (with the FBO), provision of step-by-step instructions, awareness of financial considerations and minimal disruption to usual business practices. Building strong, respectful relationships between FBOs and intervention deliverers was seen as key for success. We identified barriers to successful intervention delivery at a number of operation levels: availability of resources, both financial and workforce, and willingness of independent takeaway FBOs to engage with interventions.

Strengths and limitations of the methods

This qualitative study has provided in-depth contextual information regarding the practicalities of delivering nutritional interventions targeted at independent takeaway outlets.

Participants were identified from prior work, a systematic mapping and evidence synthesis of interventions promoting healthier ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets in England [21]. This resulted in inclusion of participants from ten different local authorities, representing a range of views of intervention delivery experience. At 11 interviews no new themes emerged, but it is possible that this is not a representative sample and therefore does not represent all views.

Interviews focused on interventions in small, independent takeaways, and therefore may not be generalizable beyond England and further it is unlikely that the findings are generalizable to larger enterprises, chains or franchises, where management structure and responsibility for the food offerings will differ substantially.

Comparison with other studies

The findings from these interviews suggest that intervention deliverers believe that multi-component catering award schemes have been broadly ineffective at recruiting independent takeaway businesses. This reflects the findings of recent work with independent fast food vendors in Scotland [22].

Our findings, suggests that FBOs may feel restricted in their ability to offer healthier food due to the market pressures under which they operate, reflecting previous work [20, 22]. Bagwell [20] explored the views of intervention deliverers in relation to the London based Healthy Catering Commitment, an award style intervention, that aimed to get small independent outlets to adopt healthier cooking practices and reported similar factors influencing the level of business commitment to such initiatives as we found. These included operational barriers, issues around the limitations of suppliers, aspects of the local trading environment such as differing cultural practices and the actual or perceived impact of the changes on profits. Similar to the perception of our participants, businesses in London also preferred less intrusive (to the customer) interventions. Our study adds further context in relation to resourcing interventions and constraints at the supply level. Our work highlights the multiple layers of influence on the food that is served within independent takeaways, and suggests the need to adopt a multi-level, socio-ecological approach to designing interventions in this complex setting [34]. In this context it is plausible that interventions either upstream (i.e. with suppliers) or downstream (i.e. with customers) of independent takeaways may be more effective than those directly targeting independent takeaway FBOs themselves.

Implications

Our work suggests that interventions specifically tailored to particular settings may be more effective than more generic approaches. Our findings highlight the practical challenges of developing and implementing interventions to promote healthier food offerings in independent takeaways. We have identified intervention components that intervention deliverers associate with effective delivery, feasibility and acceptability to FBOs. It should be noted that this does not include evaluation of effectiveness. Future intervention development could build on our findings regarding potential feasibility. For example, there should be a focus on covert interventions that deliver nutritional changes that are not immediately obvious to the customer, as these were perceived by intervention deliverers to be most feasible and acceptable to FBOs. Future interventions should also include a measure of effectiveness.

By contrast overt healthy catering award schemes were perceived as difficult to implement and unlikely to be effective. Once funding has been secured for an intervention the main focus should be on FBO engagement and building a mutual relationship of trust; this can be time consuming, but appears to be important for successful implementation. Our findings also suggest that it is critical to consider the financial implications of interventions for businesses due to tight profit margins and the competitive business environment in which they operate. Further, our study also suggests that future intervention work should look at the potential of *both* upstream and multi-level approaches such as working with suppliers or regulators and creating customer demand or local competition for healthier food choices in independent

takeaways. If addressed collectively such changes may be more effective in driving the provision of healthier food within independent takeaway outlets.

Unanswered questions and future research

Future work should look for opportunities to develop, deliver and evaluate covert (to the consumer) interventions. The 5-hole salt shaker is one such intervention, which we recently evaluated [32, 33]. We concluded that their use is associated with lower relative sodium content of fish and chip meals [32]. A limitation of this intervention technology is that it is linked to specific takeaway cuisines and to salt added at point of sale.

The 5-hole salt shaker relies on technology, but other covert (to the consumer) intervention opportunities, such as variation in recipes or cooking methods to reduce the fat or salt content of meals, require a greater level of FBO engagement. Offering training to FBOs to facilitate healthier meal preparation may appear to be an attractive option, but can be resource intensive and should be evaluated for likely benefit in relation to cost. Increased consideration should be given as to how to engage with FBOs and their staff. Interactive forums, such as workshops, where FBOs and other stakeholders are able to meet collectively to discuss issues regarding health in a non-judgmental setting, could be explored.

The participants in this study identified opportunities to consider engagement with stakeholders, other than the FBOs, such as independent takeaway customers and suppliers of ingredients and packaging to independent takeaways. One potential intervention target, which would be applicable across all independent takeaway cuisine types, is portion size. Packaging exists, for some foods that restricts portion size, such as cardboard or polystyrene boxes [35]. Thus suppliers could have a role in developing and delivering packaging that would support independent takeaway business in reducing portion size, or offering a wider choice of portion sizes.

This research lacks the voices of other key stakeholders, such as policy makers, intervention commissioners and customers. Future work could also explore how independent takeaway customers can be mobilised to increase demand for healthier options, as FBOs are more likely to be responsive to customers than any other stakeholder group.

With all future work, there is a need for rigorous theory and evidence-informed development and evaluation of interventions in order to guide future efforts in this area.

Conclusions

Participants delivering interventions in independent takeaways found such work challenging. However, they stressed that independent takeaways (despite the challenges) were important targets for change due to their nutritionally poor food offerings. Interventions need to take account of the potentially challenging operating environment, particularly the primacy of the profit motive. Participants suggested that future work should explore the possibility of utilising suppliers or customers as the agents of change. Our findings on the different operational levels at which interventions can be applied and their associated barriers and facilitators, together with the advantages and disadvantages of intervention delivery methods (covert or overt (to the consumer), single-target or multi-component, intensive or light touch) can be used to inform future intervention development.

Abbreviations

EHO: Environmental health officer; FBO: Food business operator

Acknowledgements

The authors would like to thank the participants of this study for being generous with their time and providing additional information and contacts to assist with this project.

Funding

This research was funded as part of the NIHR School for Public Health Research (SPHR) project: Transforming the 'foodscape': development and feasibility testing of interventions to promote healthier takeaway, pub or restaurant food. With additional support from Durham and Newcastle Universities, and the NIHR Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). SPHR is funded by the National Institute for Health Research (NIHR). SPHR is a partnership between the Universities of Sheffield, Bristol, Cambridge, Exeter, University College London; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster; and Fuse, the Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. Authors LG, LP, AA, VAS, CS, and AAL are members of Fuse. Funding for Fuse comes from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, and is gratefully acknowledged. AA is funded by the NIHR as a NIHR Research Professor. JA and MW are funded by the Centre for Diet and Activity Research (CEDAR), MRC Epidemiology Unit, University of Cambridge, a UKCRC Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.
The NIHR SPHR was not involved in the design of the study nor the collection, analysis, and interpretation of data or writing the manuscript. The views expressed in this paper are those of the author(s) and not necessarily those of the above named funders.

Availability of data and materials

Data and all other materials for this study are kept at the Institute of Health and Society, Newcastle University. The datasets generated and analysed during the study are not publicly available due the terms of consent to which the participants agreed but are available in anonymized form from the corresponding author on reasonable request.

Authors' contributions

AA, JA, AAL and MW devised the concept for the study and contributed to study design and interpretation of findings. LG assisted in the study design and development of methods, conducted the interviews, data analysis, and drafted the manuscript. LP assisted in the conception of the study idea, the study design and the development of methods, conducted one interview, contributed to data analysis and to the drafting of the manuscript. AAL assisted in the development of methods and the management of the study, and helped to draft the manuscript. CA, JA, VAS and CDS assisted in the

development of methods. All authors provided critical comments on drafts of the manuscript, and read and approved the final version.

Ethics approval and consent to participate
We obtained ethical approval for the study from the Ethics Committee of the Faculty of Medical Sciences at Newcastle University (Application No: 00761/2014). All participants gave written informed consent to take part and no financial or other incentives were offered.

Consent for publication
Not applicable.

Competing interests
MW is funded by NIHR as Director of its Public Health Research Funding Programme. Authors LG, LP, JA, VAS, CDS, CA, AA, and AAL declare that they have no competing interests.

Publisher's Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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Received: 25 January 2017 Accepted: 17 January 2018
Published online: 27 January 2018

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5.1 PP4 commentary

Figure 1 in my publication mapped both barriers and facilitators to delivering interventions to promote healthier food onto Story et al.'s ecological framework [183]. It is duplicated here for ease of reference, see Figure 5-1. It highlights the conflicting forces acting on those who are charged with delivery. The transfer of responsibility for public health delivery to local authorities, following the Health and Social Care Act 2012 [199], had resulted in an increased emphasis to improve local food environments. However, this was offset by the economic downturn following the global fiscal crisis of 2008, resulting in cuts to local authorities' budgets, and therefore limiting resources. These cuts have been argued to be a part of an austerity agenda [200] driven by a neoliberal political ideology [201]. Whilst interventions in this setting are challenging, as evidenced from published literature [page 76] and supported by findings reported in PP4 from intervention deliverers [Goffe et al. (2018) page 97] [55], the facilitators mapped to Story's ecological model, illustrate potential opportunities that could be explored in future interventions.

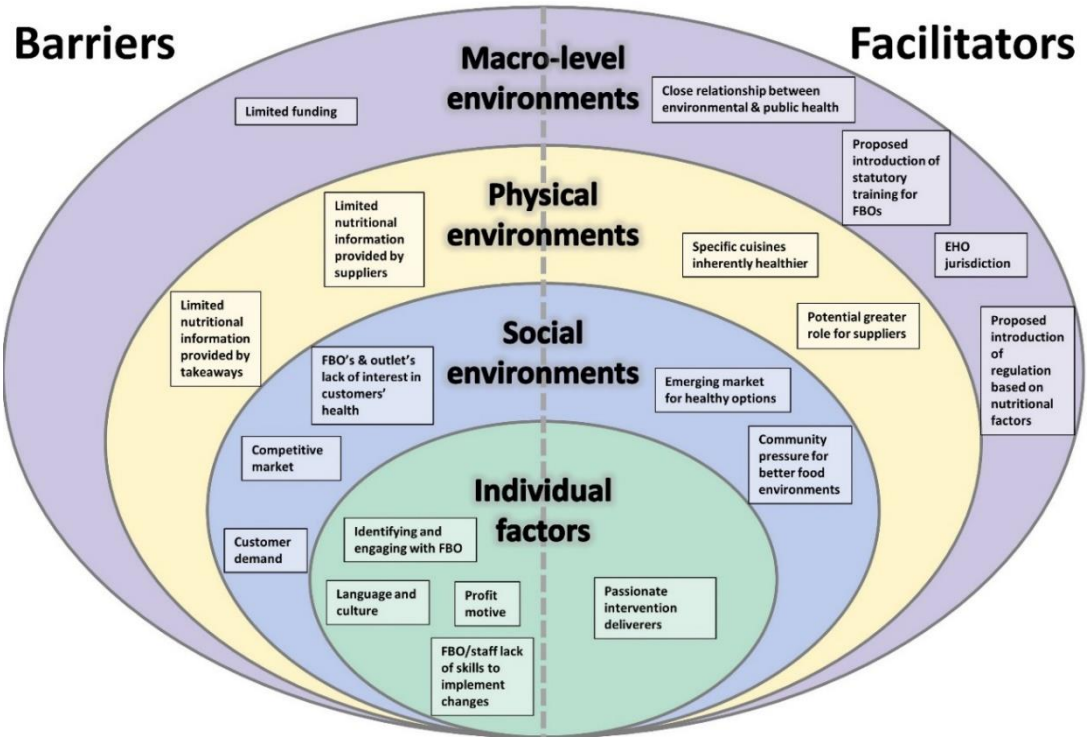

Figure 5-1 Barriers and facilitators to delivering interventions to promote healthier food in takeaways

Subjectively, the most significant challenge that emerged from my interviews with intervention deliverers was the engagement and building of trust with the FBOs. This claim, was reflected in further unpublished worked carried out as part of the Foodscape project [1] (ethical approval by the Newcastle University Research Ethics Committee: 00761/2014). I aimed to interview a range of FBOs covering different cuisine types to understand, from their perspective, the availability of healthy options. I had a two-tiered approach to recruitment; the first was in partnership with Gateshead Council and second a direct approach. Gateshead Council identified 42 independent takeaway businesses and associated FBOs that they had considered to be more likely to engage based on their experience of meal sampling for nutritional analysis of independent hot food takeaways in 2012 [100]. These comprised of 9 Fish & Chip Shops, 12 Indian, 10 Chinese, and 11 multi-cuisine takeaways. Despite multiple follow-up phone calls, and in some cases pre-arranged visits, we managed to speak with only three businesses, which included one staff interview and two owner interviews. The second tier approach was opportunistic door-to-door calling. Again, following numerous shop visits, this was largely unsuccessful. I was able to gain an interview with the owner of one multi-cuisine takeaway and a further interview with the manager of one Indian restaurant, where I was a known customer. This was particularly telling in that I was only seeking the views and perspectives of FBOs and not actively trying to recruit them into an intervention. As I was able to gain only five interviews, we did not draw definitive conclusions from this work, beyond the challenge of engagement. However, certain themes did align with those of Estrade et al. [185]. These included the pride in their produce and the availability, in their opinion, of healthy options. FBOs clearly felt that the health of their customers was not their responsibility. This lack of interest in engagement from FBOs with regards to health was also reflected by Gateshead Council when they offered to provide free feedback on the meal sampling survey [100]. Of the 187 outlets, from which meals were sampled, only three were receptive to feedback and responded as follows:

> *Thanks. I hadn't realised my portion sizes were so big compared to the competition. I'll make them smaller and save a fortune on potatoes.*

Thanks, we'll try to reformulate our meals. Please come back and sample us again.

I don't give a stuff. I have a daughter to raise and a mortgage to pay. If people choose to eat the stuff I sell then that is their choice. [202]

The FBO is the legally responsible individual for the food that is produced and provided within any given food business. Therefore, the potential impact of any given intervention within independent takeaways will be dependent on the method in which the FBOs are engaged.

5.2 Chapter summary

It is widely recognised that independent takeaways are appropriate targets for nutritional interventions. However, they are challenging establishments in which to deliver a change. Future interventions should seek to engage with the wider stakeholders, particularly suppliers and customers. However, most challenging is engagement with the food business operator. Challenges include identifying the FBO and building a relationship based on mutual trust. Once established, if the intervention requires voluntary engagement, then it must recognise the primacy of the profit motive.

Chapter 6. Can we reduce salt served using an intervention in Fish & Chip Shops?

The 5-holed Fish & Chip Shop salt shaker cap was designed to replace the established 17-holed cap with the aim to reduce the amount of discretionary salt delivered either at the point of service or by customers within the shop. This intervention has become popular, but has never been formally evaluated. In this chapter, I present two studies that I led within the Foodscape project to evaluate the 5-holed salt shaker intervention.

6.1 The development of the 5-holed salt shaker caps

The concept for the 5-holed cap resulted from an event organised by the (now defunct) Centre for Enabling Health Improvement (CEHI). This was a virtual centre established in 2003, by the Gateshead Primary Care Trust [203], whose aims for were to:

- Support the wider public health workforce
- Develop resources to improve the health of the local population [203]

As detailed to me by one former CEHI member, Peter Wright, Environmental Health and Trading Standards Manager for Gateshead Council, the group had five local authority officers on the management board and was considered to be a 'Skunkworks'[1] to address public health issues of concern to the local area. In 2005, Gateshead Council EHOs explored various opportunities across the food system for salt reduction, including bread production, but chose to focus on salt within Fish & Chip Shops. They discovered that the original primary purpose of the 17-holed salt shaker was to distribute flour. Due to the humid conditions within Fish & Chip Shops these extra holes were desirable as they kept the salt flowing even when the salt began to clump and some of the holes had become clogged. However, the requirement for numerous holes was no longer needed once the salt manufactures introduced anticaking agents, preventing the clumping of salt granules. Julia Lough, Bill Scott and Chris Hawthorne, EHOs from Gateshead Council and managed by Peter Wright,

[1] *a small hand-picked team that is formed and removed from the ongoing part of a business, to counteract ingrained organisational patterns, who are given complete responsibility and operates in an autonomous fashion for developing a new product or process* [204. Bommer M, DeLaPorte R, Higgins J. Skunkworks Approach to Project Management. Journal of Management in Engineering. 2002;18(1):21-8.

originally conceived and developed the 5-holed salt shaker caps. They contacted the manufacturer, Drywite Limited, to discuss potential production. Drywite were not initially enthusiastic, but once the development team had designed the new 5-hole arrangement and Gateshead Council agreed to pay for the manufacture of the die for the caps and the first production run, they agreed to manufacture.

6.1.1 Distribution and availability

In 2006, the 5-holed caps were trialled with a small number of businesses within Gateshead Council's authority to test for acceptability. They found that there was no adverse reaction from either FBOs or customers. A full roll-out of the scheme followed in which a free replacement 5-holed cap was offered to all Fish & Chip Shops in Gateshead. Only three business declined the offer [47] and they found FBOs to be '*very supportive and knowledgeable about salt and health*'. In some cases, Gateshead Council had received requests from FBOs for promotional material to inform their customers that they were actively trying to reduce salt. As a result of these request the group developed, in-house, a poster to accompany the new caps, see Figure 6-1.



Figure 6-1 Promotional poster created by Gateshead Council for the 5-holed caps

Gateshead Council's work was published as a case study on the Food Vision website (no longer active), which brought the 5-holed caps to the attention of others in local authority working in public health improvement. In the first instance, they were contacted by civil servants from Rochdale, Antrim, Slough, Welwyn Hatfield, East Riding of Yorkshire, Flintshire and Caerphilly.

As a direct result of the work by Gateshead Council, the 5-holed cap is now widely available nationally. The two main supplier networks: T. Quality and the Q Partnership (Henry Colbeck Ltd (HC), Friar's Pride Ltd, and V.A. Whitley & Co. Ltd) both have the 5-holed caps available for purchase (as of October 2017) with HC having the 5-holed caps as their default option with regards to replacement salt shaker caps [205].

6.1.2 Media exposure and lessons learned

The 5-holed caps intervention was reported in the mainstream media at both a regional and national level and received a polarised response. Local reporting was favourable, highlighting the positive response from both a local elected official as well as a Fish & Chip Shop owner. This positive response was further highlighted by the scheme's nomination for a Food Standards Agency award [206]. While the BBC's online reporting was similarly positive, referring to it as '*innovative*' [207], another national media outlet labelled the council as '*tinpot condiment nazis*' [208]. Despite such criticism, in conversation with Peter Wright, he said that overall this was positive experience for those involved. Following the full roll-out they had succeeded in having almost every Fish & Chip Shop within Gateshead Council's authority switch to 5-holed caps, through neither force nor coercion. They received no negative feedback from FBOs, with one FBO reporting that he had significantly reduced the amount of salt he purchased by 20kg per month (personal communication) [209].

Despite the intervention being covert to the customer [Goffe et al. (2018) page 97] [55] and seen as favourable by the FBOs, Gateshead Council still received 'nanny state' criticism. However, Wright told me that they were prepared and expectant of such comments and learned that any publically funded intervention requires both strong managerial and political support from within the Council. They realised that those delivering an intervention have to

be both '*pushy*' and '*passionate*' about making a difference in their community and the team as a whole, including those at senior levels, has to be both ambitious and courageous.

6.1.3 Gateshead Council evaluation of the 5-holed salt shaker caps

As Hillier-Brown et al. noted, evaluation of such interventions is limited and predominantly focused on acceptability of interventions to business owners [47]; and indeed this limitation also applies to Gateshead Council's 5-holed caps. They reported that the acceptability was high, FBOs were in favour of the intervention; this included both cost savings and low impact on everyday business practices. The only negative aspect was the reporting from the Daily Mail, and some libertarian groups and writers which led to '*insulting and harassing*' emails sent to those officers involved in the project.

Gateshead Council's own evaluation provided a useful insight regarding feasibility and acceptability of the intervention. However, it could not be considered either robust or conclusive with respect to the potential health impact on the customer. But criticism of lack of robust evaluation in relation to health could be considered unfair when directed at those delivering interventions. As an emergent theme of my qualitative work with intervention deliverers it was clear that they saw their job as 'service delivery'.

> *We're more, go in and do the work, what we've not been great at or not had the capacity to do [is evaluation] [Goffe et al. (2018) page 97] [55]*

Despite this, robust evaluation was universally regarded as desirable. It was seen as requiring different skills and additional knowledge in order to deliver appropriately. Furthermore, some felt that to avoid bias evaluation should be carried out independently. However, the greatest barrier to undertaking evaluation was cost. In a period where many local authorities were experiencing reduced budgets and cost-cutting measures within their department, funds were limited [Goffe et al. (2018) page 97] [55].

6.2 Suitability for further evaluation

Based on our three binary classifications [Goffe et al. (2018) page 97] [55], the intervention is covert, single-target and light-touch. For these reasons it has been widely accepted within the takeaway sector. However, in order to evaluate any potential relationship between the

intervention and population impact there were fundamental questions regarding the 5-holed cap's impact on the amount of salt delivered that first needed to be answered. Firstly, I wanted to evaluate whether the technology delivered less salt than the 17-holed version, as intended under controlled conditions [Goffe et al. (2016a) page 116] [56]. Secondly, I wanted to explore whether any change in salt delivery in controlled conditions translated into lower salt delivery under real life conditions [Goffe et al. (2016b) page 116] [57].

PP5. Reducing the salt added to takeaway food: within-subjects comparison of salt delivered by five and 17 holed salt shakers in controlled conditions

Goffe L, Wrieden W, Penn L, Hillier-Brown F, Lake AA, Araujo-Soares V, Summerbell C, White M, Adamson AJ & Adams, J. *PLOS ONE* 2016, **11**(9).

PP6. Comparison of sodium content of meals served by independent takeaways using standard versus reduced holed salt shakers: cross-sectional study

Goffe L, Hillier-Brown F, Doherty A, Wrieden W, Lake AA, Araujo-Soares V, Summerbell C, White M, Adamson AJ & Adams, J. *International Journal of Behavioral Nutrition and Physical Activity* 2016, **13**(102).

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RESEARCH ARTICLE

Reducing the Salt Added to Takeaway Food: Within-Subjects Comparison of Salt Delivered by Five and 17 Holed Salt Shakers in Controlled Conditions

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Citation: Goffe L, Wrieden W, Penn L, Hillier-Brown F, Lake AA, Araujo-Soares V, et al. (2016) Reducing the Salt Added to Takeaway Food: Within-Subjects Comparison of Salt Delivered by Five and 17 Holed Salt Shakers in Controlled Conditions. PLoS ONE 11(9): e0163093. doi:10.1371/journal.pone.0163093

Editor: Amanda Bruce, University of Kansas Medical Center, UNITED STATES

Received: September 22, 2015

Accepted: September 2, 2016

Published: September 26, 2016

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Data Availability Statement: The full dataset is available from the corresponding author. Consent was not obtained for data sharing, but personal identifiable data was not collected, and the risk of identification is low. The statistical code is available in the Supporting Information files.

Funding: This study was funded as part of National Institute of Health Research's School for Public Health Research (NIHR SPHR) project: Transforming the 'foodscape': development and feasibility testing of interventions to promote

Abstract

Objectives

To determine if the amount of salt delivered by standard salt shakers commonly used in English independent takeaways varies between those with five and 17 holes; and to determine if any differences are robust to variations in: the amount of salt in the shaker, the length of time spent shaking, and the person serving.

Design

Four laboratory experiments comparing the amount of salt delivered by shakers. Independent variables considered were: type of shaker used (five or 17 holes), amount of salt in the shaker before shaking commences (shaker full, half full or nearly empty), time spent shaking (3s, 5s or 10s), and individual serving.

Setting

Controlled, laboratory, conditions.

Participants

A quota-based convenience sample of 10 participants (five women) aged 18–59 years.

healthier take-away, pub or restaurant food. With additional support from Durham and Newcastle Universities. The School for Public Health Research (SPHR) is funded by the National Institute for Health Research (NIHR). SPHR is a partnership between the Universities of Sheffield, Bristol, Cambridge, Exeter, UCL; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster; and Fuse, UKCRC Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. FHB, CS, WW, AJA, VAS and AAL are members of Fuse. Funding for Fuse comes from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, and is gratefully acknowledged. AJA is funded by the NIHR as a NIHR Research Professor. JA and MW are funded by the Centre for Diet and Activity Research (CEDAR), a UKCRC Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. The views expressed are those of the authors and not necessarily those of the above named funders.

Competing Interests: The authors have declared that no competing interests exist.

Main Outcome Measures

Amount of salt delivered by salt shakers.

Results

Across all trials, the 17 holed shaker delivered a mean (SD) of 7.86g (4.54) per trial, whilst the five holed shaker delivered 2.65g (1.22). The five holed shaker delivered a mean of 33.7% of the salt of the 17 holed shaker. There was a significant difference in salt delivered between the five and 17 holed salt shakers when time spent shaking, amount of salt in the shaker and participant were all kept constant ($p<0.001$). This difference was robust to variations in the starting weight of shakers, time spent shaking and participant shaking ($ps</= 0.001$).

Conclusions

Five holed salt shakers have the potential to reduce the salt content of takeaway food, and particularly food from Fish & Chip shops, where these shakers are particularly used. Further research will be required to determine the effects of this intervention on customers' salt intake with takeaway food and on total dietary salt intake.

Background

Takeaway food consumption is common in developed countries. Around one-fifth of adults and children in the UK eat takeaway food at home at least once per week.[1] Eating takeaway food at home is more common in children, but not adults, living in more deprived areas.[1] Consumption of takeaway food may be even higher in other countries.[2, 3] Although population data is unavailable, when takeaway food eaten in other locations than home is taken into account, takeaway food is likely to represent a substantial element of the UK diet. One study of UK adolescents living in a deprived urban area found that almost 75% of them consumed any food or drink from fast-food outlets at least once per week.[4] Food prepared out-of-home is, overall, less healthful than food prepared at home[5] and the diets of those who eat more out-of-home food tend to be of poorer nutritional quality.[5, 6]

In England, the takeaway 'foodscape' is diverse, but independent outlets tend to be much more common than chain or franchise outlets.[7] Traditional British 'Fish & Chip Shops', serving battered and fried white fish with chipped and fried potatoes as their core offering, account for up to one-third of independent takeaways.[8] Aside from other nutrients, food from independent English takeaways is high in salt.[9–11] One study found that the median salt content of one standard portion of fish & chips, before addition of discretionary salt, was 3.0g (IQR: 2.4–4.8)[10]–equivalent to half of the recommended maximum daily intake for adults of 6g.[12] The salt content of other typical dishes served by independent takeaways ranged from 2.2–12.9g.[10] The salt content of fast and takeaway foods in other countries has also been reported to be high.[13–15] Discretionary salt added by servers as they serve and package food, as well as by consumers, would further increase salt content. Reducing salt intake has been associated with reduced blood pressure and incidence of stroke in systematic reviews.[16, 17]

Local government officials in some parts of England are taking action to improve the nutritional quality of food from independent takeaways.[18] One method that aims to reduce the salt content of takeaway food is replacing standard, 17-holed, salt shakers (17HSS) with

equivalents with only 5 holes (see Fig 1).[19] The five-holed salt shaker (5HSS) attempts to reduce discretionary salt added by servers and–if provided for customer use–consumers. They build on observational findings that discretionary salt use is related more to the size and number of holes in salt shakers, than demographic characteristics.[20]

Five-holed salt shakers were first developed and introduced in Gateshead, in the North East of England, where they were offered, free of charge, to all independent Fish & Chip shops in the area in around 2006. Since then, they have been used in a number of local government initiatives across the country.[19] Whilst 5HSS have been particularly associated with Fish & Chip shops, in some areas their use has been encouraged across the takeaway sector.[18] Although we are not aware of 5HSS being used outside of the UK, they may be useful and appropriate in other settings.

Some evidence suggests that 5HSS tend to be acceptable to takeaway owners.[19] High acceptability is likely to facilitate widespread implementation. Anecdotal, but no formal, evidence suggests that the 5HSS deliver less salt than 17HSS.[19]

We conducted four experiments to determine the salt delivered by 5HSS and 17HSS in controlled conditions; and whether any differences were robust to variations in: the amount of salt in the shaker, the length of time spent shaking, and the person serving.

Methods

Throughout, the dependent variable was the amount of salt delivered. Independent variables were: type of shaker used (5HSS or 17HSS), amount of salt in the shaker before shaking



Fig 1. 17 (left) and five (right) holed salt shakers used in UK Fish & Chip shops. Image credit: Martin White.

doi:10.1371/journal.pone.0163093.g001

commences (shaker full, half full or nearly empty), time spent shaking (3s, 5s or 10s), and the individual serving.

Materials

One 5HSS and one 17HSS produced by Drywite Limited were used and filled with Q Table Salt–supplied by a large regional takeaway supplier and commonly used across the sector. The amount of salt used in each trial was determined by weighing shakers before and after each trial using scales (MyWeigh i2600) accurate to 0.1g.

Experiment 1: does the amount of salt delivered vary between shakers?

The only independent variable that varied in experiment 1 was type of shaker used (5HSS or 17HSS). Amount of salt in the shaker, and time spent shaking were set to the 'mid-values': half full (salt plus shaker weighed 240g) and 5s. One participant was asked to shake each salt shaker for 5s. A count-down timer was used with an audible 3-2-1 lead-in so that the participant knew when to start shaking. An audible tone also indicated when the participant should stop shaking. No further instructions were given for how shaking should be conducted. Salt shakers were refilled between trials. Salt shakers were trialled alternatively. There were ten trials per condition and two conditions: 5HSS and 17HSS. Thus, the 5HSS was shaken, followed by the 17HSS, then the 5HSS, then the 17HSS until ten trials of each shaker had been completed. The participant was not informed of how much salt was delivered on each trial, but they were given limited information on the purpose of the study. Specifically, the information sheet they were provided with stated "We are inviting you to take part in the Salt Shaker research study that is exploring the amount of salt delivered by two different shakers."

Experiment 2: is the difference in salt delivered robust to changes in the amount of salt in the shaker?

In this experiment the salt shaker used and the amount of salt in the shaker before shaking commenced varied; time spent shaking was held constant at 5s. The procedure in experiment 1 was repeated twice: firstly using nearly empty salt shakers (salt plus shaker weighed 100g); and secondly using nearly full salt shakers (salt plus shaker weighed 380g). There were ten trials per condition and four conditions: 5HSS nearly empty, 5HSS nearly full, 17HSS nearly empty, and 17HSS nearly full. Nearly empty 5HSS and 17HSS were trialled alternatively and then nearly full 5HSS and 17HSS were trialled alternatively. The same participant who conducted experiment 1 performed all trials.

Experiment 3: is the difference in salt delivered robust to changes in time spent shaking?

In this experiment the salt shaker used and time spent shaking per trial varied; amount of salt in the shaker before shaking commenced was held constant at half full. The procedure used in experiment 1 was repeated twice: with the participant shaking for 3s and 10s per trial. There were ten trials per condition and four conditions: 5HSS for 3s, 5HSS for 10s, 17HSS for 3s and 17HSS for 10s. The 5HSS was trialled alternatively for 3s and 10s, followed by the 17HSS alternatively for 3s and 10s. The same participant (who conducted experiments 1 and 2) performed all trials and was not informed of how much salt was delivered on each trial.

Experiment 4: is the difference in salt delivered robust to changes in the person shaking?

In this experiment the salt shaker used and the participant varied; time spent shaking and amount of salt in the shaker before shaking commenced were held constant at 5s and half full. A convenience sample of ten participants, aged 18 years or older was recruited. Quota sampling was used to ensure at least one male and one female participant in each of the following age ranges: 18–29 years, 30–39 years, 40–49 years and 50–59 years. Each participant performed the procedure used in experiment 1.

Data analysis

Differences in the amount of salt delivered between the two shakers were compared using repeated measures ANOVA tests. One-way tests were used with data from experiments 1–3, and a two-way test with data from experiment 4. All analyses were conducted in Stata SE v13.0 (see **S1 Appendix**).

Procedure and ethics

Ethical permission was granted by Newcastle University's ethics committee. Participants were provided with a written information sheet and completed a written informed consent form before any trials began. Participants were not misled in any way. Experiments took place in May-July 2015.

Data sharing

The full dataset is available from the corresponding author. The statistical code is provided in S1 Appendix. Consent was not obtained for data sharing, but personal identifiable data was not collected, and the risk of identification is low.

Results

Table 1 shows the results of all four experiments. Across all trials, the 17HSS delivered a mean (SD) of 7.86g (4.54) per trial, whilst the 5HSS delivered 2.65g (1.22). The 5HSS delivered a mean of 33.7% of the salt of the 17HSS.

There was a significant difference in salt delivered between the 5HSS and 17HSS in experiment 1 when time spent shaking, amount of salt in the shaker and participant were all kept constant. This difference was robust to variations in the starting weight of shakers, as well as time spent shaking and participant shaking explored in experiments 2–4.

Discussion

Summary of results

This is the first documented study we are aware of exploring differences in salt delivered by salt shakers commonly encouraged in independent takeaways in England. We compared the standard 17HSS to the newer 5HSS. Across all experiments, the 5HSS delivered around 34% of the salt delivered by the 17HSS. This difference was robust to changes in the starting fullness of shakers, the length of time spent shaking and the person serving.

Strengths and limitations of methods

We considered a number of variables that may influence how much salt is delivered by salt shakers: starting fullness of shaker, length of time spent shaking, and person shaking. We

Table 1. difference in salt delivered by five versus 17 holed salt shakers.

	Start weight (g)	Time shaking (s)	Participants (n)	Trials per participant per shaker (n)	Salt delivered (g), mean (SD)		5HSS as % of 17HSS*	ANOVA F(df), p-value
					5HSS	17HSS		
Exp. 1	240	5	1	10	1.12 (0.32)	2.29 (0.65)	48.9	F(1,9) = 30.79, p < 0.001
Exp. 2	100	5	1	10	1.92 (0.32)	5.81 (0.68)	32.9	F(1,9) = 475.31, p < 0.001
	380	5	1	10	2.13 (0.31)	5.43 (1.12)	39.2	F(1,9) = 132.80, p < 0.001
Exp. 3	240	3	1	10	1.58 (0.39)	3.84 (0.70)	41.1	F(1,9) = 224.89, p < 0.001
	240	5	1	10	2.63 (0.31)	6.75 (1.15)	39.0	F(1,9) = 165.05, p < 0.001
	240	10	1	10	4.45 (0.45)	11.17 (1.20)	39.8	F(1,9) = 313.21, p < 0.001
Exp. 4	240	5	10	10	2.94 (1.29)	9.01 (4.81)	32.6	F(1,156) = 14.93, p = 0.001
All	—	—	10		2.65 (1.22)	7.86 (4.54)	33.7	—

Note. 5HSS: five holed salt shaker; 17HSS: 17 holed salt shaker;

*Mean salt delivered by 5HSS as % of mean delivered by 17HSS.

doi:10.1371/journal.pone.0163093.t001

focused on length of time spent shaking, rather than number of shakes, as our observations of real-life practice suggest that shaking a salt shaker is a continuous action, rather than a series of discrete actions. Our anecdotal observations in Fish & Chip Shops also suggest that median time spent shaking is around 4-5s, ranging from around 1-10s, indicating that the range of times we chose are largely reflective of practice. We conducted 10 trials of each condition, and recruited a range of different individuals for experiment 4 to increase the reliability of our results.

Participants were only semi-blinded to the purpose of the experiment. They were aware that we were investigating how much salt different shakers delivered. But they were not aware which was the 'new' shaker or which was proposed to deliver less salt. Given that participants could also see how much salt was being delivered (although they were not informed of how much salt was actually delivered), this may have had some influence on their shaking behaviour.

Experiments 1–3 were all conducted by the same individual and in series. It is possible that this subject was more careful in their shaking, and less tired, during experiment 1 than in later experiments. However, there remained clear differences between salt shakers in all experiments, suggesting this did not impact substantially on the results.

Salt shakers were trialed alternatively in all experiments–that is the 5HSS was trialed, then the 17HSS, then the 5HSS, then the 17HSS until 10 repeats of each had been conducted. If subjects tired during testing, this may have differentially effected the different shakers. However, by alternating shakers throughout, this is likely to have a small effect, if any.

We were not able to take account of all variables that may influence how much salt is delivered in practice. These include: customer preference, humidity leading to potential clogging of shakers, and any shop-specific special procedures. Our results represent controlled conditions and may not be generalizable to salt shaker use in practice.

The sample size in all experiments may appear 'low'. The main risk of a small sample size is of type 2 error–that is, failing to identify a difference where one exists. As we identified a

difference in all comparisons, there is no risk of type 2 error. However, it is possible that our results are subject to type 1 error–that is, identifying a difference where one does not exist. The main method for reducing type 1 error is to reduce the threshold p-value taken to indicate statistical significance. All of our p-values were ≤ 0.001 –indicating that type 1 error will occur in 0.1%, or fewer, tests. Given we have conducted 7 tests, the overall chance of type 1 error is less than 0.7%. As such, our results are very unlikely to be subject to type 1 error.

Interpretation of results and implications for policy, practice and research

Our results are encouraging for the increasing number of English local government areas and independent takeaways who promote, or use, the 5HSS to reduce the salt content of takeaway food. They may also be a useful prompt for those working to reduce the salt content of takeaway food in other countries to consider how 5HSS could work in other settings. Although our intention was not to determine under what conditions the least amount of salt is delivered, our results do suggest that less salt is delivered when shakers are half full, compared to nearly empty or nearly full. It is not clear how practical this finding could be in practice. Unsurprisingly, shaking for less time also resulted in less salt delivered.

We cannot conclude from our results that the 5HSS will necessarily be associated with less salt consumed with takeaway food. For example, in real-life settings, servers may shake for longer with the 5HSS,[21] or customers may ask for, or add their own, additional salt. There is some anecdotal evidence to suggest these, unintended, consequences do occur.[18] Further research is required to confirm that the 5HSS is associated with less salt added to takeaway food, less salt consumed with takeaway food, and to explore any impact on customers' total diets.

The results of experiment 4 showed substantial between-person variation in the amount of salt delivered by the 5HSS and 17HSS. Indeed, between-subjects variance was 1.57 for the 5HSS and 23.04 for the 17HSS, whilst within-subjects variance was 0.26 for the 5HSS and 1.87 for the 17HSS. Whilst, overall, the 5HSS delivered less salt than the 17HSS in experiment 4, the salt delivered by some individuals using the 5HSS was more than that delivered by others using the 17HSS. Between-person variation should, therefore, also be expected in practice. Substantial variation in salt content of takeaway food has been previously documented[10] and this may reflect both variations in recipes and serving practice. The variance figures reported above give variance ratios (between-subjects variance/within-subjects variance) of 6.04 for the 5HSS and 12.32 for the 17HSS–indicating proportionally greater between-subjects than within-subjects variance for the 17HSS than the 5HSS. The 5HSS may help standardise, as well as reduce, the amount of salt added to food.

The 5HSS only addresses discretionary salt added by servers, and possibly customers, to takeaway food. The 5HSS does not address the relatively high levels of salt added to these foods in preparation.[10, 12] Further interventions may be required to help takeaways reformulate recipes to reduce salt added during preparation. Reformulation to reduce salt content has been successful in the wider UK food industry.[22] Other, wider, initiatives are also be required to tackle salt consumption holistically.

Conclusion

Five holed salt shakers delivered around 34% of the salt of 17HSS in controlled conditions. This difference was robust to variations in: the amount of salt in the shaker, the length of time spent shaking, and the person serving. This confirms the potential of the 5HSS as a method to reduce the salt content of takeaway food, and particularly food from Fish & Chip shops, where

these shakers are particularly used. Further research will be required to determine the effects of this intervention on customers' salt intake from takeaway food and total dietary salt intake.

Supporting Information

S1 Appendix. Statistical code.
(DOCX)

Acknowledgments

Julia Lough, Bill Scott and Chris Hawthorne at Gateshead Council originally developed and introduced the five holed salt shaker studied in this work.

Aoife Doherty, student on the Food & Human Nutrition BSc at Newcastle University, helped with data collection.

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Goffe et al. International Journal of Behavioral Nutrition and Physical Activity (2016) 13:102
DOI 10.1186/s12966-016-0429-z

International Journal of Behavioral Nutrition and Physical Activity

RESEARCH Open Access

Comparison of sodium content of meals served by independent takeaways using standard versus reduced holed salt shakers: cross-sectional study

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Abstract

Background: Takeaway food has a relatively poor nutritional profile. Providing takeaway outlets with reduced-holed salt shakers is one method thought to reduce salt use in takeaways, but effects have not been formally tested. We aimed to determine if there was a difference in sodium content of standard fish and chip meals served by Fish & Chip Shops that use standard (17 holes) versus reduced-holed (5 holes) salt shakers, taking advantage of natural variations in salt shakers used.

Methods: We conducted a cross-sectional study of all Fish & Chip Shops in two local government areas ($n = 65$), where servers added salt to meals as standard practice, and salt shaker used could be identified ($n = 61$). Standard fish and chip meals were purchased from each shop by incognito researchers and the purchase price and type of salt shaker used noted. Sodium content of full meals and their component parts (fish, chips, and fish batter) was determined using flame photometry. Differences in absolute and relative sodium content of meals and component parts between shops using reduced-holed versus standard salt-shakers were compared using linear regression before and after adjustment for purchase price and area.

Results: Reduced-holed salt shakers were used in 29 of 61 (47.5 %) included shops. There was no difference in absolute sodium content of meals purchased from shops using standard versus reduced-holed shakers (mean = 1147 mg [equivalent to 2.9 g salt]; SD = 424 mg; $p > 0.05$). Relative sodium content was significantly lower in meals from shops using reduced-holed (mean = 142.5 mg/100 g [equivalent to 0.4 g salt/100 g]; SD = 39.0 mg/100 g) versus standard shakers (mean = 182.0 mg/100 g; [equivalent to 0.5 g salt/100 g]; SD = 68.3 mg/100 g; $p = 0.008$). This was driven by differences in the sodium content of chips and was extinguished by adjustment for purchase price and area. Price was inversely associated with relative sodium content ($p < 0.05$).

Conclusions: Using reduced-holed salt shakers in Fish & Chip Shops is associated with lower relative sodium content of fish and chip meals. This is driven by differences in sodium content of chips, making our results relevant to the wide range of takeaways serving chips. Shops serving higher priced meals, which may reflect a more affluent customer base, may be more likely to use reduced-holed shakers.

Keywords: Salt, Sodium, Takeaway, Public health, Diet, Nutrition

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Background

Takeaway food consumption makes significant contributions to total dietary intake [1]. Emerging evidence of associations between takeaway food consumption and both total diet [1], and body weight [2], has led to public health action to improve the nutritional quality of takeaway food [3, 4]. One particular area of focus has been dietary salt (sodium chloride, or simply 'salt') reduction [3]. Single takeaway meals frequently contain more salt than the World Health Organization's maximum recommended daily intake for adults of 5 g [5–9]. In systematic reviews, reductions in salt intake have been associated with reduced blood pressure [10–12]; and higher blood pressure with stroke and ischaemic heart disease events and mortality [13, 14].

In the UK, traditional Fish & Chip Shops, serving a core offering of battered and deep-fried white fish with chipped and deep-fried potatoes, account for up to one-third of takeaways.[1] Traditionally in Fish & Chip Shops, hot food is served into disposable packaging, seasoning (including salt as a minimum) offered and added by the server, and food wrapped – all in front of the customer. The addition of server-added 'discretionary' salt is relatively unique to these settings. In this context we use the term 'discretionary' salt, to mean salt that is added after food has been prepared but before consumption.

Providing outlets with reduced-holed salt shakers is one method that has been used to reduce salt use in UK takeaways. Building on observational findings that discretionary salt use is related to the size and number of holes in salt shakers [15], standard shakers with 17 holes are replaced with equivalent ones with 5 holes [3]. In a number of documented cases, individuals working for or with local authority environmental and public health departments have offered takeaway outlets reduced-hole salt shakers free of charge [16]. These shakers can also be purchased by outlets directly from wholesalers. We do not have good information on uptake of these shakers across the board (although the current work documents uptake in the areas studied), or factors influencing uptake, nor have the effects of these shakers on the salt content of food served been formally tested.

Five-holed salt shakers (5HSS) are relatively cheap (~£2.50; $3.54; €3.14) and comparable in price, look and feel to 17-holed salt shakers (17HSS; see Fig. 1). The 'health-by-stealth' approach of 5HSS is particularly attractive and acceptable to both public health practitioners and takeaway managers and staff [3, 17]. Whilst 5HSS have been particularly associated with Fish & Chip Shops, their use has been encouraged across the takeaway sector for both servers and customers [3]. Although we are not aware of 5HSS being used outside of the UK, they may be appropriate elsewhere.



Fig. 1 17 (*left*) and five (*right*) holed salt shakers. Foodnote: Image credit: Martin White © 2015

In controlled settings, we found that 5HSS delivered around one-third of the salt of 17-holed salt shakers (17HSS) [18]. This difference may not translate into practice because, for example, servers might shake for longer with 5HSS than 17HSS [19], or customers ask for additional salt when 5HSS are used [16]. We aimed to determine if there were differences in the sodium content of meals served by Fish & Chip Shops using standard (17HSS) versus reduced-holed (5HSS) salt shakers, taking advantage of natural variations (i.e. not researcher-influenced) in salt shakers used.

Methods

We conducted a cross-sectional study in two local government areas in northern England in May-June 2015. The populations of both areas are concentrated in medium-sized towns (population sizes 120,000 and 83,000) and rank in the more socio-economically deprived half of all such areas in England.

Data collection

We took a pragmatic approach to sample size determination and aimed to conduct a census of all Fish & Chip Shops in the two study areas. To identify Fish & Chip Shops, we conducted text analysis of a national database of food businesses kept to administer statutory food hygiene inspections (www.ratings.food.gov.uk). We searched business names for those likely to be Fish & Chip Shops (e.g. those containing 'fish', 'fry', 'chips' and derivatives). Additional Fish & Chip Shops identified in the study areas during fieldwork were added to the sample.

In each shop, a researcher (LG in area 1 and FHB in area 2) ordered and purchased one standard fish and chip meal. Researchers remained incognito (i.e. did not identify themselves to servers or customers as

researchers). Researchers accepted any salt offered by the server, but did not indicate how much they wanted. Researchers noted the type of salt shaker used and meal price and recorded these soon after leaving shops.

Meals were stored in their packaging in insulated bags for transport to the laboratory. Here they were disaggregated into their components parts of fish, chips, and fish batter, weighed using scales accurate to 0.1 g (MyWeigh, i2600) and frozen at −18 °C in polythene bags until analysis. Any 'loose' salt that was contained in packaging but had not 'stuck' to food was likely to have been transferred with food and included in the chips component.

Sample analysis

Sodium was measured in thawed, homogenised and desiccated samples using flame photometry (Jenway, PFP7) in October-December 2016 [20]. Due to resource constraints, analyses were completed in singlicate only. Sodium values were converted to salt values by multiplying by 2.542 [21].

Data analysis

We compared the absolute and relative (per 100 g) sodium content of meals served by shops using 5HSS vs 17HSS using linear regression. Here, sodium content was the outcome and salt shaker the exposure. Separate analyses were conducted for full meals as well as component parts (i.e. fish, chips and fish batter). In addition to unadjusted analyses, analyses adjusted for the potential confounders of local government area and meal price were conducted. As a male researcher (LG) collected data in area 1 and a female researcher (FHB) data in area 2, adjustment for area also served to adjust for researcher gender.

Results

Sixty-two shops were identified from the food hygiene database. Five of these were permanently closed on visiting, whilst eight additional shops were identified during fieldwork. Thus, sample meals were purchased from 65 shops. Samples from four shops were excluded due to no server-added salt being offered ($n = 2$) and uncertainty about the type of salt shaker used ($n = 2$). Of the remaining 61 shops, 29 (47.5 %) used 5HSS and 32 used 17HSS.

Descriptive information and unadjusted results are summarised in Table 1. Mean (standard deviation; SD) absolute sodium content of all meals was 1147 mg (424 mg) – equivalent to 2.9 g of salt. Mean (SD) total meal weight was 724 g (145 g). Post-hoc t-tests revealed no difference in the weight of meals, or their component parts, by type of salt shaker (ps > 0.05). In unadjusted regression analyses, there were no statistically significant differences in absolute sodium content of total, or component parts of meals purchased from shops using 5HSS vs 17HSS.

Mean (SD) relative sodium content of meals was 163 mg (59) per 100 g – equivalent to 0.4 g of salt per 100 g. In unadjusted analyses, relative sodium content was significantly lower in meals purchased from shops using 5HSS vs 17HSS. Meals from shops using 5HSS contained around 40 mg per 100 g (equivalent to 0.1 g per 100 g of salt), or 22 %, less sodium than meals from shops using 17HSS. This difference appeared to be attributable to differences in relative sodium content of chips. Chips from shops using 5HSS contained around 42 mg per 100 g (equivalent to 0.1 g per 100 g of salt), or 32 %, less sodium than chips from shops using 17HSS.

Analyses adjusted for meal price and local government area are shown in Table 2. There remained no difference

Table 1 Unadjusted comparison of sodium in standard fish & chip meals from shops using 5 vs 17-holed salt shakers

	Mean (SD) weight (g)	Mean (SD) sodium (mg)			Mean sodium in 5HSS as % of 17HSS	Unadjusted regression analysis of 5HSS compared to 17HSS; β (95 % CI)
		All ($n = 61$)	17HSS ($n = 32$)	5HSS ($n = 29$)		
Total sodium						
Fish	161.9 (40.3)	357.1 (156.1)	352.2 (162.7)	362.4 (151.1)	102.9	10.2 (−70.5 to 90.9)
Chips	437.7 (101.8)	460.5 (296.7)	526.6 (366.4)	387.5 (171.6)	73.6	−139.1 (−288.2 to 10.1)
Batter	122.2 (37.9)	329.8 (171.5)	355.9 (192.8)	300.9 (142.1)	84.5	−55.0 (−142.6 to 32.5)
Meal	724.4 (145.2)	1147.3 (423.7)	1234.8 (493.9)	1050.9 (310.3)	85.1	−183.9 (−397.8 to 30.1)
Sodium per 100 g						
Fish	NA	227.9 (95.4)	231.2 (91.0)	224.1 (101.6)	96.9	4.2 (−45.8 to 54.1)
Chips	NA	107.8 (64.4)	127.5 (77.0)	86.1 (37.2)	67.5	−40.7 (−73.6 to −7.8)*
Batter	NA	270.0 (107.8)	288.3 (125.4)	249.9 (81.8)	86.7	−53,2 (−109.6 to 3.1)
Meal	NA	163.2 (59.3)	182.0 (68.3)	142.5 (39.0)	78.3	−37.0 (−66.0 to −8.1)*

SD standard deviation, *5HSS* 5-holed salt shaker, *17HSS* 17-holed salt shaker, *CI* confidence intervals
*Statistically significant at $p < 0.05$

Table 2 Adjusted comparison of sodium in standard fish & chip meals from shops using 5 vs 17-holed salt shakers

	Adjusted linear regression analysis of 5HSS compared to 17HSS; β (95 % CI)			
	Fish	Chips	Batter	Meal
Total sodium				
Sodium (mg); 5HSS compared to 17HSS	8.4 (−77.5 to 94.2)	−126.0 (−280.5 to 28.4)	−76.9 (−168.3 to 14.6)	−194.5 (−421.6 to 32.6)
Meal price (£)	31.3 (−50.6 to 113.2)	−141.6 (−288.9 to 5.8)	33.1 (−54.1 to 120.3)	−77.2 (−293.9 to 139.4)
Area (2 vs 1)	−5.1 (−94.8 to 84.5)	−31.9 (−193.2 to 129.3)	−51.5 (−147.0 to 44.0)	−88.6 (−325.7 to 148.6)
Sodium per 100 g				
Sodium per 100 g (mg); 5HSS compared to 17HSS	21.0 (−29.7 to 71.7)	−32.0 (−65.0 to 1.0)	−41.2 (−100.3 to 17.9)	−28.0 (−57.2 to 1.2)
Meal price (£)	−20.5 (−68.9 to 27.8)	−41.4 (−72.8 to −9.9)*	−38.8 (−95.1 to 17.6)	−31.2 (−56.1 to −3.4)*
Area (2 vs 1)	40.3 (−12.7 to 93.3)	6.6 (−27.9 to 41.0)	28.6 (−33.1 to 90.3)	12.5 (−18.0 to 42.9)

5HSS 5-holed salt shaker, *17HSS* 17-holed salt shaker, *CI* confidence intervals
*Statistically significant at $p < 0.05$

in total sodium content of meals, or their component parts, after adjustment. Neither meal price nor area was associated with total sodium content in any analysis.

Adjustment for meal price and area extinguished the relationship between shaker type and relative sodium content of meals and chip components. Meal price was also significantly inversely associated with relative sodium content of both meals, and chip components.

Discussion

Summary of results

This is the first study we are aware of to determine whether using reduced-holed salt shakers is associated with lower sodium content of takeaway meals. We found that standard fish and chip meals purchased from Fish & Chip Shops using 5HSS had significantly lower relative sodium content than those purchased from shops using 17HSS. This appeared to be driven by a difference in relative sodium content of the chips component of meals and was extinguished by adjustment for area and meal price – higher cost meals had lower relative sodium content. There was no difference in absolute salt content of meals, or component parts of meals, purchased from shops using 5HSS vs 17HSS.

Interpretation and implications of findings

The total relative sodium content of meals in the sample was comparable to that in fish and chip meals reported in a previous survey conducted in a different part of England [8]. In this previous work, 51 portions of fish and chips were bought in a large urban conurbation in the North West of England. Mean absolute salt content per meal was 3.00 g (equivalent to 1181 mg of sodium and comparable to the 1147 mg found in the current work – see Table 1) and mean relative salt content was 0.43 g/100 g (equivalent to 169 mg of sodium and comparable to the 163 mg found in the current work – see Table 1). Whilst the mean relative salt content we found (0.4 g per 100 g) would be considered 'medium' according to UK front-of-pack traffic light labelling [22], the absolute salt content (2.9 g) equates to more than half of the WHO's maximum recommended daily salt intake for adults [9].

Our findings of unadjusted differences in relative, but not absolute, sodium content by shaker type suggest there may be a systematic difference in total weight of meals served between shops using 5HSS vs 17HSS. Whilst meals from shops using 5HSS weighed a mean of 58 g more than those from shops using 17HSS and this was primarily due to larger chip serving sizes (a mean of 47 g more in shops using 5 versus 17HSS), these differences were not statistically significant. As such, this may also reflect random, rather than systematic, variation.

Our unadjusted results suggest that customers eating full meals would not consume significantly different amounts of salt in meals from shops using 5HSS vs 17HSS. However, customers consuming similar absolute quantities of meals would consume less salt in meals from shops using 5HSS vs 17HSS. Whilst it is clear that people eat more when given larger portions [23], it is not clear how meals from Fish & Chip Shops are eaten and how this varies by overall portion size. Some meals may be eaten in full by a single person, others shared, and others eaten only in part with leftovers discarded. Further work exploring patterns of consumption is required to determine the population impact of our findings.

Differences in relative sodium content of meals from shops using 5HSS vs 17HSS appeared to be due to differences in relative sodium content of the chips component of meals. In a standard fish and chip meal, the chips are likely to have a larger overall surface area than the battered fish – meaning they are more exposed to discretionary salt. Chips may also provide a more adherent surface for salt granules than fish batter. High sodium content of chips may also reflect salting practices – researchers observed that chips were often served and salted first, before the fish was placed on top.

As the chip component of meals had the highest absolute sodium content of meals, salt reductions here have the largest potential to lead to reductions at the meal level. This also makes our results of relevance to the wide range of takeaways – beyond Fish & Chip Shops – in the UK that serve chips with discretionary salt.

Our findings that adjustment for meal price and local government area extinguished the association between salt shaker and relative sodium content, and that meal price was inversely associated with relative sodium content, hints at one potential determinant of salt shaker use. It is possible that those Fish & Chip Shops serving higher priced meals have more affluent customers. As affluence is associated with greater dietary knowledge [24] shops serving these customers may be more willing to use 5HSS. Alternatively, or in addition, total sodium intake decreases with increasing affluence in the UK [25]. More affluent customers may, therefore, have less pronounced taste preferences for salt – driving less salt use by servers in the takeaways these customers frequent. It should be noted, however, that a post-hoc t-test revealed no difference in meal cost between shops using 5HSS vs 17HSS ($p > 0.05$).

The relative sodium content of fish (removed from batter) we found (228 mg/100 g – see Table 1) was much higher than the 100–110 mg/100 g listed for a range of white fish in standard food tables [26]. This suggests that salt has been added during preparation – possibly leaching out of batter. Further work to change the amount of salt added during preparation may be required to achieve substantial reductions in the salt content of meals from Fish & Chip Shops.

Strengths and limitations of methods

Incognito researchers purchased meals from shops under natural conditions, maximising the likelihood that sample meals were representative of all meals produced by included takeaways. However, there may be unmeasured within-takeaway, between-meal variation in sodium content, leading to error and potentially bias. Variables at the takeaway level that may also have influenced salt content but that we were unable to measure include: server gender and experience, and the length of time shops have been in business and their popularity. Time of day and day of week may also have confounded our results. However, in post-hoc tests, we found no evidence that either varied by salt shaker used (ps < 0.05) or was associated with total absolute or relative salt content of meals (ps > 0.05).

For resource reasons, we only performed sodium analysis in singlicate. As additional repetitions are likely to provide more accurate estimates, this may be a further source of error. Again, there is no reason to believe that this error would vary systematically according to shaker used. Although we did not specifically compare the use of singlicate analyses to performing multiple replications on each sample, the flame photometer was recalibrated using analytical grade sodium chloride diluted in deionised water after every 9–12 samples.

Although there are regional variations in condiments offered in UK Fish & Chip Shops, server-added salt is almost universally offered (as was the case in 97 % of shops in our sample). Our findings are likely to be generalizable across UK Fish & Chip Shops. However, they may not be generalizable to other takeaway types, or takeaways in other countries. Further research is required to confirm the effects of reduce holed salt shakers more widely.

Conclusions

Meals from shops using reduced-holed salt shakers (5HSS) had lower relative sodium content than those using standard salt shakers (17HSS), but there was no difference in absolute sodium content. Whilst our findings suggest that 5HSS could be a useful public health intervention, additional work will be required to model the likely population impact fraction of 5HSS on total salt intake, blood pressure, and health outcomes such as stroke and cardiovascular disease and hence quantify the health benefits of 5HSS.

The differences in salt content we identified appeared to be particularly driven by differences in the sodium content of chips. This makes the findings of relevance to a wide range of independent takeaways in the UK that serve chips. Differences in relative sodium content were extinguished by adjustment for meal price and area, and there was an inverse association between meal price and relative sodium content. This may reflect and contribute to socio-economic inequalities in diet.

Whilst reduced-holed salt shakers may help reduce 'discretionary' salt added after food preparation by servers and consumers, takeaway food appears to be high in salt even before the addition of this discretionary salt. Additional efforts, focusing on salt added during cooking, may be required to substantially reduce the salt content of food served by Fish & Chip Shops and takeaway food more generally.

Endnote

[1]Personal communication, E Macguire (2015) – bespoke additional analysis of data described in ref [12].

Abbreviations

17HSS: 17-holed salt shaker; 5HSS: 5-holed salt shaker; SD: standard deviation

Acknowledgements

Elizabeth McHugh (undergraduate student studying for a BSc in Food & Human Nutrition at Newcastle University) contributed to laboratory analysis under the guidance of Professor Chris Seal (Newcastle University). Julia Lough, Bill Scott and Chris Hawthorne at Gateshead Council originally developed and introduced the five holed salt shaker studied in this work.

Funding
This study was funded as part of the National Institute of Health Research's School for Public Health Research (NIHR SPHR) project "Transforming the 'foodscape': development and feasibility testing of interventions to promote healthier takeaway, pub or restaurant food", with additional support from Durham and Newcastle Universities. NIHR SPHR is funded by NIHR. SPHR is a partnership between the Universities of Sheffield, Bristol, Cambridge, Exeter, University College London; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster; and Fuse, the Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. Authors FHB, CDS, WLW, AJA, VAS and AAL are members of Fuse; and JA and MW are funded by Centre for Diet and Activity Research (CEDAR). Fuse and CEDAR are UK Clinical Research Collaboration (UKCRC) Public Health Research Centres of Excellence. Funding for Fuse and CEDAR comes from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research and the Wellcome Trust, under the auspices of UKCRC, and is gratefully acknowledged. AJA is funded by the NIHR as a NIHR Research Professor.

Availability of data and materials
Data available from the last author (JA) on request.

Authors' contributions
LG, FHB, WW, VAS, CS, MW, AJA and JA conceived the idea for the study together. All authors contributed to methods development. FHB and LG collected the data. AD prepared and analysed the samples. JA analysed the data and drafted the manuscript. All authors provided critical comments on drafts of the manuscript and final version for submission.

Competing interests
MW is Director of NIHR's Public Health Research Programme, for which he is employed one day per week. None of the other authors have competing interests to declare.

Consent for publication
Not applicable.

Ethics approval and consent to participate
No human participants were recruited for this study meaning that ethical permission was not required.

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Received: 8 July 2016 Accepted: 16 September 2016
Published online: 26 September 2016

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6.3 PP5 & PP6 commentary

In PP5, Goffe et al. (2016a) [page 116] demonstrated that the technology delivered as intended, reducing the flow of salt from the salt shaker. Goffe et al. (2016b) [page 116] showed that their use in practice is associated with lower relative sodium content of meals served. However, there were limitations regarding sample collection and analysis. In PP6, Goffe et al. (2016b) [page 116] purchased and analysed one meal from each shop, the sample method employed in the study does not account for the influence of server practice within a given outlet. As the impact of this intervention is dependent on the server, crucially customer service will play a significant role. With regards to the portion control research in Fish & Chip Shops, detailed in Chapter 8 [page 179], I spoke with one owner who told me that they would moderate or increase a given portion size based on certain customer characteristics, e.g. '*bigger*', '*younger*'. Therefore, not only is there likely to be variation between shops, but also between servers and within server, an aspect which we were not able to measure [Goffe et al. (2016b) page 116] [57].

In PP6, a long-term randomised controlled trial would have been a more desirable and rigours method to evaluate the intervention than cross-sectional design. However, due to the ubiquitous nature of the 5-holed caps, finding a suitably naïve setting would have been difficult. Also, the challenging nature of recruitment within the limited time and resource constraints of the Foodscape project meant that a randomised control trial was not feasible.

A further limitation is that my published research did not capture customer behaviour. I was not able to explore who is choosing to have discretionary salt added to their meals at the point of service, or in the home, nor how they ultimately consumed these meals, that is whether they shared portions with others and/or how much of the portion served was consumed. Observational work could be used to understand discretionary salt practices by both server and customer in the shop, as well as individual level consumption by customers.

6.4 Potential role of portion size

While there was a significant difference in the relative sodium (mg/100g) content of meals, there was no significant difference in the absolute sodium content between meals served using the different salt shaker caps. In my publication [Goffe et al. (2016b) page 116] [57], it

was posited that the relative difference in sodium content between meals is largely related to the portion size of the chip component. The following explanations were proposed as to why this might be:

- *In a standard Fish & Chip meal, the chips are likely to have a larger overall surface area than the battered fish – meaning they are more exposed to discretionary salt*
- *Chips may also provide a more adherent surface for salt granules than fish batter* [Goffe et al. (2016b) page 116] [57].

In addition, during data collection, I observed a pattern of service where the server would first salt the chips before placing the battered fish on top of the chips and then wrapping the meal. Therefore, it is both the overall portion size and consistency in portions served that will likely have an impact on the sodium content of Fish & Chip meals. Using data from McCance and Widdowson's 'composition of foods integrated dataset' [115], I estimated the energy content for the total meal and all meal components for all 65 meals sampled, see Table 6-1.

Table 6-1 Energy content of Fish & Chip meals per portion in Foodscape study

Energy (kcal)		**Range**	
n=65	**Mean (sd)**	**Min**	**Max**
Total meal	1632 (318)	1028	2612
Battered fish	694 (163)	306	1121
Chips	938 (218)	623	1513
Fish only	163 (40)	78	274
Batter only	531 (130)	228	848

My data shows that both the standard deviation and range in the estimated energy content was large. The difference in estimated energy content between the smallest and largest chip portion was 890kcal. Therefore, potentially this wide variation in the chip component and overall portion size of meals could have a greater impact on the salt content of meals than the type of salt shaker cap used.

6.5 Should the 5-holed salt shaker caps be promoted more widely?

I would argue that there is sufficient evidence to suggest that this intervention has a positive impact. It is effective at reducing the flow of salt from the shaker [Goffe et al. (2016a) page 116] [56] and resulting meals that are seasoned with such caps are associated with lower relative sodium content [Goffe et al. (2016b) page 116] [57]. It is widely available and due to its minimal disruption to business practices it is viewed as acceptable by FBOs. Conversely, what evidence is there of harm? There have been suggestions regarding its use has resulted in longer queues due to servers shaking for longer [210], however the influence on server behaviour has not been studied. It is not known if customers subsequently add more salt prior to consumption to compensate for the likely less salt delivered by the server. While it would be interesting to evaluate the potential individual level impact on total dietary salt intake, it would also be of value to take the attributes of the 5-holed caps that has made it prevalent in the takeaway sector (covert, single-target and light-touch) to develop further interventions in other takeaway settings.

6.6 Chapter summary

Five-holed salt shaker caps have been widely accepted within the Fish & Chop Shop sector. As an intervention they are covert to the customer and they do not disrupt established business practices. Five-holed caps reduce the flow of salt from the salt shaker and meals seasoned by these caps are associated with a lower relative sodium content than those seasoned by the traditional 17-holed caps. The significant difference in the relative sodium content of meals and not the absolute sodium content of meals indicates that portion size, particularly of chips, will also likely impact on salt consumption.

Chapter 7. Can we improve the healthiness of takeaway food by training takeaway owners and staff in a takeaway food Masterclass?

Kirklees Council developed and delivered a takeaway food Masterclass, a three-hour interactive training event delivered to owners and staff of independent takeaways. The intervention includes nutritional and cooking skills education, taste testing, nutrition estimation activities, goal setting and action planning. In this chapter, I introduce this intervention and present a study to assess the feasibility and acceptability of delivering the intervention in practice.

7.1 The development of the takeaway Masterclass

In 2009 NHS Kirklees commissioned the establishment of the Food Initiatives and Nutrition Education (FINE) project. This team was managed by and located within the Council's Environmental Health department. Their remit was to deliver nutritional training with the aim to improve dietary outcomes within the authority [211]. The project continued to run following the transfer of responsibility of public health delivery from the NHS to local authorities following the Health and Social Care Act 2012 [199]. Like other authorities, they had developed a multi-criteria healthy catering award that had three tiers: bronze, silver and gold. However, they found takeaways and their FBOs to be apathetic to the award and they had identified this sector of the catering industry as important to deliver a nutritional improvement.

The FINE team is led by Louise Muhammad, who described the development of the Masterclass to me. Prior to the Masterclass' implementation, Muhammad was of the view that those in public health improvement were not speaking directly with takeaways, and therefore not giving sufficient consideration to understanding catering from the takeaway FBO's perspective. Therefore, she felt that if an intervention was going to have an impact in takeaways, it had to be specifically and appropriately targeted and tailored to this setting. She wanted to create an event that was relational, as opposed to transactional, i.e. engaging with FBOs and their staff, creating a two-way dialogue. While not cuisine specific, Muhammad developed the Masterclass to be open and accessible to all hot food takeaways that were rated at least a three 'generally satisfactory' on the FSA's hygiene rating scheme [89]. The Masterclass was structured to be interactive and highlight business opportunities,

such as cost-saving practices and methods to improve food hygiene rating. She identified the deep-fat-frying of chips as a universal practice within all takeaways and found an industry partner that would deliver professional training with regards to oil management. Such training was an implicit part to brand the Masterclass, making it appealing to the target audience, to emphasise that they recognised that they were working with commercial enterprises. Muhammad also stated that it was also important to provide a number of events on different days of the week and at different times of the day to provide multiple opportunities for potential participants to attend.

7.2 Kirklees Council evaluation of the takeaway Masterclass

As with others in local authorities, Muhammad, saw her and FINE's role as primarily service delivery [Goffe et al. (2018) page 97] [55], but understood the value of evaluation. While she felt that such evaluation was best conducted independently of those delivering the intervention, she had put in place measures to capture understanding of the intervention. Between January 2014 and November 2016, the FINE team had run nine Masterclasses and recruited 146 participants from 95 different takeaways. They estimated that this represented approximately 25% of eligible (FSA hygiene rating of three or more) hot food takeaways within the authority boundary [212].

7.3 Suitability for further evaluation

This recruitment data from the FINE team indicated that the Masterclass was potentially more effective at engaging and recruiting takeaways than the established healthy catering award schemes [47]. However, further research was required to assess the feasibility and acceptability of the intervention with regards to the changes in practices that it promotes. In 2016, the Foodscape project team [1] were presented with an opportunity to deliver the evaluation when Redcar & Cleveland Borough Council, a local authority in the North-East of England, commissioned the FINE team to deliver two Masterclasses to takeaways in their authority. The paper presented below (under review with the *International Journal of Environmental Research and Public Health, M*arch 2018) reports a feasibility and acceptability evaluation of the Masterclass intervention in the North-East of England.

MUR1. Feasibility and acceptability of a Takeaway Masterclass aimed at encouraging healthier cooking practices and menu options in takeaway food outlets

Hillier-Brown F, Lloyd S, Muhammad L, Summerbell C, Goffe L, Hildred N, Adams J, Penn L, Wrieden W, White M, Lake AA, Moore H, Abraham C, Adamson A, & Araujo-Soares V. *In submission to Public Health Nutrition* December 2018.

Feasibility and acceptability of a Takeaway Masterclass aimed at encouraging healthier cooking practices and menu options in takeaway food outlets

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Short title: Takeaway Masterclass feasibility study

Financial support: The Transforming the 'foodscape': development and feasibility testing of interventions to promote healthier takeaway, pub or restaurant food project is funded by the NIHR School for Public Health Research (SPHR). This study also received a small amount of matched funding from Redcar & Cleveland Borough Council and additional support from Durham and Newcastle Universities, and the NIHR Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). The NIHR School for Public Health Research is a partnership between the Universities of Sheffield; Bristol; Cambridge; Imperial; and University College London; The London School for Hygiene and Tropical Medicine (LSHTM); LiLaC – a collaboration between the Universities of Liverpool and Lancaster; and Fuse the Centre

In submission Dec 2018

for Translational Research in Public Health - a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. Authors FHB, CS, HM, WW, AA, VAS, SL and AL are members of Fuse. Funding for Fuse comes from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, under the auspices of the UK Clinical Research Collaboration, and is gratefully acknowledged. AA is funded by the NIHR as a NIHR Research Professor. JA and MW are funded by the Centre for Diet and Activity Research (CEDAR), a UKCRC Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the National Institute for Health Research, and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. This work was partially funded by the UK National Institute for Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC).

The views expressed in this paper are those of the authors and not necessarily those of the NHS, the NIHR, the Department of Health and Social Care or any of the other above named funders.

The authors would like to thank all of the individuals who participated in this research.

Conflicts of Interest:

LM led the development of the original Takeaway Masterclass and commercially promotes the Takeaway Masterclass concept to other local authorities.

The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

Authorship: JA, VAS, AL, CS, MW & AA devised the concept for the Foodscape project. FHB and LG conceived and designed the research in this paper, and VAS, CS, JA, LP, WW, MW, AL, HM and AA commented on and approved the study protocol; LM, SL and VAS developed and delivered the intervention; FHB and NH undertook the fieldwork; FHB, NH and VAS analysed the data; all authors contributed to the interpretation of the findings; FHB initially drafted the article and all authors contributed to subsequent drafts and approved the final manuscript.

In submission Dec 2018

Ethical Standards Disclosure:

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Newcastle University Research Ethics Committee (ref: 5519/2016). Written informed consent was obtained from all subjects/patients.

In submission Dec 2018

Feasibility and acceptability of a Takeaway Masterclass aimed at encouraging healthier cooking practices and menu options in takeaway food outlets

Abstract:

Objective: To evaluate the feasibility and acceptability of the Takeaway Masterclass, a three hour training session delivered to staff of independent takeaway food outlets that promoted healthy cooking practices and menu options.

Design: A mixed methods study design. All participating food outlets provided progress feedback six-weeks post-intervention. Baseline and six-weeks post-intervention observational and self-reported data were collected in half of participating takeaway food outlets.

Setting: North East England

Participants: Independent takeaway food outlet owners and managers

Results: Staff from 18 (10% of invited) takeaway food outlets attended the training; attendance did not appear to be associated with the level of deprivation of food outlet location. Changes made by staff that required minimal effort or cost to the business were the most likely to be implemented and sustained. Less popular changes included using products that are difficult (or expensive) to source from suppliers, or changes perceived to be unpopular with customers.

Conclusion: The Takeaway Masterclass appears to be a feasible and acceptable intervention for improving cooking practices and menu options in takeaway food outlets for those who attended the training. Further work is required to increase participation and retention, and explore effectiveness, paying particular attention to minimising adverse inequality effects.

Keywords: Takeaways; food environments; public health; diet; obesity; intervention; foodscape; behaviour change

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1. Introduction

Improving public health through environmental changes offers a population-wide, preventive approach that reduces the need for individuals to engage directly with interventions[1; 2]. The 'obesogenic environment' refers, in part, to the easy availability of high energy dense, palatable, inexpensive food[3; 4; 5]. Many takeaway food outlets contribute to the obesogenic environment. Most takeaway food is high in fat, salt, sugar and energy density with average portion sizes often providing a large proportion, or even exceeding, recommended daily quantities for these nutrients in one meal[6; 7]. Takeaway and fast food consumption has been associated with diets of high energy and poor nutritional quality[8; 9; 10; 11] as well as with adverse metabolic health outcomes, increased weight and diabetes[11; 12; 13; 14; 15; 16].

In England the density of takeaway and fast food outlets increases with area deprivation level[17]. Although there is no strong association between the socio-economic position of an individual and frequency of takeaway and fast food consumption[18], increased access to takeaway and fast food outlets and differences in consumption patterns of takeaway and fast foods may be leading to increased socio-economic inequalities in dietary intakes[9; 19; 20].

One approach to reducing access to 'unhealthy' takeaway food is to restrict numbers of new takeaway food outlets opening via the local planning system[21; 22; 23; 24]. A complementary approach is to improve the healthiness of existing takeaway food products. The Department for Health in England has worked with a number of national and regional chain food outlets to promote healthier ready-to-eat meals through the 'Public Health Responsibility Deal'[25]. Although few independently owned food outlets have signed up to the local equivalent, efforts are being made nationally and internationally to improve the healthiness of existing takeaway food outlet products in a variety of out-of-home food outlets using a range of strategies[26; 27]. Evaluations of local-level interventions, however, are sparse[27]. In 2016, Redcar & Cleveland Borough Council, a local authority in the north east of England with worse than average deprivation and health[28], commissioned the delivery of an established training course for staff of independent takeaway food outlets: the Takeaway Masterclass. Health promotion officers from Redcar & Cleveland Borough Council believed the intervention to be a cost effective way of meeting a health priority need of the local authority and were also keen that some formal evaluation was conducted. The health promotion officers and research team were connected through Fuse: The Centre for Translational Research in Public Health, which aims to close gaps between academia and practice, and find research solutions to address pressing local issues[29].

The aim of the work was to explore the feasibility and acceptability of the Takeaway Masterclass and the behaviours it promotes. Assessing feasibility and acceptability is an important, recognised stage in the development and evaluation of complex interventions as potential problems in compliance, intervention delivery, recruitment and retention can be identified.[30] This work was conducted as part of a larger programme of research that has evaluated a range of interventions aimed at improving the healthiness of takeaway food [31; 32; 33]. This work demonstrates a co-production (public health practitioners and academics) approach to evaluating real-world, local-level public health programmes that produces practice-based evidence and reduces barriers to knowledge translation[34; 35].

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2. Materials and Methods

2.1. Intervention description

The Takeaway Masterclass is a three-hour training course delivered by public health professionals and an industry expert to staff from independent takeaway food outlets to promote healthier changes to cooking practices and menu options. The training is designed to be interactive with a mix of information provision (nutrition and cooking skills education), practical activities (taste testing, sugar estimation) and cognitive-change techniques including goal setting and action planning. The training was developed by the Kirklees Food Initiatives and Nutrition Education (FINE) Project health improvement team from Kirklees Council, a local authority in the Yorkshire and Humber region of England, who had previously delivered it seven times over a two-year period in that region[27]. This version of this Takeaway Masterclass was evaluated in-house by the FINE team in terms of recruitment and reach, and feedback on the day of the training. Results are available on request from the FINE team as grey literature reports, and are also summarised in a systematic mapping review [27].

The Takeaway Masterclass evaluated in this study was delivered by the same health improvement team but was adapted from the original format. Adaptations included incorporation of updated information on obesity and health and the addition of enhanced goal-setting and action-planning activities developed by members of the research team with behaviour change expertise. A description of the Takeaway Masterclass using the template for intervention description and replication (TIDieR) guidance for reporting interventions[36], the research team defined intervention logic model, and intervention materials are provided as supplementary files (Table S1 and Figures S1-4).

Owners and managers of takeaway food outlets with a hygiene rating of three or above (as assessed by a food safety officer as part of England's Food Hygiene Rating scheme[37]; scores range from 0 [urgent improvement is required] to 5 [hygiene standards are very good]), located in, or near to the border of Redcar and Cleveland were invited to attend a Takeaway Masterclass session. They were given the choice of one of two sessions held on the same week day (morning or afternoon). Invitations were sent six weeks prior to the event by post. Leaflets advertising the sessions were also distributed by the local authority public health team to eligible food outlets.

The behaviours promoted during the Takeaway Masterclass were based on seven nutrition categories: reducing sugar, reducing salt, reducing fat, increasing fruit and vegetables, increasing fibre (additional to increasing fruit and vegetables), reducing portion size, and adding healthier meal deal options. Using the Nuffield intervention ladder [38], the behaviours promoted included those that restrict choice (e.g. changing oil management practices so all food is cooked in 'healthier', better quality oil; reducing fat, salt and/or sugar in recipes as standard), guide choice through incentivisation (e.g. providing meal deals with healthier options) and enable choice (e.g. the provision of healthier menu options alongside regular options or offering different portion sizes). No information provision type changes (e.g. nutritional labelling) were encouraged during the training, and no instructions or recommendations were given as to whether owners or managers should

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publicise changes that eliminate choice and may not be noticed by the customer (e.g. changing oil management practices; changing recipes).

2.2. Study design

This feasibility and acceptability study used a mixed-methods approach and with uncontrolled before and after, and cross-sectional elements. The data collection activities were conducted by members of the research team not involved in the intervention development. Two data collection methods were tested for feasibility and acceptability: 1) relatively burdensome face-to-face assessment visits collecting baseline and follow-up quantitative data collection (including a secret shopper element) and follow-up qualitative data collection ('before and after' condition); and 2) less burdensome follow-up qualitative data collection only via telephone ('follow-up' condition). Two weeks prior to the Takeaway Masterclass event, researchers purposively assigned the food outlets whose owners or managers had signed up to the Takeaway Masterclass to each group, to ensure maximum variation with respect to type of takeaway food outlet (e.g. fish and chip, Chinese, pizza) and area level deprivation. The Index of Multiple Deprivation (IMD)[39] score of the area in which the food outlet was located was used as the measure of area level deprivation. The most deprived areas were classified as those with an IMD score in the lowest quintile.

Owners or managers of food outlets in the 'before and after' condition were invited to participate in baseline and follow-up data collection by the research team. During the Takeaway Masterclass event, the remaining owners and managers who attended were asked to give permission for the research team to contact them in six weeks and ask for feedback on their pledge progress. A study flowchart is presented in Figure 1.

2.3. Consent and ethical approval

The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Newcastle University Research Ethics Committee (ref: 5519/2016). All participants provided written informed consent prior to participation.

2.4. Data collection

In the 'before and after' food outlets, assessments of catering practices and menu options were conducted by a researcher one to two weeks prior to the intervention and again six to eight weeks after the intervention using a pre-defined checklist during a visit to the outlet. The checklist included the health-promoting practices that were endorsed during the Takeaway Masterclass (e.g. reducing salt, improving frying techniques, using healthier frying oil, etc.) as well as criteria for the Chartered Institute of Environmental Health's Healthy Catering Commitment (HCC)[40]. These health-promoting practices are listed in Table 2 and are classified using the Typology of Interventions in Proximal and Physical Micro-environments (TIPPME)[41] in Table S2. Food outlets were assessed on whether they were adhering to each practice or not, or whether it was not applicable to the food outlet (e.g. the checklist item "Where sandwiches served, at least two lower fat fillings are available" was not applicable to food outlets that did not serve sandwiches). Many of the

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practices relied on self-reported data from the food outlet owners or managers, although some could be confirmed visually during the visits or determined from the food outlet's menu.

During the Takeaway Masterclass event a paper copy of the goal or goals made by all of the food outlet owners and managers that attended was retained by the research team. At the follow-up visits in the 'before and after' food outlets, before the researcher completed the checklist, owners or managers were asked if they achieved their goals or made any other changes. In addition, at approximately six weeks after the intervention, a different member of the research team (unknown to the food outlet) also visited the subsample of food outlets as a customer (secret shopper) and completed a modified version of the checklist that included only items related to the specific goals made for the food outlet and other observable items that a customer may be able to identify. Owners or managers from all of the 'follow-up' food outlets who attended the Takeaway Masterclass training were contacted at six to eight week post intervention via telephone by the research team to ask if they had achieved their goals or made any other changes.

In both groups, during the follow-up visits or phone calls, the owners or managers were invited to take part in a 30 minute semi-structured interview with a researcher to further explore the experience of taking part in the intervention and evaluation activities. All semi-structured interviews were audio-recorded and transcribed verbatim.

2.5. Data analysis

Frequency counts were used to analyse the quantitative data to explore feasibility and acceptability, and provide estimates for future work. The interview transcripts were read by one researcher to identify emergent and recurrent themes, which were checked by a second researcher. Interview transcripts were analysed using Burnard's systematic thematic content analysis [42]. This method is an adaptation of grounded theory incorporating thematic and content analysis for a systematic approach to qualitative data analysis in order to reduce researcher bias and increase the reliability of the analysis.

3. Results

3.1. Recruitment and retention

A total of 181 takeaway food outlets were invited to attend a Takeaway Masterclass session. Of these 21 (12%) registered for one of the sessions (Figure 1). Representatives from three of these food outlets were unable to attend on the day of the Takeaway Masterclass (one because of staffing issues, reasons unknown for the other two), leaving 18 food outlets (10% of all invited) attending in total. The proportion of food outlets in the most deprived IMD quintile that attended the event (Table 1) was similar to the proportion of all eligible food outlets located in the most deprived quintile (60%; data not shown) that were invited to attend.

Retention to the goal attainment follow-up data collection was just over 80%, and none of the food outlets taking part in the assessment visits that attended the training dropped out at follow-up (Figure 1 and Table 1). Recruitment to the semi-structured interviews was less successful (Figure 1 and Table 1). Four who

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declined had all taken part in both assessment visits and gave reasons of participation fatigue, and two were not invited to take part because of language barriers (a translator for non-English speakers was not available for use in this study).

Retention rates across the evaluation activities by subgroups of the food outlets by the deprivation level of the area in which they are located were examined. Only food outlets in the most deprived areas dropped out of the study; two at the goal attainment stage and a further six did not complete a semi-structured interview (see Table 1).

Figure 1 here

Table 1 here

3.2. Goal setting and progress

Each manager or owner of the 18 food outlets attending the Takeaway Masterclass committed to at least one goal to make a health-benefiting change to their usual practice. The number of goals committed to ranged from one to seven, with a median of four goals per food outlet, and a total of 69 goals overall (Table S3). Goals targeting the reduction of salt, sugar and fat were the most popular.

Feedback received at the follow-up contact, indicated that a median of three goals (range 1 to 6) per food outlet were achieved (74% of total goals set). Goals that were reportedly achieved were based on changing ingredients during cooking (e.g. salt and sugar in pizza dough), increasing salad portions and adding more vegetables to meals, changing cooking practices (grilling and poaching), and stocking water and/or reduced sugar drinks. Changing to lower fat milk (mainly as an ingredient used to make béchamel sauce of a popular dish traditional to the local area) had mixed success, with some owners and managers commenting that customers had noticed a difference in taste and provided negative feedback, while others stated customers had not noticed, or preferred, the change. Goals that were not achieved were those based on the use of reduced salt and sugar products (e.g. tomato ketchup and baked beans) because owners or managers were not able to source these products from regular suppliers and/or at reasonable price. Goals based on the use of wholemeal flour products were introduced but not maintained because customers did not purchase these products.

The median number of goals set for the food outlets was four (range 1 to 5) in the 'before and after' condition and 4.5 (range 1 to 7) in the 'follow-up' condition. A median of two (range 1 to 4) goals, 70% of goals set, were achieved in the 'before and after' food outlets, whilst a median of 3.5 (range 1 to 6) goals, 77% of goals set, were achieved in the 'follow-up' food outlets.

3.3. Assessment visits (sub-sample)

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The number of healthier changes in practice achieved in food outlets at follow-up are displayed in Table 2. A number of these recommendations were already routine practice in most of the food outlets at baseline, including: selling low sugar drinks; using straight cut chips rather than crinkle cut; allowing customers to add their own salt, but not having salt cellars on display (customers needed to request the use of salt cellar); including salad as a side option on their menu and providing salad with meals; using vegetable oil for frying and cooking; and using lean meats and removing fat from meats. At baseline, none of the food outlets sold fresh fruit or fruit juice; incorporated healthy options as part of meal deals; used reduced fat sauces (e.g. light mayonnaise) or spreads; or used thick cut chips. At follow-up, the most common changes were reducing the quantity of salt in cooking and making a change to oil management practices (e.g. refilling and filtering more regularly, or using better quality oil). Only eight positive changes observed from baseline to follow-up were associated with a goal set for a food outlet. The remaining 14 goals that were specific to behaviours on the assessment checklist were not achieved. The remaining changes that were made (n=16) were achieved without a goal having been set.

Table 2 here

3.4. Secret shopper (sub-sample)

Of the seven food outlets taking part in the follow-up assessment visits, five had set goals that were deemed feasible for observation by a secret shopper. These observations confirmed some of the findings from assessment visits (Table 2). Changes that were easy to observe were menu board items and specials boards, placement of salt shakers, availability and placement of drinks and provision of particular products (e.g. wholemeal bread buns). It was difficult to determine the type of sauces being provided (e.g. reduced salt and sugar tomato ketchup and reduced fat mayonnaise) as these are often contained in plain sauce bottles, and it was not always possible to observe all the selected changes at the time of the visit.

3.5. Intervention and evaluation acceptability

Data on intervention acceptability, for those that attended the Takeaway Masterclass, were collected through semi-structured interviews with owners and/or mangers (n=9). The main themes arising from these data are discussed below.

3.5.1. Takeaway Masterclass event acceptability

The Takeaway Masterclass was well received and participants would recommend the event to others. Overall, participants were positive about the venue, the timing and delivery of the event, and the materials provided. There was a small amount of negative feedback: one participant had found the venue difficult to find, and some thought that some of the content was not applicable to them (e.g. the oil management component was primarily applicable to fish and chip food outlets).

3.5.2. Direct effects of the Takeaway Masterclass training and effects after making changes

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Clear changes in knowledge and opinions were expressed by a number of participants during the semi-structured interviews. Increased nutritional awareness (e.g. quantity of sugar in food items) and awareness of new ideas were stated as benefits of taking part in the training. Participants reported making changes such as reformulating recipes (e.g. reducing the amount of sugar in flapjacks, reducing salt in pizza bases) and providing additional healthier items (e.g. sandwich and salad options, smaller portion options) to their menus to increase the choice available to their customers. Positive feedback from customers had resulted in some changes being sustained and some food outlets trying additional changes. Positive effects from the changes made that were reported included: perceived increases in customers; better quality of products; competitive edge or unique selling point as other food outlets do not offer the same healthier products; financial benefits and increases in sales. Negative effects resulting from making changes were also reported: negative customer feedback; lost business and healthier items not selling. These tended to result in the associated changes being abandoned. However, some owners or managers were happy to use a trial and error approach, stating that they would be willing to spend more or sacrifice some loss of business if it was outweighed by increased business overall.

There were some misunderstandings of the messages delivered during the Takeaway Masterclass that became apparent when food outlets were contacted at follow-up and also during analysis of interview data. These were mainly in relation to the oil management component of the training. Some food outlet owners and managers believed that they needed to change their oil more regularly, when in fact one of the benefits of good oil management is that oil can be changed less regularly. Some food outlet owners and managers also appeared to take on a health-promotion role with an 'instructing' or 'pushy' style in their interactions with customers – an approach not encouraged by the Takeaway Masterclass training and that was reportedly not received well by customers. Some food outlet owners and managers also stated that they were already implementing some healthier practices (which is supported by the findings from the baseline data collection) and some believed they already had a good level of nutrition knowledge.

3.5.3. Barriers and facilitators to making health-promoting changes

Many of the food outlet owners or managers identified fear of negative customer feedback, or receipt of negative feedback, as a barrier to making health-promoting changes to their practices. Many believed that customers would not be receptive to changes or not interested in healthier changes. However, some believed there is customer demand for healthier products, and that positive feedback encouraged changes to be sustained. They reported that changes perceived to affect the taste of a product were unlikely to be tried. Conversely, the perception that a change would not alter the taste of product led to these changes in practice being tried and sustained. Being unable to source certain products, at reasonable prices, and not having suitable equipment were highlighted as barriers to making certain changes, especially for food outlets under financial pressure.

It seems that some changes were acceptable while others were not, and that there was variability in the acceptability of the same change. For example one owner was happy to change to a lower fat milk in their

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béchamel sauce, but believed that using a lower fat alternative to regular butter was a compromise too far. Another food outlet manager, however, believed that using both lower fat alternatives to whole milk and butter resulted in a better quality béchamel sauce, preferred by their customers.

The personal beliefs of the food outlet owners and managers around healthy foods and diets appeared to be a major influence in how receptive they were to attempting and sustaining changes. Those owners and managers who appeared most successful in making and sustaining changes stated existing strong personal interests in health and providing healthier food alternatives.

3.5.4. Evaluation acceptability

No issues were raised with regards to the evaluation process and all owners and managers were happy with the activities they had been involved in. Some even expressed that they valued the follow-up contact.

4. Discussion

4.1. Statement of principal findings

We found evidence that the Takeaway Masterclasses was both feasible and acceptable to those who attended. At least one change in cooking practice or menu options were made in all of the food outlets contacted at follow-up, but these were not all changes that were planned during the Takeaway Masterclass. Many changes were verified by observation. The evaluation procedures were largely acceptable.

4.2. Strengths and limitations of the study

This feasibility and acceptability evaluation adds to an extremely limited evaluation evidence-base of local-level public health interventions that aim to improve the healthiness of foods sold by takeaway food outlets[27]. Although some members of the research team were involved in the modification of the intervention (mainly the goal setting and action planning component), these were not members who conducted the evaluation and the majority of the intervention was developed and delivered by local authority public health practitioners. An important strength is that baseline and follow-up measures were piloted in this study, whereas the majority of the existing evidence-base relies on follow-up data only[27]. However, the study did not include control takeaway food outlets so we were unable to compare outcomes or test the acceptability and feasibility of the evaluation methods in similar outlets not receiving the intervention. Follow-up feedback received by telephone tended to be more positive in this study, compared with feedback received at face-to-face visits. It was possible to make some objective assessments of practices (direct visual observation and menu information); however, most of outcomes were based on self-reported accounts from the takeaway food outlet owners and managers. The attendees were from a small proportion of eligible food outlets and may not have been representative of the target population. No data were collected on businesses whose manager or owner did not sign-up to attend either Takeaway Masterclass session, other than the business name and address, so we were unable to explore reasons for non-attendance. The use of translators should be considered in future work to minimise missing data because of language barriers.

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4.3. Strengths and limitations of the intervention

The Takeaway Masterclass is a relatively inexpensive intervention that, after initial development, requires facilitator, room hire and invitation and promotion costs only. The sessions primarily comprised nutritional education delivered by experienced public health practitioners and an industry representative who understood how, and the context in which, takeaway food outlets operate. The training used a mix of educational approaches and motivational techniques in order to maximise engagement with attendees. The practices promoted during the training were mainly coded towards the higher end of the Nuffield intervention ladder and may be more effective than simple information provision[26]. Of course, implementation of the recommended practices depends on the motivation and commitment of individual owners and managers, firstly to attend the training and secondly to implement changes in their food outlet, which often includes the engagement of other staff members. A major barrier to using some of the healthier products promoted during the training was lack of availability (at all or at a price comparable to regular products) from suppliers to the takeaway food outlets. This may a particular problem in the local authority where this intervention took place as takeaway food outlets may have less supplier choice than more populated areas such as major cities in the UK; however, this barrier has been identified in other evaluations of interventions implemented across England[27].

Of all eligible food outlets, attendance at the two Takeaway Masterclass sessions offered on the one day was 10%. This is initially higher than seen in the (larger) Kirklees local authority where the training was originally developed and delivered, which took a number of sessions to achieve a 10% attendance rate; to date engagement has reached 25% of all eligible takeaway food outlets after nine sessions run over three years (FINE project, unpublished results). This indicates that this type of intervention may only attract a small proportion of the target population at a time and a series of training sessions are needed to increase participation rates. Factors such as providing more flexibility around training timings, days, venue, and possibly language could be explored.

4.4. Interpretation of findings

Previous research has suggested that healthy eating interventions targeting takeaway food outlets may not be taken up by food outlets from more deprived areas[40; 43; 44]. In contrast, the Takeaway Masterclass was attended by owners and managers of food outlets located across the range of deprivation levels in proportion to eligibility. This suggests that the Takeaway Masterclass training event was acceptable to and feasible for food outlets across the deprivation level spectrum. An imbalance in socio-economic status representation was, however, evident at follow-up where a higher drop-out rate was observed for food outlets from areas of the highest deprivation level, compared with those from less deprived areas. Care is therefore needed in future intervention delivery and evaluation to ensure strategies to increase retention are in place (for example use of translators for participants with limited English language skills). It is possible that those who were more successful in making changes in response to the intervention may have been more willing to provide follow-up data, which could mean that the behaviours promoted at the Takeaway Masterclass may have been more

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acceptable and feasible in food outlets located in less deprived areas. This could also be a result of the higher economic pressures experienced in the more deprived area.

The barriers and facilitators to making healthier changes to cooking practices and menu options identified in this work are similar to those found by other projects conducted in England[27]. Changes requiring only a small level of effort at no or little extra cost to the food outlet were the most likely to be implemented and sustained (e.g. reducing current ingredients such as sugar or salt, or changing to healthier products that are easy to source at a similar price to regular products such as using semi-skimmed instead of whole milk). In contrast, using products that were difficult to source at similar prices and quantities to regular products (e.g. reduced salt and sugar tomato ketchup) or unpopular with customers (e.g. wholemeal bread) were unlikely to be tried or sustained.

4.4. Unanswered questions and future research

This study demonstrates the feasibility and acceptability of the Takeaway Masterclass in a small group of takeaway food outlets. Further development and collaboration with stakeholders is needed to identify appropriate intervention delivery methods (timings, venue, language) and outcomes; and the study design for a definitive process, outcome and economic evaluation. Pilot work in a larger sample will allow further testing of data collection methods, ensure confidence that the intervention can be delivered as intended, and allow safe assumptions to be made in terms of effect sizes and variability, and rates of recruitment and retention for a definitive evaluation[30]. There is also the need for work exploring reasons for non-attendance and how participation rates can be increased, and to work with suppliers to increase the availability of affordable healthier products for takeaway food outlets.

5. Conclusions

The Takeaway Masterclass appears to be a feasible and acceptable intervention for improving cooking practices and menu options for those food outlets who agreed to take part. However, owners or managers from a relatively small proportion of eligible food outlets attended and may not have been representative of the whole target population. Staff from the takeaway food outlets self-reported making a number of 'healthy' changes, but there was minimal objective evidence of change. Further work is required to increase participation and retention, and explore effects on menu options and customer purchases, paying particular attention to minimising adverse inequality effects.

Supplementary Materials: The following are available online at www.mdpi.com/link, Figure S1: Takeaway Masterclass intervention logic model, Figure S2: Takeaway Masterclass Notebook, Figure S3: Takeaway Masterclass Tips Leaflet, Figure S4: Takeaway Masterclass Pledge Form, Table S1: Description of the Takeaway Masterclass using the template for intervention description and replication (TIDieR) checklist, Table S2: Classification of the health-promoting practices evaluated before and after the Takeaway Masterclass using the Typology of Interventions in Proximal and Physical Micro-environments (TIPPME), Table S3: Goals set by owners and managers of the takeaway food outlets

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Tables and Figures

Table 1. Characteristics of the takeaway food outlets participating in the Takeaway Masterclass and evaluation activities

	Baseline[1]	Attended Masterclass			6 week Follow-up			Semi-structured interviews		
	BA Group	BA Group	FU Group	All	BA Group	FU Group	All	BA Group	FU Group	All
Food outlet type[2]										
Fish & chips	2 (22)	1 (14)	3 (27)	4 (22)	1 (14)	2 (25)	3 (20)	1 (33)	2 (33)	3 (33)
Pizza, burger & kebab	5 (56)	4 (57)	5 (45)	9 (50)	4 (57)	3 (38)	7 (47)	2 (67)	2 (33)	4 (44)
Chinese	0 (0)	-	1 (9)	1 (6)	-	1 (13)	1 (7)	-	0 (0)	0 (0)
Indian	1 (11)	1 (14)	0 (0)	1 (6)	1 (14)	-	1 (7)	0 (0)	-	0 (0)
Café/sandwich	0 (0)	-	2 (18)	2 (11)	-	2 (25)	2 (13)	-	2 (33)	2 (22)
Multi-cuisine	1 (11)	1 (14)	0 (0)	1 (6)	1 (14)	0 (0)	1 (7)	0 (0)	0 (0)	0 (0)
Total	**9**	**7**	**11**	**18**	**7**	**8**	**15**	**3**	**6**	**9**
Index of Multiple Deprivation (IMD) quintile[2]										
1 (most deprived)	3 (33)	3 (43)	8 (72)	11 (61)	3 (43)	5 (63)	8 (53)	1 (33)	1 (17)	2 (22)
2-5	6 (67)	4 (57)	3 (27)	7 (39)	4 (57)	3 (38)	7 (47)	2 (67)	5 (83)	7 (78)
Total	**9**	**7**	**11**	**18**	**7**	**8**	**15**	**3**	**6**	**9**

BA, before and after; FU, follow-up

[1] Two food outlets (Chinese, IMD Q1 and Pizza, burger and kebab, IMD Q1) declined to take part in BA group but did attend Masterclass and so joined FU group

[2] Number (% of column total)

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496 **Table 2.** Number of takeaway food outlets (n=7) achieving health-promoting practices at baseline and 6-8 week follow-up assessments, and the number of goals set for takeaway food
497 outlets related to the practices assessed that were achieved or not at follow-up

	Number of takeaway food outlets achieving health-promoting practice			Number of goals related to health-promoting practice	
Health-promoting practice	**Baseline**	**Follow-up**	**Not applicable**	**Achieved**	**Not achieved**
Reduce saturated fat					
Use vegetable oil rather than lard or ghee OR Polyunsaturated or monounsaturated fat or oil used for cooking	7	7	0		
Polyunsaturated or monounsaturated fat or oil used for preparation	4	4	3		
Excess fat drained from food before serving	7	7	0		
Use a lower fat cheese alternative e.g. mozzarella or half fat cheddar	0	1	1	1	0
Low fat sauces e.g. light mayo	0	0	0	0	1
Use lean meats or mince	6	6	1		
Trim visible fat off meat	6	6	1		
Take the skin off the chicken before cooking	6	6	1		
Low fat spreads/margarine	0	0	0		
Ensure alternatives to chips are not fried	5	5	0		
If chips are served, there is always a healthier starchy alternative	4	4	0		
Offer thick cut or steak cut chips	0	0	0		
Use straight cut chips rather than crinkle cut	7	7	0		
Use healthier cooking methods for at least one main menu item e.g. stir frying, poaching, boiling, grilling, dry frying and baking	7	7[1]	0		
Where rice is served, boiled/steamed is available as an alternative	2	2	5		
Where sandwiches served at least two lower fat fillings are available	1	1	6		
Semi-skimmed (or skimmed) milk used in cooking	0	4	3		

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Semi-skimmed (or skimmed) milk available for drinks	1	2	0		
Total	**63**	**69**	**21**	**1**	**1**
Reduce salt					
Reduce the quantity of salt used in cooking[2]	-	5	0	1	3
Reduce the quantity of sauce used in cooking e.g. curry sauce, soy sauce[2]	-	1	0	1	1
Salt not added to water used for cooking vegetable, rice & pasta	4	4	3		
Buy 'no added salt' canned vegetables and pulses	2	2	5		
Rinse canned vegetables and pulses in water before use	0	0	7		
Do not have salt cellars out on display	6	6[1]	1		
Customers can add own salt	6	6[1]	1		
Reduced hole salt shaker is used	1	0[3]	1		
Use reduced salt options e.g. gravy, ketchup, soy sauce, baked beans, stock cubes	0	0	0	0	1
Total	**19**	**24**	**18**	**2**	**5**
Reduce sugar					
Offer reduced sugar drink alternative instead if or as well as regular products e.g. diet fizzy drinks, water	7	7[1]	0	1[1,4]	0
Offer a reduced sugar product alternative instead of or as well as regular products e.g. reduced sugar ketchup, reduced sugar baked beans	0	1	0	0	2
Reduce sugar used in cooking[2]	-	2	0	1	0
Use sweeteners as a substitute for sugar	0	0	4		
Lower sugar snacks are available as alternative to biscuits, chocolate etc	0	0	4		
Total	**7**	**10**	**8**	**2**	**2**
Increase fruit and vegetables					
Provide a salad garnish with each meal	6	6	1		
Offer salad as an alternative to chips	5	5	1		
Include salad as an option on sides menu	6	6	1		

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Include fresh fruit juice as a drink option (150ml carton)	0	1[1]	0	0	2
Incorporate more vegetables in recipes where appropriate	-	2	0	2	1
Serve baked beans or sweetcorn as a side (e.g. with fish and chips)	1	1	6		
Fresh fruit is always available and prominently displayed	0	0	0	0	1
Total	**18**	**21**	**9**	**2**	**3**
Increase fibre					
Use wholemeal pasta and/or noodles	0	0	5		
Use brown rice	0	0	5	0	1
Use part wholemeal flour in Naan	0	0	6		
Use wholemeal bread e.g. rolls, pittas, wraps	1	1	0	0	2[2]
Total	**1**	**1**	**16**	**0**	**3**
Reduce portion size					
Reduce 'standard' portion sizes (e.g. portion of chips)[2]	-	1	0		
Offer a smaller portion size option as well as a regular portion size	3	4[1]	0		
Smaller portions are available for children	3	3	0		
Total	**6**	**8**	**0**	**0**	**0**
Overall health-promoting practices					
Incorporate healthier options as part of meal deals	0	0[1]	0		
Healthy eating is promoted by staff	1	2	0		
Improve oil management[2]	-	4	0	1	0
Total	**1**	**6**	**0**	**1**	**0**

[1] Practice confirmed by researcher acting as a 'secret shopper'; [2] Assessment at follow-up only; [3] Regular salt shaker used for regular salt and reduced hole salt shaker used for low sodium salt at follow-up; [4] Reduced sugar (diet) drinks were already supplied at the food outlet at baseline, but goal was to provide bottled water in addition

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502 **Figure 1.** Takeaway Masterclass intervention and evaluation participation flowchart

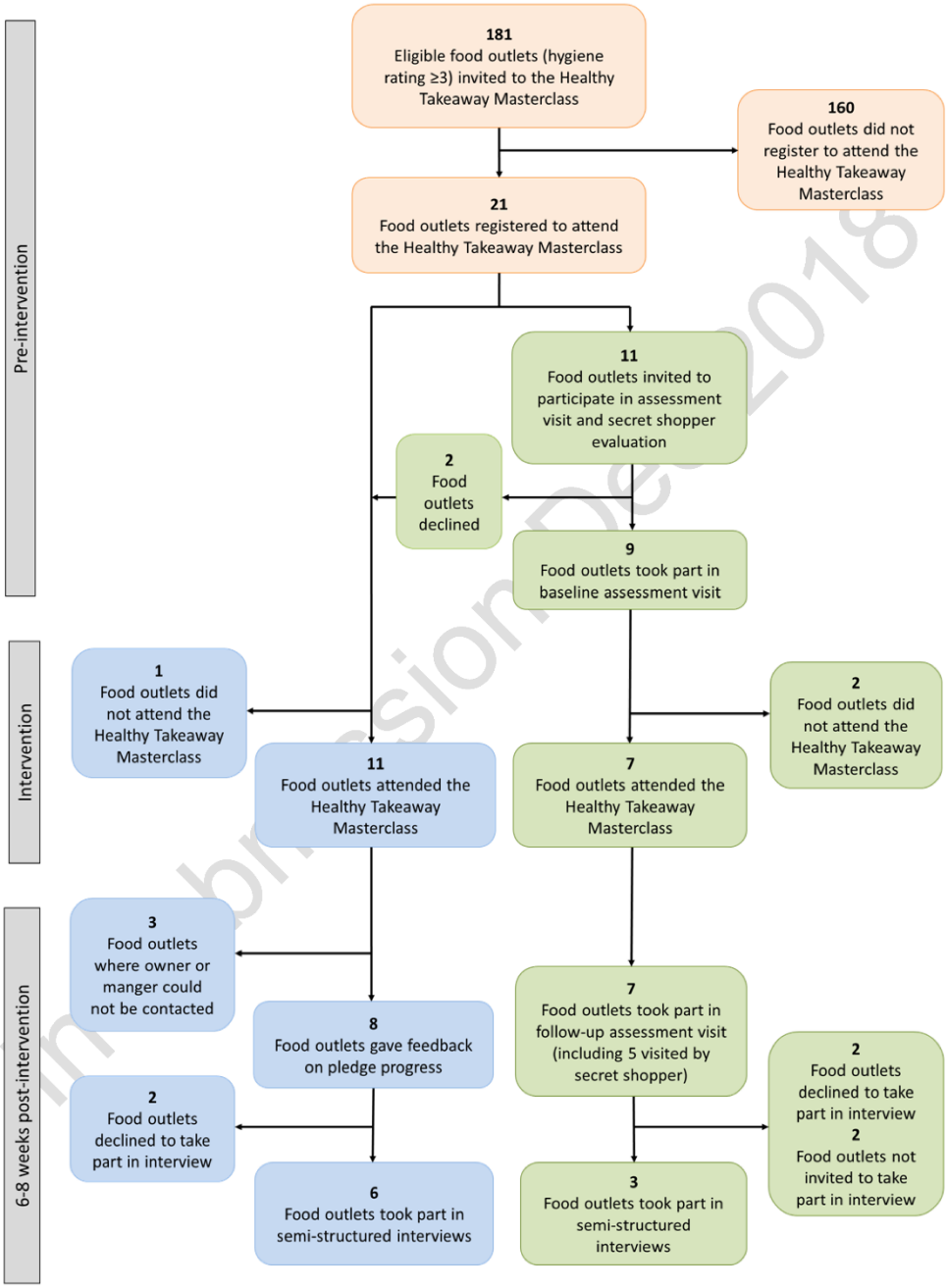

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Table S1: Description of the Takeaway Masterclass using the template for intervention description and replication (TIDieR) checklist

1. Name	Healthy Takeaway Masterclass
2. Rationale, theory, goal	Takeaway food = poor nutrient content and consumption has been linked to weight gain and adverse metabolic outcomes. The behaviour change techniques used during the training are: • Providing information on behavioural outcomes • Instructions on how to perform a behaviour. • Demonstration of Behaviour/credible source/ vicarious consequences • Prompt practice/behavioural experiment • SMART goal setting (behaviour) and action planning with problem solving/coping planning • Prompt/cue for action Aim: Healthier cooking practices are implemented and/or healthier menu options are provided in each takeaway
3. Materials	Information provision on: consequences of behaviour and behaviour change opportunities presented on slides. Using tasting experiences of alternative low sugar, low salt, and low fat ingredients as alternative condiments/produces. Modelling accurate forms of managing frying oil prolonging its quality and life using a video highlighting how to do this step by step. These materials are used during one session (approx. 3 hours). Printed handouts of the slides, a tips booklet on how to increase healthiness of their takeaway produces, a notebook (for goal setting and action planning with problem solving) and a pledge sheet (acting as a prompt/cue for action) are provided to participants to use on the day and take to the business with instructions to place in the kitchen in a easy to look at place.
4. Procedures	Takeaway owners and managers were invited via an official headed letter from the public health team at Redcar & Cleveland (R&C) Borough Council approx. 6 weeks prior to class. Leaflets advertising the training were also distributed in the borough. On day – training approx. 3 hours that includes: introduction from R&C Health Improvement Commissioning Lead including information on health context nationally and locally; slides providing information on how to increase the healthiness of the food choices offered by the business with real life examples of previous implementations and the benefits of this. This was designed and delivered by three Kirklees Food Initiatives and Nutrition Education (FINE) Project* team members. A video (approximately 7 minutes) with step by step instructions on how to care for frying oil designed, introduced and commented on by one industry representative (National Federation of Fish Fryers [NFFF]); practical activities 1) tasting of regular and 'healthier' options (e.g. low vs normal fat mayonnaise) and 2) sugar quantity estimation (in drinks); and goal setting (behaviour) and action planning with problem solving activity.
5. Who provided	Educational materials delivered by three FINE team members and one industry representative (NFFF). Members of the FINE team and R&C Public Health team assisted with the practical sessions. The goal setting and action planning activity was introduced by VAS (Health Psychology, Newcastle

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	University) and support provided by research staff (morning) with FINE and R&C team (afternoon).
6. How	Training delivered in person in a group session
7. Where	Central location in the local authority. Two sessions offered (morning and afternoon)
8. When and how much	One session approx. 3 hours.
9. Tailoring	Businesses of varying type (cuisine) and location attended. Goal setting and action planning was tailored to the business as business set these.
10. Modifications	Modifications to what had previously been delivered in Kirklees: Local context information changed from Kirklees to Redcar and Cleveland; more emphasis made on case study examples; inclusion of video (approximately 7 minutes) on oil filtering; and goal setting with action planning activity significantly enhanced.
11. Planning/fidelity (ways to maintain fidelity)	The same experienced intervention deliverers delivered both sessions, using the same materials. The enhanced goal setting and action planning activity was a new component and the plan was to deliver training to FINE and R&C staff on how to deliver this.
12. Actual fidelity	The parts of the sessions delivered by the FINE team NFFF rep were delivered as intended. It was intended that the enhanced goal setting and action planning activity was also delivered by the FINE team or R&C staff; however, this was introduced and supported by the research team, solely in the morning, and along with FINE and R&C staff in the afternoon.

**The Kirklees Food Initiatives and Nutrition Education (FINE) Project is a Kirklees Public Health commissioned provider service located within the Environmental Health Department of Kirklees Council. Its main remit is to improve nutrition literacy amongst professionals, staff as well as volunteers. In addition a proportion of their work is to engage in healthy eating interventions with the out of home food sector in Kirklees.*

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Table S2: Classification of the health promoting practices evaluated before and after the Takeaway Masterclass using the Typology of Interventions in Proximal and Physical Micro-environments (TIPPME)

Health promoting practice	TIPPME classification
Reduce saturated fat	
Use vegetable oil rather than lard or ghee OR Polyunsaturated or monounsaturated fat or oil used for cooking	Product, Placement: availability
Polyunsaturated or monounsaturated fat or oil used for preparation	
Excess fat drained from food before serving	
Use a lower fat cheese alternative e.g. mozzarella or half fat cheddar	
Low fat sauces e.g. light mayo	
Use lean meats or mince	
Trim visible fat off meat	
Take the skin off the chicken before cooking	
Low fat spreads/margarine	
Ensure alternatives to chips are not fried	
If chips are served, there is always a healthier starchy alternative	
Offer thick cut or steak cut chips	
Use straight cut chips rather than crinkle cut	
Use healthier cooking methods for at least one main menu item e.g. stir frying, poaching, boiling, grilling, dry frying and baking	
Where rice is served, boiled/steamed is available as an alternative	
Where sandwiches served at least two lower fat fillings are available	
Semi-skimmed (or skimmed) milk used in cooking	
Semi-skimmed (or skimmed) milk available for drinks	
Reduce salt	
Reduce the quantity of salt used in cooking[2]	Product, Placement: availability
Reduce the quantity of sauce used in cooking e.g. curry sauce, soy sauce[2]	
Salt not added to water used for cooking vegetable, rice & pasta	
Buy 'no added salt' canned vegetables and pulses	
Rinse canned vegetables and pulses in water before use	
Do not have salt cellars out on display	Related product, Placement: position
Customers can add own salt	Product, Properties: functionality
Reduced hole salt shaker is used	Related product, Properties: functionality
Use reduced salt options e.g. gravy, ketchup, soy sauce, baked beans, stock cubes	Product, Placement: availability
Reduce sugar	
Offer reduced sugar drink alternative instead if or as well as regular products e.g. diet fizzy drinks, water	Product, Placement: availability
Offer a reduced sugar product alternative instead of or as well as regular products e.g. reduced sugar ketchup, reduced sugar baked beans	
Reduce sugar used in cooking[2]	
Use sweeteners as a substitute for sugar	
Lower sugar snacks are available as alternative to biscuits, chocolate etc	

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Increase fruit and vegetables	
Provide a salad garnish with each meal	Product, Placement: availability
Offer salad as an alternative to chips	
Include salad as an option on sides menu	
Include fresh fruit juice as a drink option (150ml carton)	
Incorporate more vegetables in recipes where appropriate	
Serve baked beans or sweetcorn as a side (e.g. with fish and chips)	
Fresh fruit is always available and prominently displayed	Product, Placement: availability and position
Increase fibre	
Use wholemeal pasta and/or noodles	Product, Placement: availability
Use brown rice	
Use part wholemeal flour in Naan	
Use wholemeal bread e.g. rolls, pittas, wraps	
Reduce portion size	
Reduce 'standard' portion sizes (e.g. portion of chips)[2]	Product, Properties: size
Offer a smaller portion size option as well as a regular portion size	Product, Placement: availability
Smaller portions are available for children	
Overall health promoting practices	
Incorporate healthier options as part of meal deals	Product, Placement: availability
Healthy eating is promoted by staff (*HCC 22)	Wider environment, Properties: information
Improve oil management[2]	Related objects, Properties: functionality

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Table S3: Goals set by owners and managers of the takeaway food outlets

1	Reduce sugar - change ketchup						
2	Swap to lower sodium salt	Buy reduce sugar and salt ketchup	Buy reduced sugar and salt baked beans	Increase fibre - buy brown rolls	Put poached fish on the menu		
3	Increase fruit and vegetable	Reduce saturated fat					
4	Add a bigger portion of salad	Remove the salt shaker	Add more healthy drinks to menu	Use less fat products	Refill the oil tank regularly		
5	Reduce salt (e.g. sauces)	Reduce sugar (Buy sugar free drinks)	Reduce fat (Buy low fat cheese)	Buy brown rice and brown bread buns			
6	Less salt	Low fat mayo	Low sugar tom sauce	Increase veg	Introduce smaller portions		
7	Reduce salt						
8	Reduce salt and sugar in cooking	Reduced sugar contained drink to water (???)					
9	Reduce salt	Reduce sugar	Change ??? ??? Oil				
10	Offer a fruit and salad option in kid's box	Give option of wholemeal bread bun and pitta's	Reduce the fat in the bechamel sauce	Don't offer to put salt and vinegar to food			
11	Reduce salt in ketchup and beans	Reduce sugar in ketchup and beans	Reduce saturated fat (in fryers)	Use wholemeal pasta/flour	Promote smaller portion sizes more	Include water as part of meal deal	Put water at eye level in fridge
12	Remove salt from counter	Stock bottled water and more zero sugar	Offer a poached fish	Offer alternative to kid's meal	OAP/child portions(?)	Try some cuscus as an alternative to chips	
13	Reduce salt - less hole shakers	Reduce sugar - reduced sugar ketchup					

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14	Reduce sugar and salt on the products	Might add a new salad on menu	Change oil more often	Put on menu healthier products (such as vegetable ???)	Reduce portions on ingredients/meat that contain fats	Change the milk	
15	Reduce salt (remove(?) salt shaker)	Reduce sugar (low sugar ketchup)	Healthier option (salad(?)/chips in olive oil)	Reduce fat (green top milk)			
16	Reduce salt - change salt shaker	Reduce sugar - introduce fruit juice	Reduce saturated fat - trim fat from meat	Increase fruit and veg - salad option (instead of just side salad)	Small portion - introduce lite bite	Healthier options - introduce baked potatoes	
17	Reduce salt in dough	Recommend water/water on meal deal as opposed to cola	Cucumber sticks with kid's meal	Grilled chicken kid's option	More salad with kebab		
18	Reduce my sugar by 10-20% in flapjacks/cakes						

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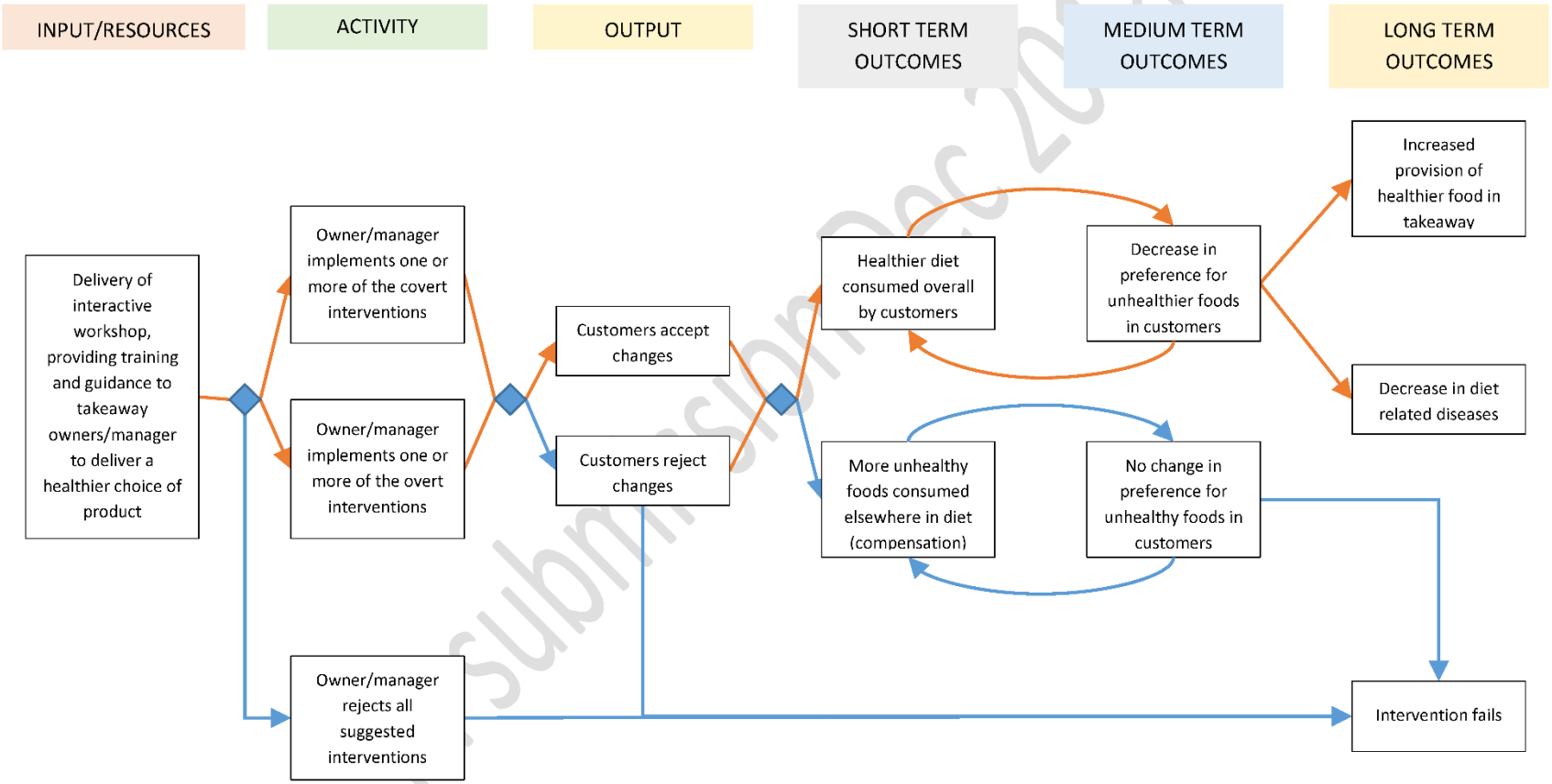
Figure S1: Takeaway Masterclass intervention logic model



PURPOSE: To improve dietary intake of takeaway food customers by increasing the availability of 'healthier' food within takeaways

CONTEXT: Regular consumption

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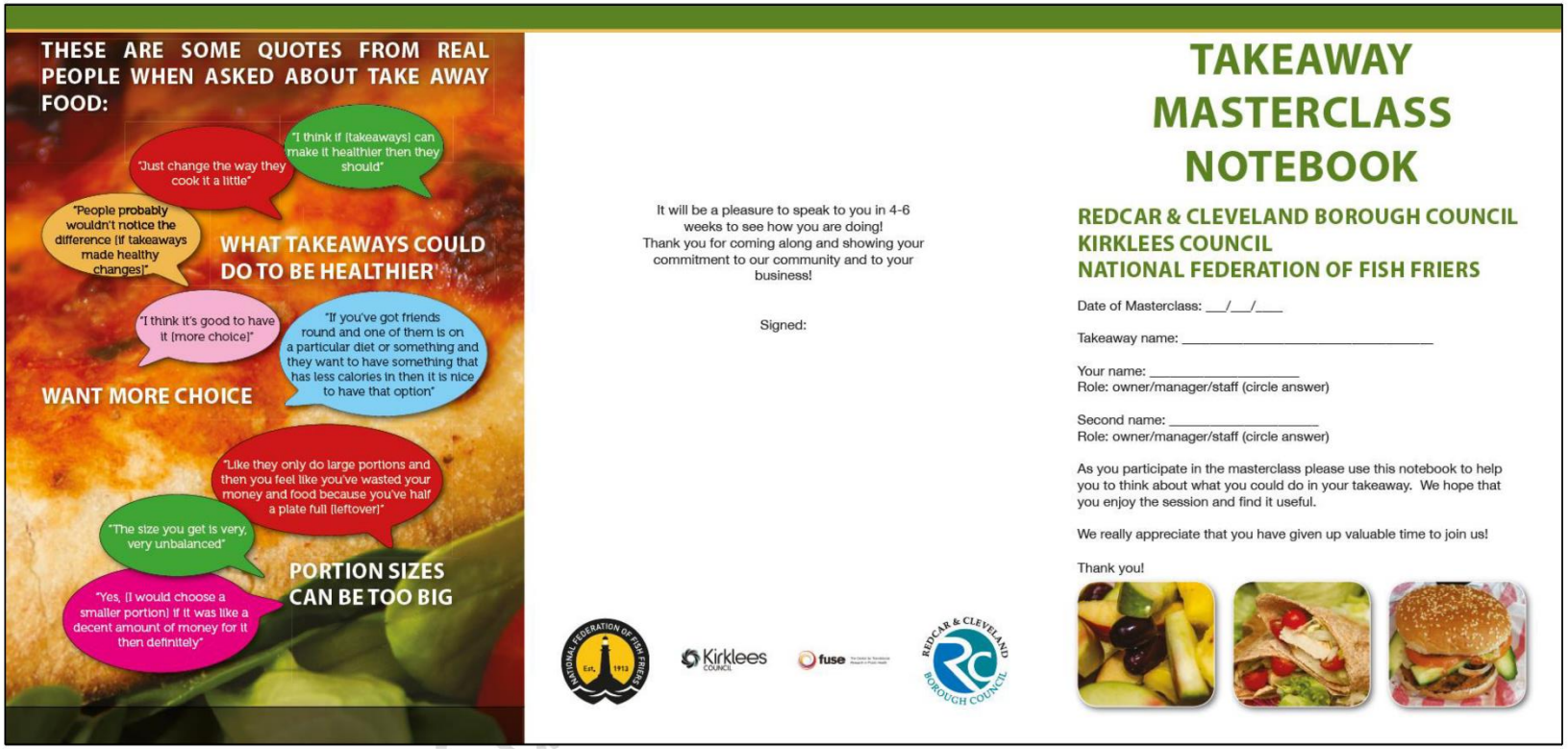
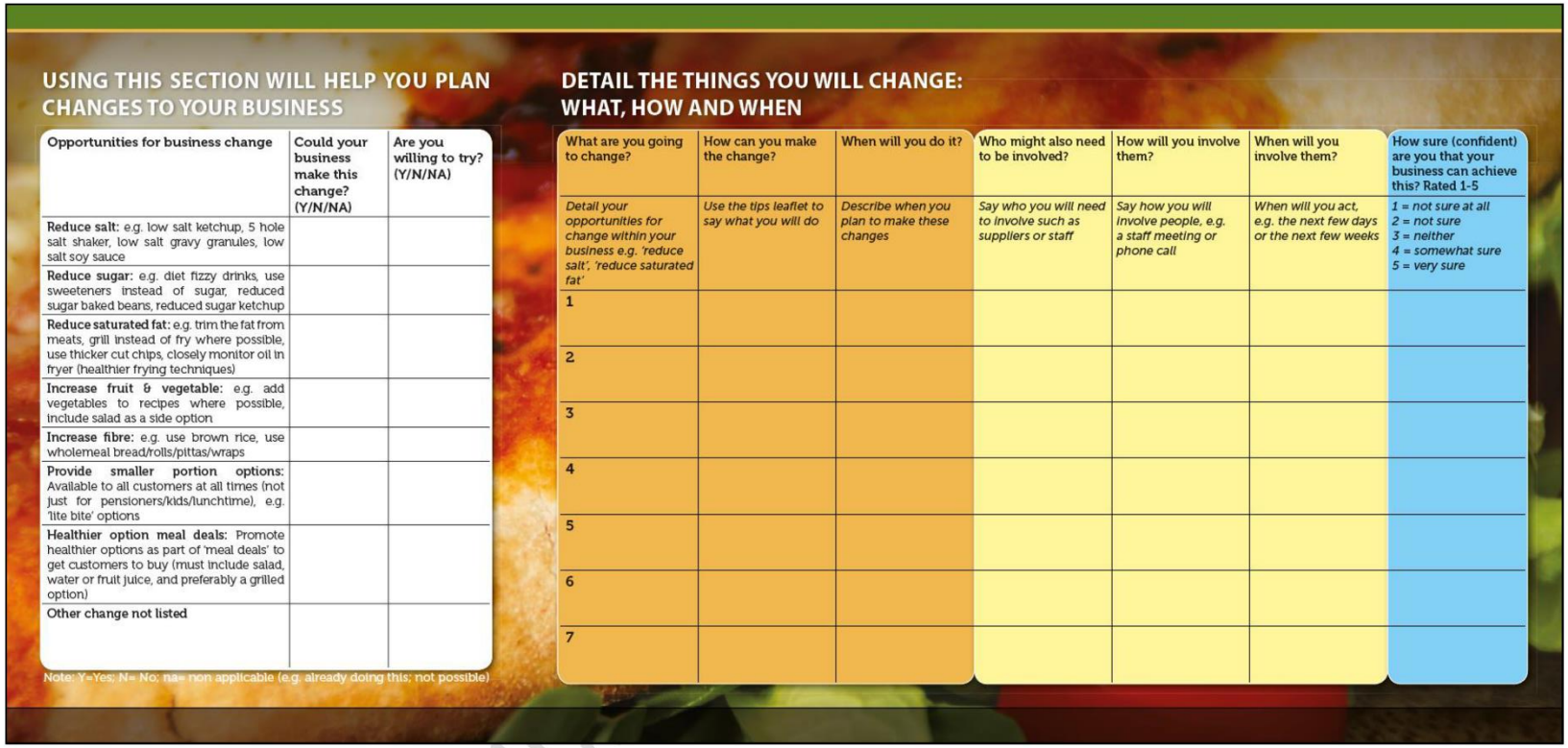
Figure S2: Takeaway Masterclass Notebook





USING THIS SECTION WILL HELP YOU PLAN CHANGES TO YOUR BUSINESS

Opportunities for business change	Could your business make this change? (Y/N/NA)	Are you willing to try? (Y/N/NA)
Reduce salt: e.g. low salt ketchup, 5 hole salt shaker, low salt gravy granules, low salt soy sauce		
Reduce sugar: e.g. diet fizzy drinks, use sweeteners instead of sugar, reduced sugar baked beans, reduced sugar ketchup		
Reduce saturated fat: e.g. trim the fat from meats, grill instead of fry where possible, use thicker cut chips, closely monitor oil in fryer (healthier frying techniques)		
Increase fruit & vegetable: e.g. add vegetables to recipes where possible, include salad as a side option		
Increase fibre: e.g. use brown rice, use wholemeal bread/rolls/pittas/wraps		
Provide smaller portion options: Available to all customers at all times (not just for pensioners/kids/lunchtime), e.g. 'lite bite' options		
Healthier option meal deals: Promote healthier options as part of 'meal deals' to get customers to buy (must include salad, water or fruit juice, and preferably a grilled option)		
Other change not listed		

Note: Y=Yes; N= No; na= non applicable (e.g. already doing this; not possible)

DETAIL THE THINGS YOU WILL CHANGE: WHAT, HOW AND WHEN

What are you going to change?	How can you make the change?	When will you do it?	Who might also need to be involved?	How will you involve them?	When will you involve them?	How sure (confident) are you that your business can achieve this? Rated 1-5
Detail your opportunities for change within your business e.g. 'reduce salt', 'reduce saturated fat'	*Use the tips leaflet to say what you will do*	*Describe when you plan to make these changes*	*Say who you will need to involve such as suppliers or staff*	*Say how you will involve people, e.g. a staff meeting or phone call*	*When will you act, e.g. the next few days or the next few weeks*	*1 = not sure at all* *2 = not sure* *3 = neither* *4 = somewhat sure* *5 = very sure*
1						
2						
3						
4						
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6						
7						

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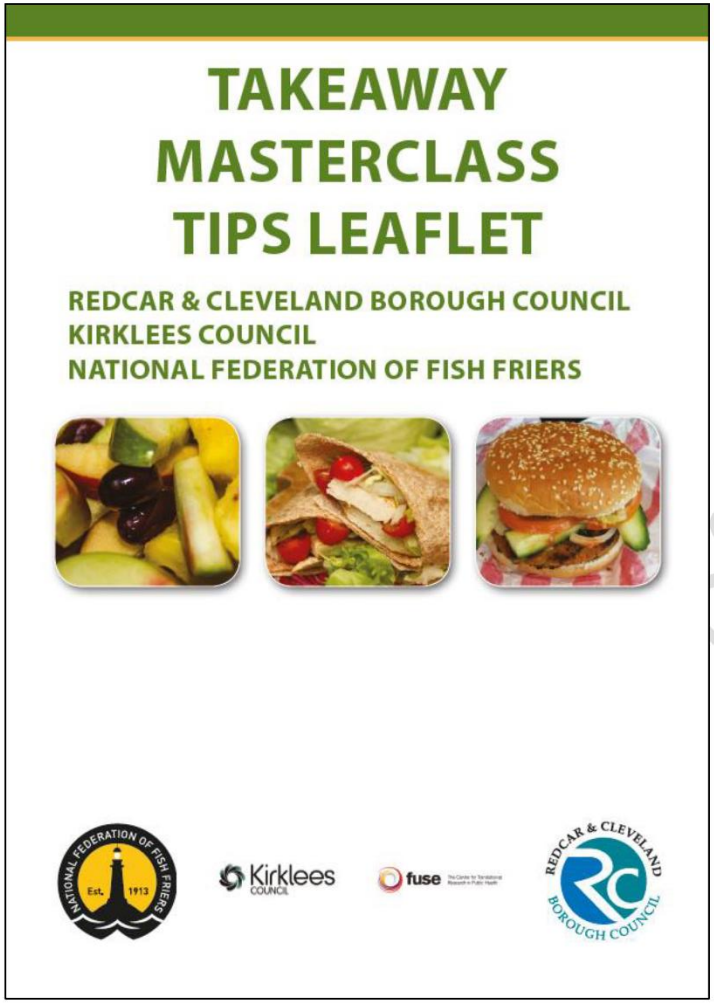
Figure S3: Takeaway Masterclass Tips Leaflet






WHEN DEEP FRYING:
Use a good oil from a reputable supplier (look out for the National Edible Oil Distributors Association logo)
Check oil quality daily with discard kits and discard oil when necessary
Carry out filtration daily using mechanical or manual equipment
Clean table top fryers at least once a week with a good quality degreasing agent, taking care that no degreasing residue left in the fryer.
Keep equipment (including utensils) clean, dry and in good condition
Do not repair equipment with solder
Fill table top fryer to below the fill line and top up if necessary
Melt down solid fats at lower temperatures (120°C)
Temperature – check thermostat with a manual probe regularly
Use a timer if possible to ensure consistent results
When preparing the food load the frying basket away from the fryer and shake off any excess crumb or ice (ensure well drained and free of excess water)
Fry 1 part food to 6 parts oil
Drain off excess oil before serving
Clean debris from fryer after each batch with a skimmer
Ensure oil level is kept consistent by regularly topping up with fresh oil
Turn fryer temperature down to less than 100°C during quiet periods
Keep fryer covered when not in use (to minimise light and air ingress)
Turn fryers off immediately after session has ended and replace lids where possible
Avoid using frying mediums which contain trans fats. These are sometimes referred to as hydrogenated fats.
SAVING MONEY ON OIL
FRYING AT 320°F INSTEAD OF 350°F = SAVING ON ENERGY BILLS


TIPS FOR REDUCING SALT
WHY?
High salt consumption is linked to a number of health issues including high blood pressure, stroke and heart disease. Small changes in both the kitchen and at service delivery can significantly reduce the amount of salt consumed by your customers.
POSSIBLE SAVINGS
Reducing salt in both your food preparation and food delivery could save your business money.
TIPS
Reduce the quantity of sauce used in cooking e.g. curry sauce, soy sauce
Buy 'no added salt' canned vegetables and pulses and rinse in water before use
Do not have salt cellars out on display (wait for customers to ask)
Put smaller holes in the shaker or block up some holes (or use a shaker with less holes e.g. 5 hole salt shaker)
Use reduced salt options e.g. gravy, tomato ketchup, soy sauce, baked beans and stock cubes
SUCCESS STORY
Gateshead Council 5 hole salt shaker project
Fish and chip shops used 5 hole salt shaker, instead of 17 hole salt shaker
Result = Businesses saved around 20-25kg of salt a week, which costs around £10-15, depending on the supplier and quality.


TIPS FOR REDUCING SUGAR
WHY?
High sugar intake is associated with weight gain and obesity, increased risk of type 2 diabetes and is the major cause of tooth decay.
POSSIBLE SAVINGS
Reducing sugar in both your food preparation and food delivery could save your business money
TIPS
Swap regular products for a reduced sugar alternative or offer a reduced sugar alternative as well as regular products e.g. diet fizzy drinks, reduced sugar ketchup, reduced sugar baked beans
Reduce sugar used in cooking
Use sweeteners as a substitute for sugar in cooking
Ensure sweeteners are available as a substitute for sugar for hot drinks
SUCCESS STORY
Oregano Pizza, East London
Altered pricing policy for drinks
Bottle of water is 50p rather than 65p for fizzy drinks
Places healthy drinks at eye level
Result = Increase in sales of water


TIPS FOR INCREASING FRUIT AND VEGETABLES
WHY?
Fruit and vegetables are a vital source of vitamins and minerals. It's advised that we eat at least five portions of a variety of fruit and vegetables each day. There's evidence that people who eat at least five portions a day have a lower risk of heart disease, stroke and some cancers.
POSSIBLE SAVINGS
Adding vegetables to dishes may result in the use of lower amounts of more expensive ingredients
TIPS
Provide a salad garnish with each meal
Offer salad as an alternative to chips
Include salad as an option on sides menu
Include fresh fruit juice as a drink option (150ml carton)
Incorporate more vegetables in recipes where appropriate e.g. curries, stir fries, pizza toppings
Serve baked beans or sweetcorn as a side (e.g. with fish and chips)
SUCCESS STORIES
Fu Lin Chinese, Marsden
Encourage customers to choose dishes with large amounts of fresh vegetables in.
Customers are happy with the change.
Sajan Sweet Centre, Huddersfield
Now add cauliflower, carrots and other fresh vegetables to curry dishes
Jerk Hut, Huddersfield
Now adds vegetables to all main meals


TIPS FOR INCREASING FIBRE
WHY?
Fibre can help prevent heart disease, diabetes, weight gain and some cancers, and can also improve digestive health.
TIPS
Use wholemeal pasta and/ or noodles
Use brown rice
Use part wholemeal flour in Naan bread
Use wholemeal bread e.g. rolls, pittas, wraps
Incorporate healthier options as part of meal deals
Provide a salad garnish with each meal
Offer salad as an alternative to chips
Include salad as an option on sides menu
Incorporate more vegetables in recipes where appropriate e.g. curries, stir fries, pizza toppings
Serve baked beans or sweetcorn as a side (e.g. with fish and chips)
SUCCESS STORY
Towngate Fisheries, Bradford
To increase the choice of wholemeal bread rolls, staff ask customers "would you like to try these new [wholemeal] bread rolls?"
Result = Increase in the number of customers choosing wholemeal rolls rather than white rolls


TIPS FOR DECREASING PORTION SIZE
WHY?
Decreasing portion sizes is an effective way of reducing the consumption of excess calories, fat, salt and sugar.
POSSIBLE SAVINGS
In a fish and chip shop, three standard sized chips weigh an ounce. Ensuring that staff serve the 'correct' portion size will result in customers consuming less and businesses increasing their profits.
TIPS
Control portion size
Reduce 'standard' portion sizes (e.g. portion of chips)
Offer a smaller portion size option as well as a regular portion size (see 'lite bite' example)
SUCCESS STORY
Towngate Fisheries, Bradford
Owner Mark Drummond introduced a lite bite fish and chip option to his menu and his business won the Healthy Eating Award at the 2015 National Fish & Chip Awards organised by Seafish.

Figure S4: Takeaway Masterclass Pledge Form



PUBLIC PLEDGE

Based on what you have heard at today's take-away masterclass and on the things your business will want to change please write down below what things you want to do in your business. Remember, these are your business choices!

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

I give my consent to be contacted by phone, by the research team, in 4-6 weeks from today to give you a progress update on what has been achieved in my takeaway (whether I have managed to make the changes or not).

Signed: _____

Print Name: _____Date: ___/___/___

Takeaway name: _____

Position in Business: _____

Post Code: _____

Phone Number (and best time to call): _____

NATIONAL FEDERATION OF FISH FRIERS Est. 1913

Kirklees COUNCIL

fuse

REDCAR & CLEVELAND RC BOROUGH COUNCIL

MUR1 commentary

In this paper, the Masterclass was evaluated to be both feasible and acceptable to those that attended, with evidence of at least one change in cooking practices or menu option made in all participating takeaways. Despite this, the recruitment rate of 10% was viewed as low for a public health intervention. However, this recruitment should be viewed within the context of existing interventions in this setting. The UK Government's initiative to 'localise' the Public Health Responsibility Deal, which aimed to incorporate takeaways, was poorly reported and highly criticised to the extent that no useful data was reported [page 83]. A perhaps more comparable intervention would be with the Healthier Catering Commitment evaluated by Bagwell (2013) [page 85]. However, Bagwell's evaluation focused only on the components of the intervention and not the recruitment rate by catering outlet type [48]. Whilst the recruitment figure of 10% of all independent takeaways may be seen as low, with recommended modifications to the recruitment strategy (as reported in the paper), there is potential to improve recruitment [Hillier-Brown et al. (in submission) page 137] [58]. As Kirklees Council has shown, they successfully recruited one-in-four eligible takeaways over a series of Masterclasses [212]. Although, lacking the financial data to support, I would posit that the Masterclass is likely to be a more cost-effective way to engage with FBOs, than the resource intensive site delivery of a healthy catering award. The Masterclass provides a platform to collectively engage with a number of owners, managers and their staff as opposed to the individual food outlet visits required to assess a business' suitability to a given healthy catering award.

The commercial sector is responsible for the majority of food consumed in the UK, and any solutions that improve nutritional quality and reduce the energy content will ultimately involve businesses. Therefore, transparent and constructive relationships with commerce could play a crucial role. The relational, as opposed to regulatory, nature of the Masterclass could help to build trust between FBOs and local authorities with potential to support formation of a better relationship between businesses and local government, thereby increasing the potential effectiveness of future interventions delivered by the local authority in this setting.

For the ninth Masterclass (Thursday 20 October 2016) delivered within Kirklees, which followed the Masterclasses delivered in Redcar & Cleveland (Wednesday 13 April 2016),

Muhammad and the FINE team captured a range of quantitative and qualitative measures. These included Masterclass participants' details: type of food produced by their takeaway, geographical location, and attendee's role within the takeaway. Additionally, they captured qualitative details regarding participants' views on the Masterclass and what changes they 'pledged' to implement. Six weeks following the Masterclass, a member of the FINE team made a follow-up phone call to request details regarding changes implemented [212]. Details of those pledges and those reported as implemented can be seen in Table 7-1. Within Table 7-1, I have classified these changes according to the Nuffield Council on Bioethics Intervention Ladder [213].

Five of the eight takeaways from which participants attended reported making at least one change. While two takeaways, A and B, implemented changes that aimed to inform their customers to support them to make a healthier choice, three takeaways, C, D and G, implemented changes that restricted choice, protecting their customers by reducing unhealthy ingredients.

The changes made were self-reported, without independent validation. However, Muhammad and the FINE should be commended for putting in place evaluation measures that are an improvement on what currently exist with regards to such out-of-home food outlet interventions [47]. Their evaluation has provided the FINE team with a better evidence base to detail the improvements that they have achieved within their community. As a result, in 2017, they initially suspended their healthy catering award, 'Healthy Choice Award' [214], due to limited evidence of impact [215], and have focused their efforts on interventions which they can evaluate and measure change. Currently, following the suspension of the Healthy Choice Award, the Council plan that from March 2018 they will discontinue this award and replace it with a generic food Business Masterclass [215].

Table 7-1 Kirklees Council Masterclass 20 October 2016: takeaway pledged and self-reported changes implemented

Business ID	Changes FBO pledged to make at Masterclass	Changes reported as implemented at six week follow-up *(Nuffield Council on Bioethics option on intervention ladder [213])*
A	• Implement fruit pieces • Sticker for healthier options	• Placed stickers on healthier options *(provide information)*
B	• Fruit pieces in drinks cabinet for children's menu • Introduce more drink options	• In the process of updating menus, adding fruit to children's menu and making small water an affordable option for all *(provide information, enable choice)*
C	• Swap to a lower fat milk – used in pizza dough • Reduce salt and sugar in homemade sauces (chilli, garlic, mint sauce and coleslaw salad) • Reduce salt and sugar in pizza base sauce	• Reduced the temperature of the oil and implemented better oil maintenance practices • Reduced salt in dough and sauces *(restrict choice)* • Stopped salting chips *(restrict choice)*
D	• Reduce sugar and salt in homemade peas • Turn heat down on fryer in quiet times • Source 5-holed salt shaker • Reduce salt in the batter • Take salt off the counter • Try sweetcorn either tinned or frozen • Look into sauce sachets and baked beans which are reduced salt/sugar	• Reduced the oil heat during quieter times for cost efficiency • Salt shaker relocated under the counter as on the top *(restrict choice)* • 5-holed salt shaker has been sourced (g*uide choices through changing the default policy*) • Reduced salt in batter from a handful to half-handful *(restrict choice)*
E	• Brown flour in chapattis • Better oil management – clean and filter • Reduce salt and sugar in curries • Reduce fat in fried rice	Called – no answer
F	• Wholemeal flour in pizza bases • Reduce oil temperatures in quiet times	Called – no answer
G	• Reduce sugar in sauces • More vegetables in dishes • Reduce fat in fried rice	• Reduced sugar in the sauces *(restrict choice)* • More vegetables in every dish e.g. beansprout and onion *(restrict choice)*
H	• 5-holed salt shaker • Brown tea rolls available • Zero sugar in drinks • Oil management – topping up, drying chips • Brown flour in chapattis • Using margarine instead of butter	Called – no answer

7.4 Chapter summary

The Masterclass is an example of an intervention that specifically targets independent takeaways to deliver a nutritional improvement. It was designed to be relational, that is to engage with, and not dictate to, the food business operators. Our independent evaluation deemed the intervention feasible and acceptable to those food business operators who participated. While food business operators and other staff from the takeaways reported making a number of 'healthy' changes, there was limited objective evidence of change. Further work may be required to improve recruitment rates to the Masterclass. Further studies should seek to explore the value of the relational mechanism and the role it may play in building better relationships between the local authority and food business operators.

Chapter 8. Can meal sizes be reduced through portion control measures and can smaller portion meals be promoted in Fish & Chip Shops?

In this chapter, I discuss portion size in takeaways and the role of packaging, using Fish & Chips as a case study. I detail the feasibility of working with a wholesale supplier to co-design an intervention targeted at Fish & Chip Shop FBOs to promote better practices regarding portion control and increase the provision of smaller portion meals in Fish & Chip Shops in the north of England.

8.1 Portion size in independent takeaways

The large portion sizes of meals found in independent takeaways was the consistent issue that emerged both from the academic literature [page 8] and my engagement with intervention deliverers [Goffe et al. (2018) page 97] [55]. Jaworowska et al.'s main finding of their analysis of 489 meals from 27 cuisine types from independent takeaways was that '*the majority of meals were excessive for portion size*' [46]. While the multinational chain restaurants have been the focus for much criticism, a US study concluded that '*independent and small-chain restaurants, which provide no nutrition information, also provide excessive dietary energy in amounts apparently greater than popular meals from chain restaurants*' [45]. In the UK, there is currently no legislation that requires a hot food outlet to provide nutritional information. However, most chain restaurants have either voluntarily, or through 'pledges' as part of the Public Health Responsibility Deal [38], provided nutritional information that is accessible to customers, which some have argued enables customers '*to make informed choices and to adopt a healthier lifestyle*' [216].

8.1.1 Meal portion size and impact on consumption

Increased portion size leads to increased energy intake [217]. Furthermore, the number of, and size, of portion options available at meal time is also likely to impact on energy intake [218]. A customer selects a portion in relation to all available options, supporting the previous government's call '*to make healthier options more available*' [24]. Critically, independent of the portion selected, the size of the portion impacts on how much energy is consumed [218]. A customer, given multiple portion size options, will likely have a preconceived idea of what they want, for example 'small', but the volume of food they

consume will vary dependent on how big this 'small' portion is. Therefore, the availability, labelling and controlling of options and portion sizes will impact on a consumer's energy intake.

Conversely, if we can reduce all portions, this is likely to lead to a reduction in energy intake [219]. While the issues of portion size may seem like 'low-hanging fruit', addressing it, particularly in the independent sector, is more analogous to 'picking a prickly pear'. As stated in Chapter 2, many businesses promote themselves, based on 'value-for-money' [page 14]. It is implicit in their business model that they provide their customers with cheap, voluminous meals and meal deals, such as 'two-for-one', which are used to target and attract a youthful customer base [220].

8.1.2 The increasing size of portions

Work commissioned by the British Heart Foundation highlighted that many foods and meals have increased in portion size over recent years, for example individual chicken pies were found to be 40% larger in 2013 than in 1993 [221]. I attempted to attain data relating to portion size for the Fish & Chip industry and contacted suppliers, shop owners and the industry body the National Federation of Fish Friers (NFFF). While there was anecdotal evidence that portions in the industry had grown, there was no data to validate this claim. A former industry trainer for the NFFF, Arthur Parrington, detailed to me work that had been carried out in conjunction with HM Revenue & Customs to provide an insight to the workings and profitability of Fish & Chip Shops that was published in 1990. While this is not substantive evidence of the size of portions of meals delivered circa 1990, it provides an indication as to what Fish & Chip Shops, at that time, may have been targeting. It reports target weights of 5 to 10oz (142 to 283g) for cooked chips, and 3 to 6oz (85 to 170g) for uncooked fish [222]. Compared to the weights recently proposed for standardised portions by a steering group within Seafish [223], a non-departmental public body whose primary focus is the promotion of seafood industry, including The National Fish & Chip Awards [224], a cooked chip weight of 10oz and uncooked fish weight of 6oz would only be considered as a 'regular' portion. This steering group gave further guidance regarding an 'extra large' as a cooked chip weight of 20oz (567g) and uncooked fish weight of 12oz (340g), exactly double of that proposed for the 'regular' meal [225].

8.1.3 Packaging and portion size in Fish & Chip Shops

Hollands et al's 2015 systematic review stated that '*people consistently consume more food and drink when offered larger-sized portions, packages or tableware than when offered smaller-sized versions*' [226]. The same authors in a separate paper suggested that we '*demarcate single portion sizes in packaging through wrapping or visual cues*' [227]. As part of my evaluation of the 5-holed salt shaker cap intervention [page 112] I was also interested in how packaging had been used and the resultant impact on meal portion size. As part of data collection we recorded details of packaging used for each Fish & Chip meal purchased.

We surveyed a total of 65 Fish & Chip Shops: 42 in Gateshead; and 23 in Stockton-on-Tees. In our survey I classified packaging into five different types: Bio box (biodegradable box made from sugar cane); corrugated cardboard box; paper; polystyrene box; and trays. From portion weights I was able to estimate total energy (kcal) of meals using data from McCance and Widdowson's 'composition of foods integrated dataset' [115], see Table 8-1.

Table 8-1 Energy content of Fish & Chip meals per portion by packaging type in Foodscape study

Packaging	n	Total food energy (kcal)			Chips energy (kcal)			Fish in batter energy (kcal)		
		Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Bio box	1	1354	NA	NA	781	NA	NA	572	NA	NA
Corrugated cardboard box	17	1548	200	49	886	183	44	661	165	40
Paper	38	1666	356	58	990	236	38	677	154	25
Polystyrene box	7	1495	256	97	891	109	41	604	180	68
Tray	2	1297	55	39	645	1	1	652	54	38

There was no statistically significant difference in the total energy contained within each packaging type. However, structured packaging, both corrugated cardboard and polystyrene boxes, delivered a more consistent portion size when compared with paper only packaging. While structured packaging types alone, are not associated with smaller portion sizes compared with paper, the data suggests that it ought to be possible to identify an optimal

packaging type and size that could improve consistency of portion size and reduce the amount of food delivered. Through my engagement with Kirklees Council [Hillier-Brown et al. (in submission) I had established contact with Mark Drummond, a Fish & Chip Shop owner from Bradford, who from 2009 to 2015 was the head of training for the NFFF. He detailed to me his range of 'Healthy Choices', which included both a 'lite-bite' and a 'lighter meal' option, which had been laboratory tested for a range nutritional components [228]. He explained the particular choice of packaging and also the staff training and regulation required to deliver a consistent product. This provided a template for other business to potentially replicate.

As identified in my evaluation of the 5-holed salt shaker caps [Goffe et al. (2016a) page 116 [56]; Goffe et al. (2016b) 116], the focus is predominately on the chip component of the meal. Fish & Chip Shop FBOs buy their fish by size graded fillets. As explained to me by FBOs, the preparation of the fish prior to frying is the most skilled and important job in the meal preparation process, as they are the highest value commodity. Therefore, waste has significant implications for profits. This job is usually carried out by the FBO or their most trusted member of staff. Some FBOs purchase fillets that are ready-to-fry, but due to the fact that the fish are a living organism and under strict fishing regulation, size of fillets can never be guaranteed. Therefore, there is usually some cutting/trimming required. As a result, the portion of fish is predetermined and only the portion size of chips is subject to the discretion of the server.

I had conversations with both suppliers and FBOs regarding the use of chip scoops as a form of portion control, but to date, these had been largely ineffective as they are reliant on serving staff being consistent in their delivery, which is difficult to monitor and regulate. Despite this, there are those who continue to develop this technology and there have been new scoops available to purchase which aim to restrict the volume of chips served [229]. However, it is likely that either packaging or tableware will have the most significant influence on portion delivered, as serving staff can only fit an amount of chips into a box or onto a plate that the dimensions will allow.

Paper is two-dimensional and unstructured and hence is difficult to use to constrain volume, resulting in meals that have a wide range of portion sizes, see Table 8-1. The introduction of

structured corrugated boxes into Fish & Chip Shops is relatively recent, circa 2000 [230], but today there is a diverse range of packaging options available to FBOs. They come in different material types, including those that are bio-degradable, and offer a range of dimensions and number of compartments, see Figure 8-1. As explained to me by staff from wholesale supplier, the two-compartment boxes were designed to split boxes into unequal sections, one larger to accommodate the fish, and one smaller to accommodate the chips. However, not all severs adhere to this designated practice and will either put the chips in the larger compartment or not use divider at all.

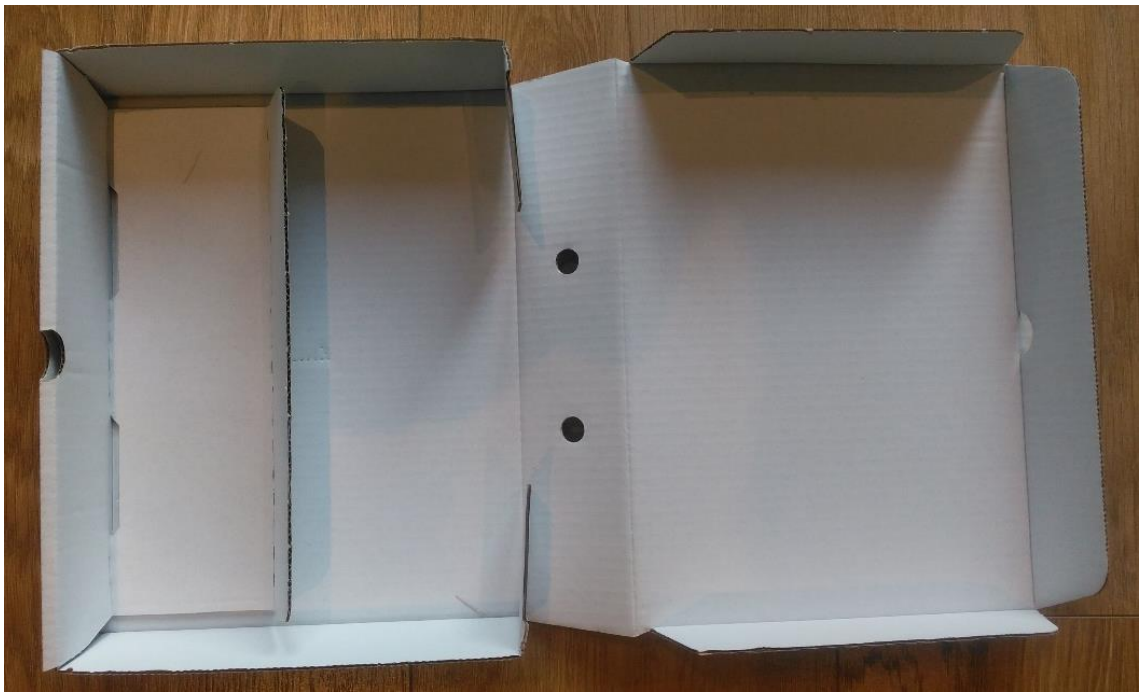


Figure 8-1 Two-compartment Fish & Chip meal corrugated cardboard box

From my Fish & Chip Shop survey data, I extracted and plotted the range of total energy per meal component by type packaging, separately for battered fish, see Figure 8-2; and for chips, see Figure 8-3. These figures provide a further insight into the possible relationship between packaging type and portion size. There is no discernible relationship between packaging type and the portion of battered fish. However, while not statistically significant, there does appear to be a potential relationship between packaging type and the portion of

chips, where both the interquartile and total range are noticeably smaller for both the two structured packaging types than for paper.

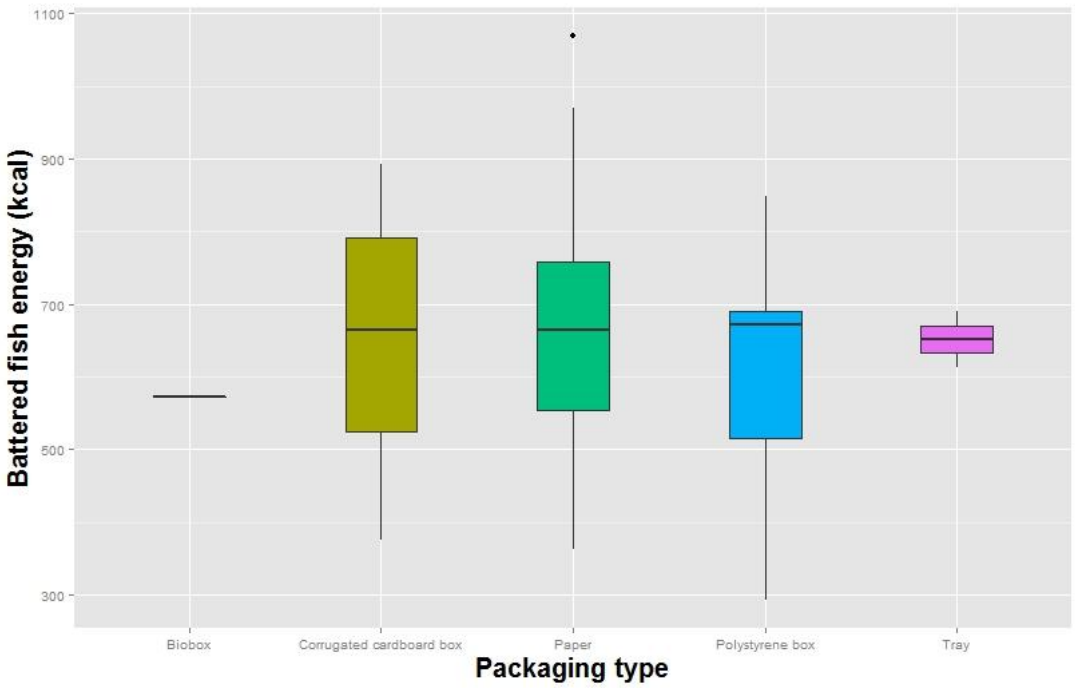


Figure 8-2 Energy content of battered fish per portion by packaging type in Foodscape study

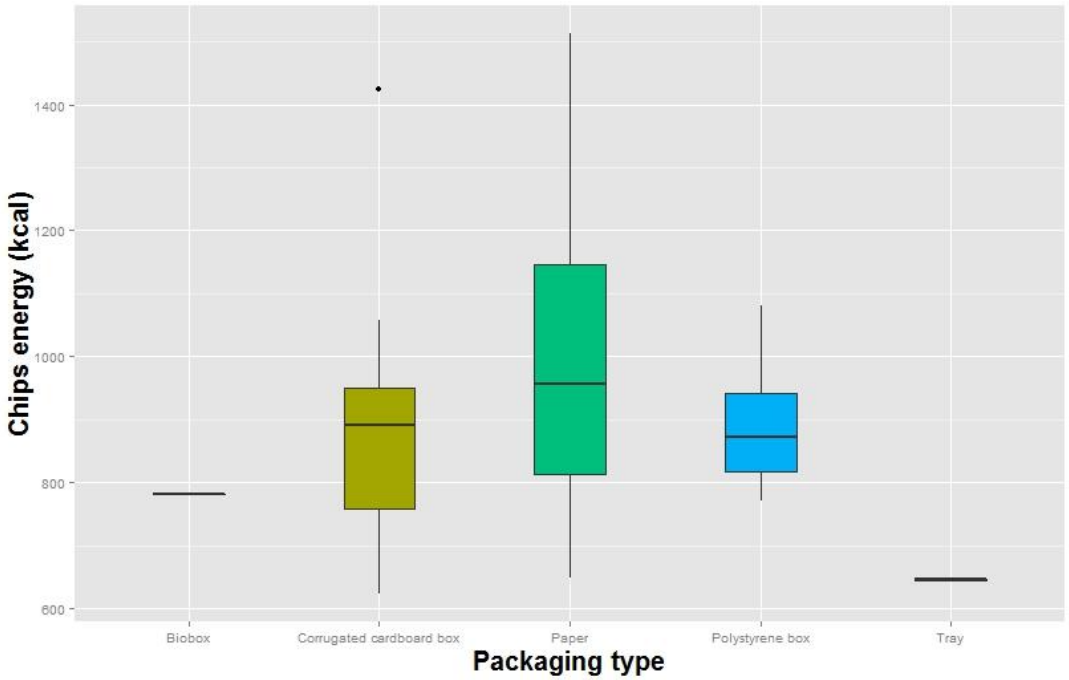


Figure 8-3 Energy content of chips per portion by packaging type in Foodscape study

8.2 Why are Fish & Chip Shops a suitable target?

Unlike many other takeaway meals, for example Indian and Chinese food, Fish & Chips presents a clearly defined one-person portion meal, which in many takeaways is not available, for example pizza, in a variety of portions sizes. The few ingredients in a Fish & Chip meal has likely led to the limited number of suppliers supplying a market of approximately 10,500 Fish & Chip Shops in the UK [81]. This and Gateshead Council's success with the roll-out of their 5-holed salt shaker caps in Fish & Chip Shops, suggests that an intervention based on portion control in Fish & Chip Shops may potentially be feasible and acceptable.

8.3 Working with a commercial partner

There is tension between industry and public health bodies as each group is driven by different and often directly opposing motives. The majority of literature on the subject refers to 'Big Food' defined as *multinational food and beverage companies with huge and concentrated market power* [231]. Such companies have a significant influence over our food intake, and as a result some academics have given consideration to the level of engagement that researchers should have with industry. The Centre for Diet and Activity Research (CEDAR), a UKCRC Public Health Research Centre of Excellence based in Cambridge, hosted an event in December 2015 to discuss this issue, entitled 'Dietary public health research and the food industry: towards a consensus' [232]. The meeting was built on an opening debate between those who opposed and those who argued in support of industry engagement. The case against engagement was proposed by Anna Gilmore, Professor of Public Health, Department for Health, University of Bath, and Simon Capewell, Professor of Public Health and Policy, Institute of Psychology Health and Society, University of Liverpool University. The evidence that they present was based on the tenet that *corporate funding corrupts and undermines credibility in science* and as a result industry funded research *undermines efforts to progress policy and improve public health* [232, 233]. They argued that such research was systematically biased towards favourable outcomes to industry, both overtly, for example, peer-reviewed publications which disclosed a potential conflict of interest were five times more likely to report a non-positive association between sugar sweetened beverage

consumption and weight gain than those publications that reported no conflicts of interest [234] and covertly, as funders, the industry is in control of the research agenda and can determine the framing of research questions, i.e. what questions are and are not asked [232, 233]. Professors Gilmore and Capewell focused their arguments on the 'Big Food' industry, the suppliers of ultra-processed food and high sugar drinks, who have substantial financial resources at their disposal.

While I do not disagree with the arguments put forward by Professors Gilmore and Capewell, as stated, these were in reference to companies with the resources to finance both research projects and research institutions. FBOs working in the fractured setting of independent takeaways have limited resources and in some cases are struggling to survive [185], therefore they are unlikely to have an interest in activities beyond their standard trading practices. However, this does not mean that there are no conflicts. Seafish and AHDB Potatoes recently carried out research on portion sizes and menu options available in 580 Fish & Chip Shops around the UK [82]. As industry bodies, their focus is to support and promote the sector. Their survey reported that a medium portion of cod in their survey varied from 93g (~223kcal) to 562g (~1,349kcal) and a medium portion of chips varied from 100g (~214kcal) to 797g (1,706kcal), indicating a substantial variation in portion sizes. They did not report any measure relating to the average size across samples, but each of the largest component portions alone represent over 50% of an adult male's recommended daily energy intake. Additionally, further survey work that they carried out with customers found that 15% thought that chip portions were too large and almost one in two (44%) threw away some of their chips. Despite the evidence implying that portions are large, their suggestion to FBOs was 'giving your customers extra choice', provides them with the option to buy smaller portions and they were not overtly critical of the excessively large meals available.

Successful engagement with takeaways in nutritional interventions, to date, has been limited [47]. Therefore, any leverage gained though cooperation with stakeholders in this industry, i.e. FBOs and suppliers, could potentially be beneficial. Specifically, working with independent takeaway businesses it is unlikely there will be conflicts of interest as such small business will neither be interested in funding, nor in a position to fund research. Provided we are transparent, constructive and pragmatic, and have a clear set of ground

rules to govern interaction with industry partners [232], we can maintain our credibility and not be compromised. Conversely, if we choose not to collaborate, what is the alternative? To date, in the independent takeaway sector the UK Government has demonstrated a lack interest in regulatory measures and has a strong preference for voluntary schemes [38], although the SDIL might represent a changing view with policy makers [40]. If the UK Government were to introduce regulatory measures, what would these be and who would be responsible for monitoring? For example, if there were to be mandatory calorie labelling measures put in place on independent small businesses, monitoring would likely be a trading standards issue, but under the current constraints enforced on local authority budgets through austerity, it is difficult to see how the volume of testing required to ensure that businesses were not misleading customers would not be prohibitively expensive. Therefore, it seems that under the current framework set out by the UK Government and the current local authority landscape, interventions that seek active engagement with industry should at least be explored.

8.4 Six steps in quality intervention development

I decided to follow the Six steps in Quality Intervention Development (6SQuID), as it provided a pragmatic guide specifically targeted at public health interventions [235]. The steps included:

1. *Defining and understanding the problem and its causes*

The meals from independent takeaways generally serve foods and portions that are in excess of dietary recommendations for energy [page 16]. Regular consumption has been associated with weight gain and obesity, as well as other adverse health outcomes [page 22].

2. *Clarify which causal or contextual factors are malleable and have greatest scope for change*

The serving practices and the lack of structure of certain forms of packaging (paper wrapping) play a part in the resulting large portions delivered in Fish & Chip Shops [page 181]. There is also a lack of availability and promotion of smaller portion meals for all shop customers to purchase.

3. *Identify how to bring about change: the change mechanism*

The change in portion size through the use of structured box packaging for all meals and the introduction of smaller portion meals available to all customers using SMART goal setting and action planning [Goffe et al. (Accepted Dec 2018) page 188 – TIDieR checklist] [59].

4. *Identify how to deliver the change mechanism*

A supplier-led engagement activity that used peers (Fish & Chip Shop owners) to encourage a greater emphasis on portion control of all meals served through box packaging, and to actively provide and promote smaller portion meals [Goffe et al. (Accepted Dec 2018) page 188] [59].

5. *Test and refine on small scale*

The engagement event and subsequent evaluation was delivered from April to June 2016 [Goffe et al. (Accepted Dec 2018) page 188] [59].

6. *Collect sufficient evidence of effectiveness to proceed to a rigorous evaluation*

Sales of subsequent specific smaller meal packaging suggests promotion of such meals are viable and sustainable. The mean total weight of both regular and smaller portion meals decreased across the evaluation period. We did not identify any serious unintended effects [Goffe et al. (Accepted Dec 2018) page 188] [59].

MUR2. Feasibility of working with a wholesale supplier to co-design and test acceptability of an intervention to promote smaller portions: an uncontrolled before-and-after study in British Fish & Chip Shops

Goffe L, Hillier-Brown F, Hildred N, Worsnop M, Adams J, Araujo-Soares V, Penn L, Wrieden W, Summerbell C, Lake AA, White M, Adamson A. *Accepted by BMJ Open* December 2018.

Feasibility of working with a wholesale supplier to co-design and test acceptability of an intervention to promote smaller portions: an uncontrolled before-and-after study in British Fish & Chip Shops

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Accepted Dec 2018

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Word count: 4,013 (excluding tables)

Accepted Dec 2018

ABSTRACT

Objectives

To explore the feasibility of working with a wholesale supplier to co-design and deliver, and to assess the acceptability of, an intervention to promote smaller portions in Fish & Chip Shops.

Design

Uncontrolled before-and-after study.

Setting

Fish & Chip Shops in northern England, 2016.

Participants

Owners (n=11), a manager, and customers (n=46) of Fish & Chip Shops; and intervention deliverers (n=3)

Intervention

Supplier-led, three-hour engagement event with shop owners and managers, highlighting the problem of excessive portion sizes and potential ways to reduce portion sizes; provision of box packaging to serve smaller portions; promotional posters and business incentives.

Accepted Dec 2018

Data collection

In-store observations and sales data collected at baseline and post-intervention. Exit survey with customers. Semi-structured interviews with owners/managers and intervention deliverers post-intervention.

Results

Twelve Fish & Chip Shops were recruited. Observational data were collected from eight shops: at baseline, six shops did not promote the availability of smaller portion meals; at follow-up all eight did and five displayed the promotional poster. Seven out of 12 shops provided sales data and all reported increased sales of smaller portion meals post intervention. Of 46 customers surveyed: 28% were unaware of the availability of smaller portion meals; 20% had bought smaller portion meals; and 46% of those who had not bought these meals were interested to try them in the future. Interviews revealed: owners/managers found the intervention acceptable but wanted a clearer definition of a smaller portion meal; the supplier valued the experience of intervention co-production and saw the intervention as being compatible with their responsibility to drive innovation.

Conclusions

The co-design of the intervention with a supplier was feasible. The partnership facilitated the delivery of an intervention that was acceptable to owners and customers. Sales of smaller meal packaging suggest that promotion of such meals is viable and may be sustainable.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first study we are aware of to evaluate the feasibility of working with a wholesale supplier to co-design and deliver a public health intervention targeting hot food takeaways.

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- It is also the first study we are aware of to detail the potential role that wholesale suppliers can play in improving the healthfulness of food offerings from hot food takeaways, exemplified by Fish & Chip Shops.
- A mixed-method approach was employed, which successfully captured impacts of the interventions on all stakeholders.
- Data available on customer behaviours were limited and did not include takeaway food consumption.
- We had a small sample size, focused on one takeaway cuisine type and therefore the results may not be generalisable beyond the setting of Fish & Chip Shops.

KEYWORDS

Takeaways; Fish & Chips; food environments; public health; diet; obesity; intervention; behaviour change

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INTRODUCTION

Takeaway and fast food meals, particularly from independent businesses, have been found to deliver excessive energy by means of large portion sizes,[1] driving high energy consumption,[2] which is a major public health concern.[3] Our previous work found that adults and children who ate takeaway meals at least weekly consumed 63-87kcal and 55-168kcal per day, respectively, more than those who consumed such meals rarely.[4] High takeaway meal consumption has been linked to weight gain [5] and diet-related diseases.[6]

In the UK, 'Fish & Chips' are culturally embedded,[7] with an estimated 10,500 shops nationally.[8] Typical Fish & Chip Shop meals consist of white fish in batter and chipped potatoes, both deep fried.[9] One survey found that the median energy content of 64 Fish & Chip meals was 1,658kcal,[1] representing 79% of a woman's and 64% of a man's estimated average daily energy requirement.[10] This suggests reducing portion sizes could be a means to promote population health.[11-14]

As most outlets use a limited number of wholesale suppliers,[15] these have substantial influence on what food is offered by independent hot food takeaways.[16] Whilst working with suppliers provides an opportunity for intervention,[17] to date, limited research has done so.[16]

The aim of this study was to explore the feasibility of working with a wholesale supplier to co-design and deliver an intervention to promote smaller portion meals in Fish & Chip Shops in northern England; and the acceptability of this intervention to shop owners/managers and their customers. It was not a process or outcome evaluation study.

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METHODS

Intervention co-design

We approached Henry Colbeck Limited (HC), an independent specialist Fish & Chip Shops wholesaler, supplying over 2,500 shops across northern England and Scotland,[18] within a partnership supplying over 6,000 shops across the UK.[8] We asked HC if they would work with us to co-design and lead delivery of an intervention to encourage Fish & Chip Shops to improve portion control and promote smaller portion meals. Members of the research team and HC staff set out their respective positions and terms of partnership that included: for HC – responsibility for intervention development and intervention delivery (including costs), as well as data sharing; for the research team – responsibility for study design and co-ordination of data collection, independence of analysis and right to publish findings.

We discussed findings of our previous studies on independent takeaways [4, 19-23] with HC, and in turn they shared their knowledge, detailing meal packaging options currently used: boxes, trays, and paper wrapping. It was established that large portion size meals existed across the sector, driven primarily by high competition and a desire to offer customers 'value-for-money'. We agreed the dual-focus of an intervention to facilitate and promote: better portion control, supported through use of box packaging that standardises portion size (in particular in comparison with paper wrapping); and active promotion of smaller portion meals. We agreed that implementation of the intervention should not incur direct costs to the participating Fish & Chip Shops and that HC should promote to owners/managers primarily on the potential financial benefits of portion control and smaller portion sizes. HC recruited two owners with established smaller portion meal promotion to support intervention delivery to detail their practical experience and financial benefits. The intervention was theorised in detail by the research team (Supplementary File A).

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Intervention description

The research team supported HC to develop a three hour engagement event held in April 2016 at a hotel in North-East England. Fish & Chip Shop owners, managers, and their staff were invited to attend by HC. The programme included sessions delivered by HC and two Fish & Chip Shop owners, followed by a question and discussion session.

Owners/managers were encouraged to place a greater emphasis on portion control by using box packaging, and to actively promote smaller portion meals. The potential financial benefits of attracting a wider customer base and reducing portion sizes without pro-rata reductions in price charged were stressed throughout, such as an increase in trade and higher meal profit margin. Participants were presented with a range (by size and material) of smaller portion boxes, but the choice of packaging selected was made by the owner/manager. An enhanced action-planning activity developed by the research team included a goal-setting form (Supplementary File B).[24] This included a 'public pledge', where Fish & Chip Shop owners/managers detailed what changes they would make, how and when these would be delivered, and how confident they were to deliver them. Owners/managers were encouraged to keep these pledges. We completed a template for intervention description and replication (TIDieR) checklist [25] (Supplementary File C).

Following the engagement event, owners/managers were offered two copies of one of two different A0 size posters promoting smaller portion meals for their shops (Figure 1). These were delivered to shops within 16 days. HC suggested that one poster could be displayed in-store, and the other made visible to passers-by. Additional incentives offered by HC were 100 units of the box packaging chosen by the owner/manager and HC customer loyalty scheme points.

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158

159 **Figure 1. Promotional A0 size poster options**

160

161 Additional intervention delivery was undertaken by HC sales staff who visited owners/managers who
162 had expressed an interest in the engagement event but had not attended. An overview of the
163 information presented at the event was provided to owners/managers and they were asked to
164 complete the goal-setting form, offered the incentives and posters, and the recording of sales data
165 was explained (see below).

166

167 **Recruitment to the intervention**

168 HC purposively selected shops in northern England to be invited to the engagement event with the
169 aim of recruiting shops: located in a range of socio-economic settings; both within and outside major
170 conurbations; and either known to be likely to engage or whose likelihood to engage was unknown.

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HC sent a postal invitation one month prior to the engagement event. This included a tailored message to the owner/manager with an invitation for them to attend along with a member of their staff. Owners or managers who did not respond were contacted by phone by HC.

Study design

We used an uncontrolled before-and-after study design to explore the feasibility of working with HC to co-design and deliver the intervention and its acceptability to Fish & Chip Shop owners/managers and their customers.

Data collection

Fish & Chip Shop owners/managers

Data collected about owners/managers who attended the engagement event or took part in one-to-one visits included: owner or manager status; number of Fish & Chip Shops owned (if owner); and whether they attended the engagement event with a member of their staff. We recorded details on each shop's: geographical location; local authority; location description (e.g. city centre, village high street); Indices of Multiple Deprivation (IMD) decile of location;[26] seating provision; and Food Standards Agency food hygiene rating.[27]

Goal-setting

A digital image was taken of all completed goal-setting forms, to record pledged changes.

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192 *Covert observations*

193 To provide objective measures of change, covert data collection was completed in a subset of
194 participating shops that were accessible to the research team, at three time points (baseline, two
195 and six weeks post-intervention). Members of the research team posed as customers. Data collected
196 included the visibility (including the display of promotional posters) and availability of smaller portion
197 meals. One regular size meal and one smaller portion meal (where available) was purchased from
198 each shop. The shop menu description of the smaller portion meal was recorded as was the
199 packaging used and meal cost. The components (battered fish, chips) of meals were weighed within
200 two hours of purchasing.

201

202 *Sales of Fish & Chip meals*

203 Participating shops were provided with a booklet to record sales of regular and smaller portion meals
204 from at least five days before to at least five days after first receiving the posters.

205

206 *Customer survey*

207 Following the completion of the six-week post-intervention covert data collection, a customer survey
208 was conducted in participating shops (Supplementary File D). Interviews were conducted in-person
209 after customers had ordered their food but before food had been served. Questions covered
210 customer gender, age-group, awareness of availability of smaller portion meals, views on meal
211 portion size and purchasing behaviour including: frequency of and reasons for purchasing; whether
212 they had tried smaller portion meal; and willingness to try smaller portion meals in the future.

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Semi-structured interviews

All shop owners/managers who engaged in the intervention were invited to participate in a semi-structured interview, either in-person or by telephone, to explore their experience of the intervention (Supplementary File D), conducted by LG. Interviews were also conducted with those responsible for development and delivery of the intervention at HC to explore their experiences of the intervention (Supplementary File D). Interviews with HC were conducted by a researcher, FHB, not involved in intervention development and delivery.

Data analysis

Descriptive statistics (sample size, means, proportions), conducted in R (LG), were used to summarise quantitative data but not for the purpose of statistical inference.[28] Interviews were transcribed verbatim checked for accuracy and then anonymised. Thematic framework analysis with constant comparison was used to identify themes related to feasibility and acceptability of the intervention.[29] The coding framework for each set of interviews was based on a priori themes from the interview topic guides and emergent themes from the data. The final coding framework was then applied to all transcripts and the resulting themes were reviewed and agreed upon by team members involved in the analysis (LG, AA & MWh).

RESULTS

Recruitment and retention

Thirty-one Fish & Chip Shop owners or managers were invited to attend the engagement event. Of these, 15 (48%) stated an intention to attend, nine (29%) attended and three did not attend but took part in one-to-one sessions with HC staff. Thus, 12 took part in the evaluation (39%) (Figure 2).

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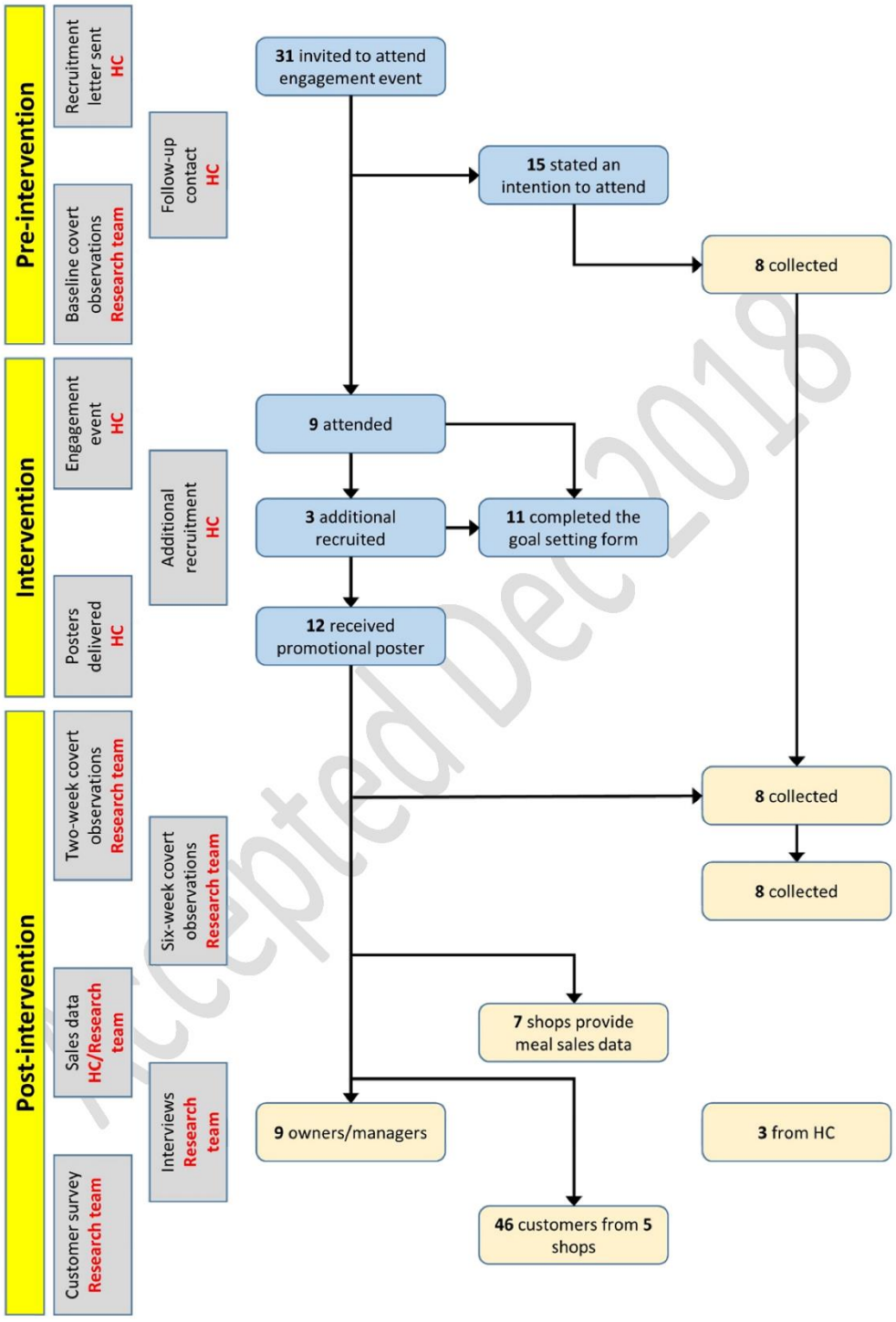

238

239 **Figure 2. Portion control intervention participation and data collection flowchart**

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240

241 **Shop setting**

242 Shops were spread across nine local authorities. Six of the 12 shops provided seating. Shops were
243 located in areas across all IMD deciles.[26] The FSA hygiene rating of the shops was high, with ten
244 receiving a maximum rating of five (Table 1).

245

246 **Goal-setting**

247 Eleven owners/managers completed the goal-setting form. All considered that they were already
248 providing all of their customers with opportunities to purchase smaller portion meals in some form.
249 The principal change to usual business practices that could be inferred from the forms was a public
250 pledge to promote smaller portion meals, primarily through displaying posters (n=5; Table 1).

251

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252 **Table 1. Summary of data collected**

	Shop-level summary (count)	Individual Fish & Chip Shop											
		ID01	**ID02**	**ID03**	**ID04**	**ID05**	**ID06**	**ID07**	**ID08**	**ID09**	**ID10**	**ID11**	**ID12**
Participant position	Owner = 11 Manager = 1	Manager	Owner	Owner	Owner	Owner	Owner	Owner	Owner	Owner	Owner	Owner	Owner
Number of total Fish & Chip Shops owned	Own 1 = 10 Own > 1 = 2	1	1	7	1	1	1	1	1	1	2	1	1
Attended the engagement event (number attendees)	Yes = 9 No = 3	Yes (2)	Yes (2)	Yes (1)	Yes (2)	No	Yes (1)	No	Yes (1)	Yes (2)	No	Yes (1)	Yes (1)
Completed goal-setting form	Yes = 11 No = 1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Public pledge		"Smaller box"	"Smaller box/ Display poster"	"Smaller portion"	"Already doing"	"Advertising"	"Will promote smaller portion"	"Already using"	"Will display promotion posters"	"Bio box"*	Not completed	"Already doing"	"Display poster & use on social media to promote lite bite"
Covert observations conducted	Yes = 8 No = 4	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Semi-structured interview	Yes = 9 No = 3	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Number of customers surveyed	Shop n = 5 Customers n = 46	7	0	0	4	0	13	0	0	10	12	0	0
Semi-structured interview	Yes = 9 No = 3	Yes (person)	Yes (telephone)	No	Yes (person)	Yes (person)	Yes (person)	No	No	Yes (telephone)	Yes (person)	Yes (telephone)	Yes (telephone)
Shop region	North-East = 8 Yorkshire = 3	North-East	North-East	Yorkshire and The Humber	North-East	North-East	North-East	North-East	North-East	Yorkshire and The Humber	North-East	North-West	Yorkshire and The Humber

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	North-West = 1												
Shop location description		Centre of a rural village	Residential area of a market town	Residential area of a city	Shopping centre in a residential area of a metropolitan borough	Shopping centre in a residential area of a metropolitan borough	High street in a seaside town in a metropolitan borough	High street in a seaside village in a metropolitan borough	High street in a seaside town in a metropolitan borough	Centre of a rural village	High street in a seaside town in a metropolitan borough	City centre	High street in a residential area of a metropolitan borough
Sit-in restaurant	Yes = 6 No = 6	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	No
IMD decile (where 1 is most deprived 10% of LSOAs)		9	4	7	1	3	8	5	8	9	7	3	5
Shop FSA hygiene rating (0 to 5, where 0 is low and 5 is high)		5	5	3	5	5	5	5	5	5	4	5	5

253 * Bio boxes constructed from biodegradable material extracted from sugar cane.

254

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255 **Covert observations**

256 We collected observational data from eight shops (Table 2). At baseline, only two shops clearly
257 displayed availability of smaller portion meals. During at least one of the post-intervention visits
258 (two or six weeks), all eight shops displayed availability of smaller portion meals. At baseline, one
259 shop had smaller portion meals on their main menu, two provided smaller portion meals on their
260 lunchtime menu only, two on their children's menu only, and two had no smaller portion meals on
261 any menu. Post-intervention, five of the eight shops actively promoted smaller portion meals using
262 an in-store facing poster, and two also displayed a poster facing outside. Of the other three: one
263 actively promoted their own branded smaller portion meals throughout but did not displayed the HC
264 posters; another had introduced a smaller portion meal by the six-week follow-up; and one only had
265 a smaller portion on the children's menu. All but one shop used box packaging at baseline and all did
266 so at follow-up.

267

268 Between baseline and six-week follow-up, we observed a 24g increase in mean weight of battered
269 fish, a 61g decrease in mean weight of chips, and a 37g decrease in mean total meal weight of
270 regular meals. With regards to the smaller portion meals, we observed a 2g decrease in mean weight
271 of battered fish, a 26g decrease in mean weight of chips, and a 27g decrease in mean total meal
272 weight.

273

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274 **Table 2. Summary of covert observation data collected from each shop**

		Post-intervention	
	Baseline	Two-weeks	Six-weeks
Clearly displaying smaller portion meals available to all customers	Yes = 2 No = 6	Yes = 7 No = 1	Yes = 6 No = 2
Smaller portion meals available to buy	Yes = 6 No = 2	Yes = 6 No = 2	Yes = 8 No = 0
Active promotion of smaller portion meals	NA	Yes = 5 No = 3	Yes = 4 No = 4
Packaging used for regular meal	Boxes = 7 Paper = 1	Boxes = 8	Boxes = 8
Weight of regular meal (g): battered fish	Mean = 265.1	Mean = 277.9	Mean = 289.3
Weight of regular meal (g): chips	Mean = 399.9	Mean =384.9	Mean = 339.1
Weight of regular meal (g): total	Mean = 665.0	Mean = 662.8	Mean = 628.4
Packaging used for smaller portion meal	Boxes = 6	Boxes = 6	Boxes = 8
Weight of smaller portion meal (g): battered fish	Mean = 175.7	Mean = 170.7	Mean = 174.0
Weight of smaller portion meal (g): chips	Mean = 273.0	Mean = 233.7	Mean = 247.4
Weight of smaller portion meal (g): total	Mean = 448.7	Mean = 404.3	Mean = 421.4
Cost of regular meal (£)	Mean = £5.80	Mean = £5.79	Mean = £5.79
Cost of smaller portion meal (£)	Mean = £4.22	Mean = £4.07	Mean = £4.00

275

276 ## Sales of Fish & Chip meals

277 Seven shops returned usable sales data covering a mean of seven days pre- and 32 days post-
278 delivery of the posters. However, this was inconsistent in format and detailed analyses were not
279 possible. The mean proportion of all meals sold which were smaller portion was 14.2% pre-
280 intervention and 21.2% post-intervention. One shop did not return sales data due to illness, the
281 remaining three did not provide a reason.

282

283 ## Customer survey

284 Five owners/managers permitted customer surveys to be conducted in their shops (Table 1). A total
285 of 46 questionnaires were completed (Table 3). Most customers surveyed bought meals once a
286 month or more, choosing the shop for taste or convenience. Most were aware that smaller portion
287 meals were available (72%) though only 20% had purchased them. Of those who had not previously
288 tried smaller portion meals, 46% said they would be interested in trying them in the future.

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289

290 **Table 3. Customer survey responses**

Variable	Level	n (%)
Gender	Female	21 (46)
	Male	25 (54)
Age category	18 – 30	10 (22)
	31 – 40	11 (24)
	41 – 50	2 (4)
	51 – 60	8 (17)
	61 – 70	7 (15)
	> 70	8 (17)
Regular customer	Yes	35 (76)
	No	11 (24)
How regular	More than once a week	2 (4)
	Once a week	10 (22)
	Once every 2 weeks	4 (9)
	Once a month	10 (22)
	Once every 3 months	6 (13)
	Once every 6 months	5 (11)
	Once a year	0 (0)
	First time	9 (20)
Reasons for buying (up to 2 choices)	Taste/Quality	29
	Convenience	32
	Price	3
	Portion size	0
	Other	1
Portion sizes	Too small	0 (0)
	Just right	36 (78)
	Too big	2 (4)
	NA (first time customer)	8 (17)
Know about small portion	Yes	33 (72)
	No	13 (28)
Notice posters (where known to have been displayed)	Yes	10 (37)
	No	17 (63)
Tried the promoted smaller portion meals	Yes	9 (20)
	No	37 (80)
Try in the future	Yes	17 (37)
	No	20 (43)
	NA (previously tried)	9 (20)

291

292 **Semi-structured interviews**

293 *Interviews with owners/managers*

294 Interviews were conducted with eight owners and one manager, five in person and four by

295 telephone (Table 1). Thematic analysis identified six main themes.

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296

297 *Relationship between owner/manager and Henry Colbeck Limited*

298 Those who had attended the engagement event were more enthusiastic about the process than
299 those who received the intervention in a one-to-one session. They reported that the event provided
300 a *"unique"* [ID06, ID04] opportunity to speak about an industry matter with their peers. They were
301 impressed with the speakers, but did not value the goal-setting form. Participants felt well-
302 supported by HC throughout. While they appreciated the incentives offered by HC they did not feel
303 these were necessary.

304

305 *Suggested changes and smaller portion meal definitions*

306 All respondents considered they were already providing smaller portion meals in some form at
307 baseline. For most, therefore, the intervention constituted the posters; whereas others reported
308 developing a detailed strategy to promote smaller meal portions. One owner suggested industry-
309 wide standards regarding portion sizes but acknowledged that *"universal adoption"* [ID12] was
310 unlikely.

311

312 *Posters and shop setting*

313 There was a mixed response to the posters. Some respondents felt they were *"really good… it really*
314 *just says it all… it's [poster] very relevant to our business"* [ID05], whereas others felt they did not fit
315 with their shop's ethos. The only manager who attended the engagement event, stated that the
316 shop's owner felt the poster clashed with the shop's branding and did not display it [ID01]. Another
317 owner was highly critical stating that *"posters that big look stupid"* and suggested a preference for
318 alternative promotional material (e.g. leaflet), detailing the *"benefits of buying smaller"* [ID06].

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Importance of quality customer service

All respondents stressed the importance of high quality customer service to delivering smaller portion meals. One owner who had been involved in the Fish & Chip industry *"Pretty much all my life"* [ID09], had implemented numerous changes following the intervention with support from an owner who spoke at the engagement event. One owner who had been unable to attend the event, reported that they had not implemented smaller portion meals in the evening as they could not rely on serving staff to deliver these consistently [ID05].

Customer feedback

Few respondents reported receiving feedback on smaller portion meals from customers. However, one detailed the enthusiasm from a group of builders who had seen the posters and welcomed the change [ID09].

The ease of recording sales data

Those who provided sales data, reported that this had been straight forward. However, till systems limited the value of these for analyses.

Interviews with those who developed and delivered the intervention

Interviews were conducted with three people from HC. Thematic analysis identified five themes. In order to retain anonymity, the quotes below are not specifically attributed to a given intervention deliverer.

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Intervention deliverers' motivations regarding intervention delivery

HC representatives viewed individual shops as focused on daily sales meaning it was up to HC to take *"strategic long-term views of the industry"*. Respondents wanted shops to succeed in an increasingly competitive marketplace. They took responsibility for driving sector innovation and acknowledged that *"I need Fish & Chip Shops to stay in business because they pay my wages"*.

Considerations in development of the intervention

HC representatives stated that effective engagement on smaller portion sizes with owners/managers could only be achieved by highlighting the financial and customer service benefits. HC staff saw themselves as providing information and choice to their customers, *"It is up to the customer [business owner] to make that choice, we are not going to force them to do anything"*. They were also happy to take the lead on intervention development and delivery and the cost to HC was viewed as an *"investment"*.

Intervention deliverers' views on acceptability

Representatives of HC were disappointed with attendance at the engagement event (9 of 31) and were frustrated that some shops *"didn't realise the potential"*. While many had not provided a reason for non-attendance, some reportedly told HC that it was due to staffing issues. However, the responses HC received from those who did attend were positive, *"I had quite a lot of people ring up and thanking me for the event"*, and they had viewed it as a rare *"interactive"* event: *"Fish fryers in the same room sharing ideas and you could see people writing down notes and bringing up their own problems. Other people were listening, engaging and offering advice and help. That doesn't happen often enough"*.

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HC staff were aware that not all businesses would display the posters, with some owners/managers reporting that they were too big. However, they felt that it was important to provide the means to clearly distinguish between regular and smaller portion meals.

HC also viewed the incentive component of the intervention as an act of *"goodwill"* showing their commitment to the intervention. They did not see incentives as imperative to owner/manager involvement and, indeed, not all shops took advantage of them.

Future plans

As a direct result of this work, HC staff developed specific packaging for smaller portion meals and associated promotional material. At the time of interviews they were also trying to source smaller fish fillets for this new packaging.

While HC staff saw smaller portion packaging as a sustainable change, more sustainable methods of delivering the portion control message were required. The engagement event and one-to-one visits were not considered scalable or efficient, *"I can't go around and visit thousands of Fish & Chip Shops because I am only one person"*.

Experience of working with the research team

HC staff found working with the research team a positive and *"enjoyable experience"*. It had *"re-stimulated our [HC's] efforts"* and was felt to be rewarding for both parties.

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DISCUSSION

Statement of principal findings

We found it was feasible to co-design and deliver an intervention to promote smaller portions with a commercial partner and the intervention was acceptable to both Fish & Chip Shops and their customers. Attendees at the engagement event valued and enjoyed it. Shop owners/managers were broadly willing to introduce and promote smaller portion meals. We successfully measured portions sizes and collected some sales data. We observed a reduction in the size of both regular and smaller portion meals after the intervention and an increase in the proportion of meals sold that were a smaller portion. The reduction in portion size of regular meals was due to reduction in chips – the least nutrient-dense component of the meal. As all participating owners/managers considered that their businesses provided smaller portion meals in some form at baseline, the additional overt promotion was broadly acceptable. Most also used box packaging at baseline meaning introduction of this was unlikely to be a key component of the intervention. The evaluation was conducted independently, avoiding the potential for competing interests of the commercial partners.

Strengths and limitations of the study

To our knowledge, this is the first study to evaluate the feasibility of working with a wholesale supplier to co-design and deliver a public health intervention, and to demonstrate the potential role of wholesale suppliers in improving the food offerings from hot food takeaways.

Covert observations, while feasible, would be resource intensive in a larger study. While participating shops had high FSA hygiene ratings,[27] they covered a wide range of IMD deciles,[26] suggesting the intervention may be feasible across a range of socio-economic settings. Acceptability to shops with lower hygiene ratings is unknown. Participants did not feel goal-setting through the

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'public pledge' was useful. Greater clarity concerning what was expected of shop owners/managers may have improved this. Some shops did not make use of posters and other marketing materials, such as leaflets, may have engaged a wider range of shops. We did not conduct in-depth interviews with customers and these would provide more insight into their choices and preferences. Some aspects of the intervention were not felt to be sustainable by HC and further thought is required to determine how any such intervention could be scaled-up. We collected no data on customers' total diets or total population impact.

Due to time and resource constraints our data is unlikely to be representative. Furthermore, we did not reach data saturation in interviews, nor was our customer survey validated or piloted prior to use. Our findings may not be generalisable beyond the UK.

Strengths and limitations in relation to other studies

There are a limited number of intervention studies targeting takeaways in England, and few have been evaluated.[23] Most interventions to date have been delivered by local authorities, limiting their geographical reach. Suppliers, such as HC, have a much greater geographical reach. While mandatory approaches to portion control may be more effective than voluntary schemes,[30, 31] these may be harder to implement.[32, 33] Our intervention is a rare voluntary, industry-led approach to portion control. Difficulties engaging independent takeaways in public health interventions have been previously described, where simply identifying a given takeaway owner can be challenging.[17] The 29% recruitment rate we achieved compares favourably to other interventions in the sector; in another, unpublished, local authority-led study we achieved a 10% recruitment rate.[34] We received limited feedback from those who did not attend the engagement event, although lack of staff cover may be a problem.

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436

437 **Study implications**

438 Our findings suggest that, within the takeaway sector, it is feasible to develop a supplier-led
439 intervention based on 'providing information' and 'enabling choice'[35] and that this is acceptable
440 across stakeholders. We highlight the importance of product specific packaging that constrains
441 portion size, which can, in part, offset variability in servers' ability to deliver consistent portions. HC's
442 smaller portion box packaging was designed and branded to deliver a smaller sized 'Lite-BITE®'
443 meal.[36] Sales of these boxes provide evidence of longer-term viability; in 2017 HC sold 552,300
444 units of the 'Lite-BITE®' boxes to 253 unique accounts [D. McLean, personal communication, 2018].
445 Takeaway owners/managers seem likely to be more receptive to messages about portion control
446 from peers than external organisations, framed primarily in the context of the potential financial
447 benefits. The individual responsible for implementing changes in a takeaway (usually the owner or
448 manager) may require clear and practical instructions on how to make changes. Ideally,
449 interventions should seek to engage with takeaway owners, or those responsible for branding, and
450 this person should communicate changes to serving staff, within the wider context of good
451 'customer service'.

452

453 **Unanswered questions and future research**

454 HC are not planning further engagement events. An alternative platform to deliver the information
455 and guidance in a collective format may be required to maximise the potential of smaller portion
456 packaging (e.g. seminars at trade events). While the promotion of smaller portion meals was broadly
457 acceptable, over half of the customers surveyed, that had not previously purchased the smaller
458 portion meals, were not interested in trying in the future. However, smaller portion meals were
459 clearly attractive to others. Further work is required to assess whether and how customer choices
460 can be further changed.[35] Qualitative interviews with customers could usefully inform this,

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inclusive of their views with regards to meal value-for-money. Future research could explore the impact of smaller portion meals in Fish & Chip Shops on customers' diet and the wider public health implications, as well as the potential to promote smaller meal portions through trade organisations and their events. Owners and managers would additionally benefit from a clearer definition of what constitutes a smaller portion meal from a practical perspective. Defining and developing guidelines to support delivery would be of use.

While this intervention was feasible in a sample of Fish & Chip Shops, further work should seek to identify other sectors of the takeaway and wider catering industry where such an approach could be applied.

ETHICS

The study received ethical approval by the Newcastle University Research Ethics Committee. All Fish & Chip Shop owners/managers and those from HC who delivered the intervention provided written informed consent prior to participation. All customers who participated in the customer survey were provided with study information and provided oral consent prior to participation. Owners/managers were not required to give specific consent for the covert observation component of the data collection.

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ACKNOWLEDGEMENTS

We thank Duncan McLean (director) and Bill Colbeck (chairman) of Henry Colbeck Limited for their time and commitment of resources to delivering the intervention, as well as their patience, understanding and respect of the study's research process. We would also like thank Laura Cutler,

484 Eimear Duffy, Joel Halligan, Eimear Mullen and Maisie Rowland from the Human Nutrition Research
485 Centre, Newcastle University who provided invaluable help with data collection.

486

487 **FUNDING**

488 This paper presents independent research funded by the National Institute for Health Research
489 (NIHR) School for Public Health Research (SPHR). The views expressed in this publication are those of
490 the author(s) and not necessarily those of the NHS, NIHR or the Department of Health. The SPHR
491 was not involved in the design of the study, analysis, interpretation of data nor writing the
492 manuscript.

493

494 This research was part of the SPHR funded project: *Transforming the 'foodscape': development and*
495 *feasibility testing of interventions to promote healthier takeaway, pub or restaurant food,* with
496 additional support from Durham and Newcastle Universities, SPHR is funded by the National
497 Institute for Health Research (NIHR). At the time of funding SPHR was a partnership between the
498 Universities of Sheffield, Bristol, Cambridge, Exeter, University College London; The London School
499 for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and
500 Lancaster; and Fuse, the Centre for Translational Research in Public Health, a collaboration between
501 Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. Authors LG, FHB, NH, VAS,
502 LP, CDS, AAL and AA are members of Fuse. Funding for Fuse comes from the British Heart
503 Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council,
504 the National Institute for Health Research, under the auspices of the UK Clinical Research
505 Collaboration, and is gratefully acknowledged. AA is funded by the NIHR as a NIHR Research
506 Professor. JA and MWh are funded by the Centre for Diet and Activity Research (CEDAR), a UKCRC
507 Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Cancer
508 Research UK, Economic and Social Research Council, Medical Research Council, the National Institute

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for Health Research, and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.

COMPETING INTERESTS

The research funding contributed to the cost of design and production of some of the intervention materials. HC also contributed to the costs of intervention development and funded delivery. HC developed and sell the 'Lite-BITE®' Fish & Chip meal boxes detailed in the study. Neither the project, nor individual researchers, received financial contributions from HC for this study or any other work.

MWh is funded by NIHR as Director of its Public Health Research Funding Programme. AA is funded by NIHR as a Research Professor and the National Director of NIHR SPHR. CS and MWh are principal investigators in the NIHR SPHR. MWo led and delivered the intervention and provided the packaging materials; at the time of the research he was an undergraduate student at Newcastle Business School, Northumbria University on secondment to HC. After completion of the study (and his degree programme at Northumbria University), he became an employee of HC.

Henry Colbeck Limited

HC an independent supplier to over 2,500 Fish & Chip Shops in the North-East of England, Yorkshire, Cumbria and Scotland. HC is a private limited company founded in 1893 and based in Gateshead, North-East England. Company number 00822749 (www.colbeck.co.uk).

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DATA SHARING STATEMENT

Anonymised data relating to the covert observations, sales of Fish & Chip meals, customer survey and semi-structured interviews are available on reasonable request from the corresponding author (LG).

AUTHOR CONTRIBUTIONS

JA, VAS, CDS, AAL, MWh & AA devised the concept for the Foodscape project. MWo developed the intervention with support from LG, FHB, VAS and AA. The evaluation study and associated methods were designed by LG, FHB, JA, VAS, LP, WW, CDS, MWh and AA. Data collection was overseen by LG and completed by LG, MWo, FHB, NH and AA. LG led on data analysis and drafting the manuscript, supported by MWh and AA. All authors provided critical comments on drafts of the manuscript, and read and approved the final version.

PATIENT INVOLVEMENT

No patients were involved in the study.

COPYRIGHT STATEMENT

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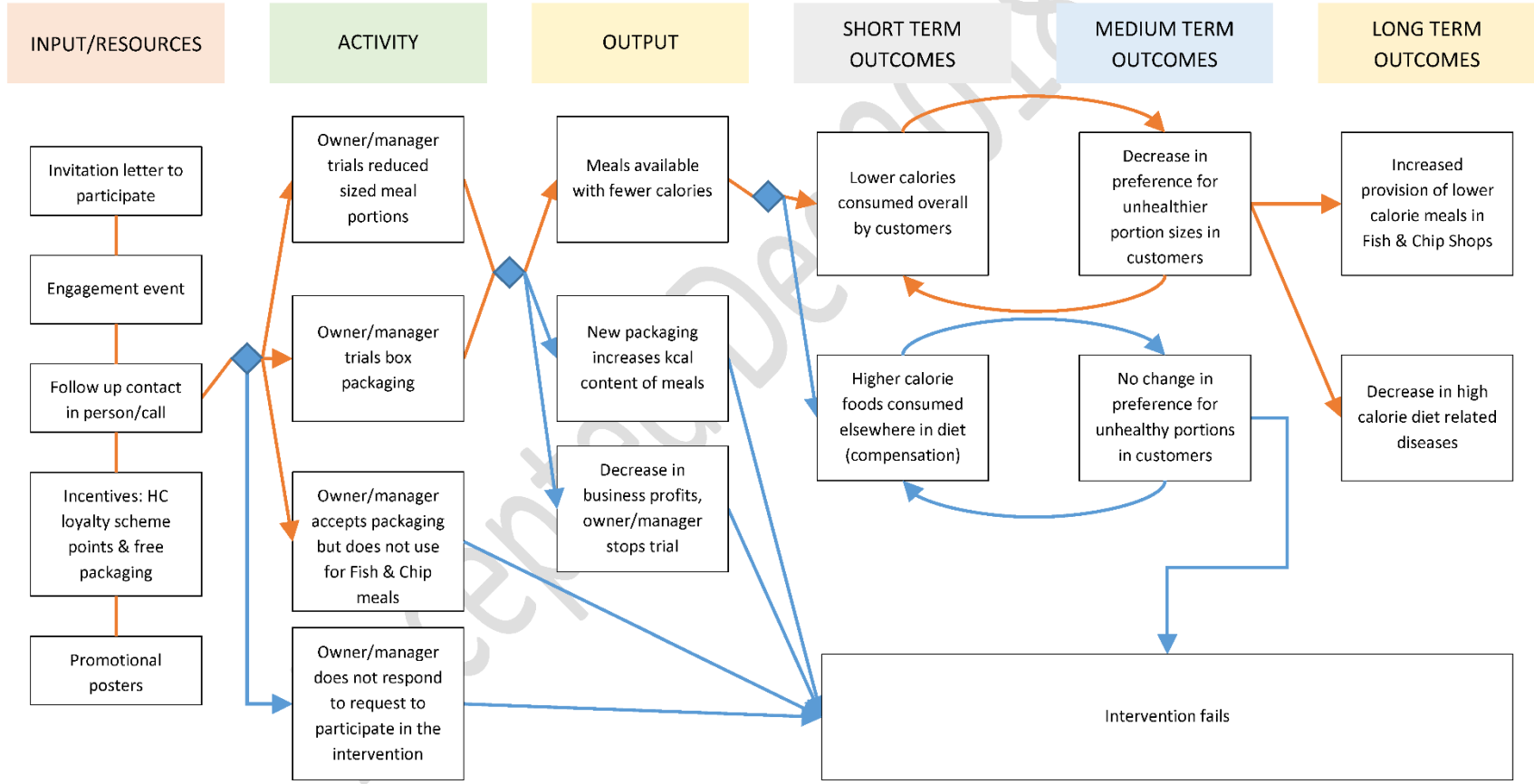
Supplementary File A: Logic model



Supplementary File B: Goal-setting form

Team Spirit Event, Henry Colbeck Limited,

Wednesday 6th April 2016

Business name: _____

Business representatives:

Name: _____ Role: owner/ manager/ staff (circle answer)

Name: _____ Role: owner/ manager/ staff (circle answer)

From the topics covered at this Team Spirit event; what are the things you could change in your business?

	1. Could your business make this change? (Y/N)	2. Are you willing to try this change? (Y/N)
Change to structured packaging: *e.g. introduce bio boxes*		
Make smaller portions available to your *customers* at *all times*		

Public Pledge: *Detail what, which and when you will change*

What to change? *Structured packaging /Smaller portions*	**Which packaging will you use for which change?** *Single compartment corrugated cardboard box/Double compartment corrugated cardboard box/Bio box/MK*	**When will you do it?** *Date*	**How sure (confident) are you that your business can achieve this?** *From 1-5 (1=not at all sure; 5= very sure)**
1.			
2.			

*1= not at all sure; 2= not very sure; 3= neither; 4= somewhat sure; 5= very sure

I give consent to be contacted both, by phone, or in person by Newcastle University to provide them with details of the:

- Packaging changes I have made (if any)
- The number of Fish & Chips portions (all sizes) sold before and after the project
- My comments and opinions of the Team Spirit event
- My comment and opinions of any changes I have made following the event

Additionally, I will allow Newcastle University to speak with a few of my customers to hear their thoughts.

Signed_____ Print Name_____

Phone Number (and best time to call) _____

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Packaging key:

- Corrugated cardboard boxes are available in either single or double compartment versions. The double compartment boxes provides separate compartments for each of the Fish & Chip meal components.
- The Bio box packaging are a single compartment box constructed from biodegradable material extracted from sugar cane.
- MK packaging are a single compartment box constructed of non-corrugated food grade cardboard.

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Supplementary File C: TIDieR checklist

Description of the portion control engagement event using the template for intervention description and replication (TIDieR) checklist.[1]

1. Name	Engagement event – Henry Colbeck Ltd
2. Rationale, theory, goal	Fish & Chip meals from takeaways are generally characterised by large portion sizes.[2] People who eat more meals away from home tend to eat more calories per day [3] and consumption of takeaway meals has been linked to weight gain [4] and diet-related diseases.[5] A systematic review revealed that a person consumes more when presented with a larger-sized portion.[6] The behaviour change techniques [7 8] used during the training were: • Providing information on behavioural outcomes • Instruction on how to perform the behaviour • Demonstration of behaviour/credible source/vicarious consequences • Information about others' approval • Pros and cons • Behavioural practice/rehearsal • SMART goal setting (behaviour) and action planning • Behavioural contract • Adding objects to the environment • Self-monitoring of behaviour (sales) • Monitoring of behaviour by others without feedback • Reward (outcome)/Material Incentive • Financial incentive/form for specific goods [8] Aim of the intervention: To increase the provision and promotion of smaller portion meals available to all customers throughout all opening hours and/or increased/renewed focus on portion control across all meals.
3. Materials	Information provision on the consequences of behaviour and behaviour change opportunities, presented by owners of established Fish & Chip Shops and the supplier. Owners, managers and their staff of Fish & Chip Shops that attended were presented with details, primarily financial, of the benefits of effective portion control and the promotion and provision of smaller portion meals. These were predominantly in the form of PowerPoint presentations, but also included further visual aids such as the displaying of a locally purchased Fish & Chips meal on an 11 inch plate to illustrate the volume of food delivered.

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	Participants were asked to read and sign a 'public pledge' as part of the goal setting form that stipulated which proposed activities they could and would be willing to make in their business. Owners/managers were offered, by the supplier, two incentives to support fulfilment of the pledges. These were loyalty scheme points (financial) and a free case (100 units) of box packaging of their choosing (specific goods). Additionally, they were offered free posters to promote the availability of the smaller portion meals to the shop's customers. The research team also provide a booklet to record Fish & Chip meal sales during the evaluation period to monitor sales behaviour. A free lunch was included as part of the engagement event for all those that attended.
4. Procedures	Fish & Chip Shop owners/managers were invited via a postal communication from the supplier one month prior to the engagement event. On the day of the event, participants were invited to a hotel in close proximity (under 3km) to Henry Colbeck Ltd's office and warehouse facility. There was a range of presentations delivered from both the perspective of the supplier, Henry Colbeck Ltd and Fish & Chip business owners, as well as study data collection requirements from the research team (LG). Henry Colbeck Ltd's presentations set out the reasons for initiating the event, and contextualised existing portion sizes in the Fish & Chip industry in relation to both an adult's diet as well as other sectors of the fast-food industry. They detailed the packaging available to support improved portion control and smaller meal portion delivery. They also stated the items that they would provide to incentivise shop participation. One business owner (Owner A) detailed his experience of delivering highly regulated portion sizes, as well as the benefits to his business of providing a range of smaller portion meals. This included knowing one's target portion size, selecting the appropriate packaging, staff training, sales and profit margins of smaller meals. A second business owner (Owner B) detailed the experience of the implementation and financial success within his shop of smaller portion meals. LG detailed what data the research team intended to collect as part of the evaluation. Following the presentations, participants were provided with lunch and refreshments, followed by a question and answer session before the close.

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	Promotional material was provided through the sales team at Henry Colbeck Ltd and owners/managers ordered the free case of packing using their usual method of ordering through Henry Colbeck Ltd.
5. Who provided	The educational material delivered by Henry Colbeck Ltd were developed by themselves in conversation with the research team. Additionally, Owner A, created his own presentation material and Owner B, presented without supporting material. The goal setting, action planning and pledge form (behavioural contract) was developed by the research team, guided by VAS, health psychology expert. The research team provided all material to enable participants to record sales data in the required format.
6. How	Training delivered in person in a group session.
7. Where	Hotel, in close proximity to Henry Colbeck Ltd's office and warehouse facility, Gateshead.
8. When and how much	One session approximately three hours.
9. Tailoring	The material provided were tailored specifically to Fish & Chips Shops that offered a takeaway service.
10. Modifications	This was the first time the intervention had been delivered. However, previous material circulated by Henry Colbeck Ltd to its customers had been adapted and incorporated accordingly to the setting of delivering the information 'in-person'.
11. Planning/fidelity (ways to maintain fidelity)	Members of the research team attended the engagement event to assess if it was delivered as intended. As the event was a one-off no strategies were implemented to maintain or improve fidelity.
12. Actual fidelity	All presentations were delivered as intended. However, the goal setting activity was not. Participants had little time to complete the form and no support. During follow-up interviews many could not recall completing this or had not seen any value in the pledge.

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Supplementary File D

Customer survey

Interviewee ID	
Business name	
Date	

Fish and chip shop use

1. Do you use this fish and chip shop regularly?

Yes	No
☐	☐

2. What do you mean by regularly?

More than once a week	Once a week	Once every 2 weeks	Once a month	Once every 3 months	Once every 6 months	Once a year	First time
☐	☐	☐	☐	☐	☐	☐	☐

3. What are the main two reasons why you come to this fish and chip shop?

Taste/Quality	Convenience	Price	Portion size
☐	☐	☐	☐

Purchase behaviour

4. For how many people do you usually order for?

Write answer:

5. What do you normally order and what portion size? i.e. large/regular/smaller

Write answer:

Portion size

6. What do you think of the portion sizes here?

Too small	Just right	Too big
☐	☐	☐

Smaller portions

7. Are you aware of the smaller portions offered?

Yes	No
☐	☐

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8. Have you noticed the new posters or other forms of promotion in the shop?					
Yes ☐			No ☐		
9. Have you tried the smaller portions?					
Yes ☐			No ☐		
10. If not, would you buy it in future?					
NA ☐		Yes ☐		No ☐	
11. If yes, who for?					
Write answer:					
Other options					
12. Are there any meals/dishes/portion sizes you would like to see offered at this fish and chip shop?					
Write answer:					
Gender					
Female ☐			Male ☐		
Age category					
18 – 30 ☐	31 - 40 ☐	41 - 50 ☐	51 - 60 ☐	61 - 70 ☐	Over 70 ☐

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Owner/manager interview topic guide

Interviewee background

- Please could you introduce yourself and state your role in the business
- Do you have any other premises?
- How long have you been working in fish and chips?
- How did you get into fish and chips?
- What is special or unique about your business?

Engagement with the project

- Did you attend the engagement event?
    - Why did you decide to attend the event?
    - What did you think about the event?
        - Prompts:
            - Speakers
            - Material
            - Location, i.e. convenience
            - Venue & refreshments
            - Henry Colbeck and their staff
            - Information delivered
    - What did you like?
    - Did you learn anything new?
    - Did you speak with other owners?
    - Any missing stakeholders?
    - Was there any part of the event you thought was missing, disliked or would change?
    - Was it worthwhile attending?
- If you didn't attend, did you speak with Henry Colbeck about portion control?
    - What did they tell you about portion control?
    - Was any of the information new?
    - What changes did they ask you to make?
    - What made you choose to give the posters/smaller portions a go?
    - Anything further at the time of the visit that could have been offered or suggested to support you to make changes?
- Did you complete a pledge sheet/Do you remember the pledge sheet?

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Changes

- What changes have you made since attending the event?
    - Prompts
        - Increased awareness/regulation of portion control in your staff
        - Reduced portion sizes
        - Changed packaging
        - Introduced smaller portions
        - Put up poster(s)
- What's the role/importance of customer service?
- What response from customers?
    - Prompts
        - Changes in sales increase/decrease
        - Comments/Conversations
- Have you gained new customers?

Posters

- Where you offered both poster designs?
- Did you display them? And where? (possibly answered from previous questions)
    - If not, why not
    - If only inside/outside why?
- What did you think about the posters?
    - Prompts
        - Design
        - Wording
        - Appropriateness for your shop
- Any comments from customers? (possibly answered from previous questions)
- Could you suggest any changes?
- Will you keep the posters up?
- Did you do any further promotion?
    - Prompts
        - Staff led
        - Social media

Incentives

- What did you think of the incentives provided by Henry Colbeck?
    - Prompts
        - Loyalty scheme points
        - Free packaging
- Anything further you feel that they could have offered to support you in offering smaller portions/regulating portion size?

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Sales data

- Did you record sales data?
- Was it easy to keep track of sales data?
    - Prompts
        - Lunchtime/Evening service
- Were the sales booklets that we provided of use?
- Have any of the changes you've made been financially beneficial?

Portion control

- Prior to this engagement with Henry Colbeck was portion control something that you considered?
- As a result of the engagement with Henry Colbeck do you give greater consideration to portion control?
- Is it important to you and your business to offer your customers a range of portion sizes?
- Will you continue to monitor the portion size of your meals?

Future plans

- Are you happy with the changes?
- Will you stick with the changes that you've made?
- Do you plan to make any further changes?

AOB

- Is there anything further you'd like to add about this process?

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Intervention deliverer interview topic guide

Interviewee background

- Please could you introduce yourself and state your role in Henry Colbeck
- How long have you been working for Henry Colbeck?
- What do you feel separates Henry Colbeck from other suppliers in the industry?

Motivation for the work

- History of portion control
    - What work that you know of has been done broadly, what work has Henry Colbeck done specifically?
- Why were you interested in furthering such work (motives)?
    - What does your business stand to gain from such work?
    - Is it purely financial, or other broader enhancement of the industry?
- How did this specific work come to fruition?

Development

- What was your role in the development process?
- What was your role in the delivery process?
- How did you identify suitable project partners and speakers for the event?
- What role did the University research team play in the development of the intervention?
- Incentives, why were they chosen?
- Did it detract from your usual business operations?
- Was it costly to the business?

Engagement event

- Was it delivered as you had envisioned?
- What did you like most about the event?
- Any problems on the day?
- Any feedback from those that attended?
- Anything that you would do differently?

Posters

- Please could you detail the design process regarding the posters?
    - Prompts:
        - Costs
        - Time
        - Stakeholders
        - Designers
- You offered two posters, was there a preference for one over the other?
- Did you receive any feedback from owners?

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- Anything learnt for future poster production?

Incentives

- You offered both loyalty scheme points and a free case of packaging, how were they received?
- How important did you feel they were to getting businesses to trial the smaller portions?
- Is there anything else that you considered offering?

Packaging

- You have a wide range of different packaging, was there a particular type you were interested in promoting as part of this work?
- Does the active promotion of specific packaging types raise any issues with customers, for examples those customers that have their own branded packaging?
- Did you receive any useful feedback from your customers?

Your assessment

- Overall how have your customers responded to this work?
- Do you feel that this project has been significant increase in your efforts to promote portion control and smaller portions compared to previous efforts?
- What is your overall assessment of the project? Are you happy? Was this extra and unnecessary work?
- What were the major learning issues for you?
- Did anything surprise you?
- Did you personally enjoy the work?
- Anything you didn't enjoy or found frustrating?
- Anything that you would do differently?
- What does Henry Colbeck, gain from this work?
- What have you gained personally from this work?

Future plans for smaller portions

- You have continued to the develop packaging for smaller portions, please can you detail what further work you done since the work with the feasibility study
- What was your motivation to continue on with this work?
- How receptive have your customers been?
- Do you have any other future work or ideas regarding portion control or reduced sized portions that you would like to detail?

AOB

- Is there anything further you'd like to add about this process?

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8.5 MUR2 commentary

While the study did observe an increase in the proportion of smaller portion sizes sold from 14% to 21%, this cannot be interpreted as significance, nor was it tested for significance. As explicitly stated, this was a feasibility study to assess the acceptability of the intervention and the feasibility of the data collection methods. Further study with robust trial design, potentially as a randomised controlled trial, would be required to test for effectiveness. However, in this initial stage, I found that our data collection methods were feasible. For me, working with a commercial supplier (HC) to co-design the intervention was a positive experience. Our respective aims were clear to both parties from the start and information was shared in a spirit of collaboration with due care and diligence. No one from HC was involved in the analysis of the evaluation data nor the interpretation of the findings. This maintained a degree of separation between HC and the research team that ensured scientific integrity and avoided any potential conflicts of interest. Throughout, HC were responsive to my questions and queries. One difference I noted was that our respective organisations worked to different timescales: HC had to be responsive to market trends and their customer demands, which presented challenges to ensure robust research protocols could be in place to meet these demands. For example, once HC had realised that there was a market for specific packaging to cater for the smaller portions, they developed the Lite-BITE® packaging [236]. There was not sufficient time for me to process the evaluation data and feedback the findings to HC, in order for them to incorporate the findings in this product development. Despite this, HC were patient and understanding of the research process and have not used their involvement in the study for any promotional material to date. HC came from a position of knowledge and authority regarding packaging, claiming to be the first company to introduce corrugated cardboard boxes to the Fish & Chip Shop market [230]. Not only did they have a well-established relationship with FBOs, they were also able to identify those businesses with a high profile that may have greater influence over other businesses in the sector. One FBO who participated in the study was particularly complimentary about the experience of meeting with a well-known FBO from the Fish & Chip industry. He explained that following the event, they had kept up a dialogue that had supported other aspects of his business. Working with a wholesale supplier gave me access to FBOs of independent takeaways that otherwise would not have been achievable. This

level of engagement provided me with the knowledge and experience of the potential parameters for this and future interventions within independent takeaways. A potential limitation is that this relationship with the FBOs may have led to a potential selection bias. The purposive recruitment strategy for this feasibility study was led by HC, and included businesses that they felt would be more receptive to engagement. Therefore, any expanded trial would be unlikely to achieve the same recruitment rate as this feasibility study.

The most direct and quantifiable outcome of this research was the resultant development by HC of the smaller portion-specific packaging, the Lite-BITE® [236]. From 1 January 2017 to 31 December 2017, HC sold 5,523 cases (100 units) of the Lite-BITE® packaging to 253 unique accounts [237]. This potentially represents over half a million meals from approximately 10% of their estimated 2,500 customers (Fish & Chip Shops) across the North-East of England, Yorkshire, Cumbria and Scotland. This figure also excludes sales of the same product from their partner suppliers in the Q-Partnership: VA Whitley and Friars Pride, which between all three supply over 6,000 Fish & Chip Shops throughout the UK. However, it is still unknown what impact the provision of this packaging that 'enables choice' has at the customer level (i.e. in terms of calories consumed). But it does demonstrate that interventions that are commercially viable and have the potential to achieve public health goals may be viable. They can achieve rapid uptake in the independent sector and suppliers can play a crucial and effective role in leading such interventions. The success of the Lite-BITE® packaging, may in part explain HC current decision not run any further engagement events. It is presumably a more cost-effective method for HC to promote the packaging through their established sales network than through further specific engagement events as detailed in the feasibility study. Furthermore, due to respect by HC for the research process, they were conscious of not promoting the specifics of the engagement event during the evaluation period.

While the evidence strongly suggests that interventions linked to 'price', for example taxes and subsidies [159, 160], are more likely to have equitable impacts in relation to dietary health, particularly in comparison to voluntary interventions that require a high level of individual agency [158], the policy landscape in which public health interventions have to operate must be considered [page 82]. Currently, the UK Government has not published any mandatory nutritional legislation with regards to independent takeaways. Whilst I do not argue that regulatory measures should not be considered and modelled for potential impact,

it is important to understand the tools at our disposal. I would contend that my work with HC clearly demonstrates that there is a greater role for suppliers to play in improving the food offering within independent takeaways.

8.6 Chapter summary

The large portions delivered in independent takeaways remain a public health challenge. The provision of large portions leads to increased food consumption. Meal packaging could offer a solution to controlling portion size and providing smaller portion meals. Due to the proximal relationship with food business operators, suppliers could be an effective partner in this regard. We approached an independent specialist supplier to Fish & Chip Shops, Henry Colbeck Limited, to ask if they would be interested in co-designing an intervention to help with portion control and promotion of smaller meal availability. Both parties set out their respective positions on the partnership from the outset. Henry Colbeck Limited led on intervention delivery and the research team led and conducted the evaluation, independent of the suppliers' input or influence. Both food business operators and customers were accepting of the intervention. We observed a reduction in portion size in both regular and smaller portion meals and an increase in the proportion of smaller portion meals sold. This research demonstrated the feasibility of working with a commercial partner, without compromising scientific integrity, in delivering and evaluating an intervention in takeaways that either provides information or enables choice.

Chapter 9. Discussion

9.1 Principal findings

My research has shown that UK independent takeaways offer an important opportunity for interventions to promote healthier diets and that at least some standard practices are amenable to change. Takeaways have a pervasive presence across the country, clustering in low-income areas and broadly providing a nutritionally poor offering. In the UK, we are regular consumers of takeaway food, with one fifth of us eating such meals at least once per week [Adams et al. (2015a) page 30] [52]. This, coupled with the fact that higher habitual consumption is associated with greater energy intake [Goffe et al. (2017) page 42] [53] supports the argument that takeaway food is directly contributing to diet related diseases and obesity. The evidence is clear that legislative action that restricts or eliminates choice is the most effective and equitable at improving a population's diet. Such interventions are politically challenging and, to date, those specifically targeting independent takeaways have been entirely reliant on the voluntary engagement of FBOs, who are conflicted by their need for their business to generate a profit.

A key driver of takeaway consumption is convenience [page 56]. Therefore, interventions that exclusively target developing skills and knowledge to prepare food from scratch at home are unlikely to have a significant impact on our diet at a population level [Adams et al. (2015b) page 59] [54]. To date, interventions that target a change in the nutritional quality of food have had minimal impact in independent takeaways [page 84]. My qualitative research with intervention deliverers emphasised the challenging nature of this setting and expressed a need for targeted and tailored interventions [Goffe et al. (2018) page 97] [55]. Catering award schemes, which have dominated in this setting to date, have not been successful [page 87, Goffe et al. (2018) page 97] primarily because they do not account for the specificity of the takeaway operating environment, in particularly the primacy of the profit motive [Goffe et al. (2018) page 97] [55].

Covert ('stealthy') interventions, that have minimal impact on business practices, were viewed by intervention deliverers as more likely to be acceptable [Goffe et al. (2018) page 97] [55]. The 5-holed Fish & Chip Shop salt shaker cap is an example of a covert intervention that has seen wide acceptance among FBOs [page 115]. My evaluation of the 5-holed salt

shaker cap found that, in controlled conditions, it was effective in reducing the amount of salt delivered [Goffe et al. (2016a) page 116] [56]. Furthermore, its use in practice, is associated with lower relative sodium content in Fish & Chip meals than those meals served using an equivalent 17-holed shaker cap [Goffe et al. (2016b) page 116] [57].

Local authority-led resource intensive FBO engagement workshops were viewed to be more successful than light-touch approaches, such as the provision of tip sheets [Goffe et al. (2018) page 97] [55]. The takeaway Masterclass is an example of such an intervention that we found to be both feasible and acceptable to FBOs. However, further evaluation is required to determine the impact on both the food offered and customer behaviour [Hillier-Brown et al. (in submission) page 137] [58].

Local authorities have been charged with the responsibility of delivering interventions within independent takeaways [page 83]. As such, interventions that they deliver are geographically restricted to those takeaways within their jurisdiction. Furthermore, development and delivery can be resource intensive, which may have implications for affordability and sustainability. As identified by those in practice, involving others stakeholders may increase impact [Goffe et al. (2018) page 97] [55].

One largely neglected stakeholder group is wholesale suppliers to independent takeaways [page 89], who may offer an alternative and complementary approach. My work with one such supplier, Henry Colbeck Ltd, suggests that a co-produced intervention on portion size and portion control is both feasible and acceptable. Furthermore, the proximal and trusted relationship suppliers may have with FBOs, as well as their shared financial interests, may result in an improved recruitment, commitment and retention, in comparison with interventions delivered by local authorities alone [Goffe et al. (Accepted Dec 2018) page 188] [59]. Further work is required to determine impact and effectiveness.

It is my ethical duty to objectively report the potential impact of the interventions assessed in my research. While both the takeaway Masterclass and the introduction and promotion of smaller portion meals in Fish & Chip Shops have been shown to be feasible interventions, their impact on intake or diet overall was not assessed. Establishing impact on diet would require further pilot and effectiveness trials utilising a robust study design. The 5-holed salt shaker caps were associated with a statistically significant reduction in relative sodium

content, equivalent to 0.4g salt per 100g of food [Goffe et al. (2016b) page 116] [57]. However, the relationship between meal purchased and food consumed are unknown. Furthermore, out-of-home Fish & Chip meal consumption constitutes a relatively small proportion of our diet in the UK, estimated at approximately 4% for average consumers as estimated from the UK Living Costs and Food survey [238]. Therefore, at the population-level, the potential impact is likely to be minimal, but could be of benefit for frequent consumers of such food.

9.2 Strengths and limitations of the studies

The body of work presented here provides a comprehensive narrative regarding the influence of takeaway food within England and on those of us that each such food, an overview of established nutritional interventions delivered within the independent sector, and suggestions for best practice as well as the future direction of such interventions and the need for further research. My work involved a wide range of stakeholders, including intervention delivers, food business operators, suppliers and customers. I have taken account of the ecological model for intervention development, and have presented the case for wider stakeholder involvement, particularly suppliers, with evidence to support both feasibility and acceptability of this approach. I took appropriate steps and sufficient care to ensure that I avoided any potential conflicts of interest with commercial partners, maintaining a degree of separation, and analysed and interpreted data with full independence. I received no financial reward or recompense or gifts in kind for my research.

While the evidence presented for both the Masterclass intervention and the implementation of small portion meals in Fish & Chip Shops supports feasibility, we did not collect data regarding behaviour of consumers or their consumption. We collected robust evidence for the impact of the 5-holed salt shaker cap on resultant sodium content of Fish & Chip Shop meals, but again we collected no data at the point of consumption. Therefore, while my work adds to our understanding relating to the potential impact of interventions within takeaways, it does not provide evidence on whether such modifications to independent takeaway food environments have impacts at the point of consumption and ultimately on consumers' diet and health. Therefore while my research demonstrated intervention feasibility, further work is required to establish if either the Masterclass or the small portion meals in Fish & Chip Shops can have an impact and contribute to improving individual and/or

population diet. Further, trials should adopt a robust randomised control trial design to reduce the risk of bias.

In Chapter 1 I detail my research process, which included conversations with a range of stakeholders. Consideration of these conversations in isolation, could rightfully be seen as anecdotal. However, while these conversation served to increase my understanding of the context and setting of my research and build relationships they did not directly contribute to any of my published papers nor my manuscripts under review. Given this, rather than a limitation, I see the conversations as a strength, illustrating my immersion in my research subject.

9.3 Limitations of intervention methods

My published papers: PP5 and PP6, and manuscripts currently under review: MUR1 and MUR2, focused on pragmatic interventions in the UK takeaway sector. Such interventions are principally limited due to their downstream setting, which I acknowledge are not the most effective mechanisms to deliver a dietary change. They are fundamentally restricted due to the restraint that takeaways are commercial enterprises that have to generate a profit resulting in a permanent conflict of interests. However, the parameters of what interventions are feasible are dictated by the established neoliberal political ideology, the driver behind what Thaler & Sunstein (2003) coined 'libertarian paternalism'. This is the tenet that a person can be steered in the direction of health promoting behaviour, whilst preserving their sense of freedom of choice [239]. It was this doctrine that provided the supporting theory for *'nudging'*, and what the same authors define as:

> *any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives [239].*

Our environment is critical in supporting healthy behaviours. However, Thaler & Sunstein (2003) definition excludes those actions that are known to be most effective and equitable, that is fiscal and regulatory policies [240]. Nudges, such as the 5-holed salt shaker caps and the promotion of smaller portion meals may potentially have a modest population improvement, but at the same time such positive influences are in conflict with those negative nudges inclusive of meal deals and the increased value per calorie of the larger

portion meals that actively incentivise over-consumption. Therefore, in the existing absence of regulatory interventions, takeaway environments are shaped by those industry practices that are motivated by profit, maximising the customer's spend and likely leading to increased consumption [241].

Not only are the interventions likely to be modest in their impact, they are predicated on the engagement and cooperation of the FBO. From my own experience of delivering this research and those with experience of delivering interventions, discovering the identity of the FBO is a challenging task [Goffe et al. (2018) page 97] [55]. The takeaway Masterclass, which utilised the proximal relationship between the local authority and FBO recruited only 10% of all invited businesses [Hillier-Brown et al. (in submission) page 137] [58]. While the supplier-led intervention to promote smaller portions in Fish & Chip Shops, obtained a higher rate of engagement, this is likely to be subject to selection bias and may not reflect a wider acceptance of willingness to engage across the sector [Goffe et al. (Accepted Dec 2018) page 188] [59].

As my research took a pragmatic approach to intervention, it focused on what methods were feasible and acceptable to deliver within existing independent hot food takeaways. As stated above, these are dependent on the voluntary engagement of an outlet's FBO. While top-down national policy-led interventions such as the Soft Drinks Industry Levy (which include produce sold within takeaways but not exclusively targeting these outlets) provide an example of how fiscal interventions can be applied to improve our foodscape, as of date of publication, there are no such policy interventions in the UK that specifically target the food in hot food takeaways. Whilst I have given consideration to policy measures that could be potentially more effective, they were not the focus of my intervention research, and the literature cited reflects my focus on voluntary interventions within the hot food takeaway foodscape.

9.4 Interpretation in relation to other studies

As Hillier-Brown et al. detailed in their systematic mapping and evidence synthesis, there are '*very few interventions involved working upstream with food suppliers, generating customer demand, changing competition effects, or reducing portion sizes*' [47]. My work, while not able to address all these issues, certainly adds to the evidence base relating to the potential

for working with food suppliers, in this case in reducing portion sizes (or at least the feasibility of providing customers with the option to purchase a smaller portion meal).

Hiller-Brown et al. also emphasised that the majority of existing interventions do not operate at a population level [47]. While politically challenging to implement in comparison to interventions that operate at the individual level [page 82], those that reduce individual agency are more likely to have a broader impact [158]. All three of the interventions evaluated in the work presented here, were considered in the context of potential population impact. The 5-holed salt shaker cap is now ubiquitous and has low impact on business operation or viability. Therefore, its potential for public health impact is high. However, further modelling work is required to estimate the likely impact on total salt intake, blood pressure and associated health outcomes such as stroke and CVD [Goffe et al. (2016b) page 116] [57]. The takeaway Masterclass was deemed to be feasible [Hillier-Brown et al. (in submission) page 137] [58]. However, there was minimal objective evidence of change and the study was limited geographically. Further work is required with the Masterclass to increase participation and assess effectiveness before estimating the potential public health impact. The work with the Fish & Chip Shop supplier, Henry Colbeck Ltd, achieved a higher recruitment rate of independent takeaway FBOs in comparison to the Masterclass. A key facilitator is likely the trusted and mutually beneficial relationship between takeaway business and supplier. While expansion of the engagement event is not feasible, the active promotion of smaller portion meals should be, but further work is required to understand how this impacts on customer choice and so potentially population health [Goffe et al. (Accepted Dec 2018) page 188] [59].

There is only one comparable study in the academic literature: Bagwell's uncontrolled evaluation of healthier catering initiative in London [48]. Bagwell detailed the paradox that exists in Government policy between addressing issues related to health inequalities and eschewing the most effective tools which could be delivered in the out-of-home food outlet setting. She identified that the more 'intrusive' intervention components that either guided choice by disincentives, or restrict or eliminate choice, were more effective, whereas those that promoted healthier alternatives, at a premium, were favoured by those located in more affluent areas and hence potentially widening health inequalities [48]. These findings directly relate to those of Adams et al. on the role of individual agency, who have stated '*Population*

interventions that require individuals to use a low level of agency to benefit are likely to be most effective and most equitable.' [158]. My interviews with intervention deliverers reflected many of the themes detailed in Bagwell's work, with additional proposals for further regulatory measures such as the introduction of a licence for takeaways, similar to that issued to premises that serve alcohol [Goffe et al. (2018) page 97] [55].

My work with Henry Colbeck Ltd, was novel. While others have stated a need for greater involvement with suppliers [242], to my knowledge there is no published work that has detailed how such involvement could be structured and delivered. This provides an interesting challenge to both public health bodies and industry as to how they could collaborate towards the benefit of the public's health.

The intervention work undertaken was delivered within the confines of voluntary engagement, the preferred method of the current UK Government [page 83]. I did not look at mandatory and regulatory policy alternatives that the evidence suggests are more effective in delivering a nutritional change [page 76]. A rising number of local authorities have developed and adopted hot food takeaway supplementary planning documents (SPDs) [page 83], which seek to restrict the future opening of takeaways, and thus overall density in any area. My work is complementary to such developments with a focus on what can be done to improve the nutritional content of food offered by existing businesses.

9.5 Implications for decision makers and practitioners

The implications of the body of work I have presented in my thesis are not limited to policy makers. Currently, the UK Government, while providing guidance, appears not to be interested in direct intervention within the independent takeaway sector [page 83]. As such, the implications of my work, while of interest to policy makers and the public health nutrition research community, will primarily be of relevance to those in local authorities working to develop and deliver interventions in this setting. This said, the poor nutritional profile of such food [page 16] and potential health outcomes associated with high consumption [page 22] have been acknowledged by central Government [50]. Therefore, their actions should reflect their stated concern that more work needs to be done to improve the nutritional offering in this specific setting. If independent takeaways are

designated as a target for nutritional improvement, then more resources will be required to support targeted interventions that are deemed feasible.

Those involved in commissioning and the developing of interventions targeted at independent takeaways should look beyond the established generalist catering awards. While such awards contain components that may have an impact, there is little evidence to suggest that such awards, as a whole, are an effective tool in delivering significant nutritional improvement in independent takeaways and are viewed as having little or no value to such outlet's FBOs. The development of future interventions should be considered within an ecological framework [183], to understand the multiple levels of influence that impact on the resultant food offering in hot food takeaways. Additionally, it is important that consideration is given to the level of individual agency required among both the public and also takeaway staff, where possible prioritising those interventions demanding the lowest level of agency, as these are most likely to be effective and equitable [158].

Catch-all generalist schemes, which seek an improvement across a range of catering establishments should not be considered for independent takeaways, given the breadth of factors to consider within the takeaway market. What might be effective in a Fish & Chip Shop may not be relevant to an Indian, Chinese, etc. takeaway. However, in most settings, the relationship between intervention deliverer and FBO is critical. It is important that there is a level of respect and trust between the two. My work has shown good relationships are vital, whether involving staff from local authorities or suppliers, even to identify and gain the first level of engagement with an FBO. Where possible opportunities to develop covert [to the customer] interventions should be considered.

My work with Henry Colbeck Ltd will be the first example in the academic literature to evaluate the feasibility of working with a supplier in this setting. There may be other opportunities for suppliers to play a role as they have an industry perspective as to what mechanisms and tools are most likely to incentivise FBOs. While there may be those in industry that see a focus on health improvement as an altruistic act, such sentiment was not shared by Henry Colbeck Ltd. Rather their willingness to engage came from their perspective that being innovative and open to change is crucial to stay competitive in an increasingly competitive market place, even within an established cuisine such as Fish & Chips. While regulation may be viewed as last resort by the present Government, the rising prevalence of

hot food takeaway SPDs may be a prelude to future policies that further impose on the practices of running a takeaway. These could include calorie labelling requirements or restrictions on salt content. Therefore, it is in an FBO's best interest to be ahead of any such implementation, especially as innovation may open their business up to a wider customer demographic that includes those who are more health conscious.

My findings suggest that takeaway packaging could play a significant role. Fish & Chip Shops were accepting of the intervention and the resulting new smaller portion packaging developed by Henry Colbeck Ltd has been sold throughout the UK, suggesting an element of sustainability. However, based on the Nuffield intervention ladder the provision of smaller portion meals is classed as 'enabling choice' [213] and, while there was evidence for both feasibility and acceptability, it still requires a certain level of individual agency by the customer to select the smaller portion meal. Ideally, packaging would be used to restrict all meals to adhere to calorie guidelines, but recent, albeit limited, evidence from work with takeaways in London suggests that reductions in the established standard food portions, is noticed by the customer and not viewed favourably [243]. Despite this, it was noted by many in the Fish & Chip Shop industry that both businesses and customers would benefit from standardised portions, which could be, in part, be facilitated through structured packaging.

While my work has primarily focused on those interventions that broadly fall within the category of choice architecture, or 'nudge', style interventions. As stated above, it must be cautioned that without further epidemiological modelling it is unknown what impact they may have at population level. While nudge approached are favoured politically, the evidence suggests that such interventions delivered in isolation are unlikely to yield significant population health improvement [241], particularly if the aim is to enable, as opposed to eliminating or restricting choice. If they are to be used, it may help if they are delivered in conjunction with a suite of other actions. Marteau (2018) states that efforts to persuade people to resist unhealthy environments is not effective; however informing them of potentially harmful habits can play a role in supporting those interventions that directly target these harms. She argues that it is first the minds of the public that need to change in order to drive a demand for change in our environments, which will ultimately change the

minds of the policy makers. Fundamental to this is a shift in the view that it is our environments and not 'free will' that causes obesity [244].

My work has made a substantial contribution to the public health literature with regards to interventions in this setting. As stated above, these interventions are dependent on the voluntary actions on the part of the independent takeaway FBOs, and I acknowledge that the evidence suggest these are not the most effective nor equitable ways to deliver a nutritional improvement [158-160]. As such, my work should not discourage policy makers from exploring regulatory measures that could be implemented within takeaways. While the findings from my interviews with intervention deliverers does provide some examples of potential measures that could be developed, much further work would be required to shape these ideas into workable policy. However, it is essential that those with relevant experience and knowledge, such as those that I spoke with in the industry, are involved in the co-design of future policy and provided with the requisite resources required to comply with any future measures.

9.5.1 Ranking potential public health actions in hot food takeaways

The Nuffield intervention ladder provides a framework for decision makers and practitioners to evaluate potential actions, with progression up the ladder from the lower rungs of individual freedom and responsibility towards the higher rungs that require state intervention [213]. The framework is predicated on individual agency, with a reducing level of individual agency as interventions ascend the ladder. Adams et al. (2016) contends that the higher-rung interventions are the most effective and equitable at improving diet and reducing obesity [158]. I have provided examples as to different intervention or intervention components with regards to each rung of the Nuffield intervention ladder, see Table 9-1. These should not be considered in isolation, as effectiveness is dependent on to the process by which any given intervention is enforced. For example, if it is expected that an intervention will be delivered through resource intensive engagement by a local authority initiative, and is reliant on the voluntary engagement of the FBO, then the likely impact is negligible. Whereas if an intervention is developed and enforced through a national policy framework and delivered equitably across the country, then the likely impact will be far greater.

Table 9-1 Intervention ranking by the Nuffield intervention ladder [213]

Nuffield intervention ladder rung	Description [213]	Example intervention / intervention component
Eliminate choice	Regulate in such a way as to entirely eliminate choice	Eliminate meal deals
Restrict choice	Regulate in such a way as to restrict the options available to people with the aim of protecting them	Nutrient reduction in both cooking and serving, such as deep fat frying management practices, 5-holed salt shakers
Guide choice: disincentives	Fiscal and other disincentives can be put in place to influence people not to pursue certain activities	Increased price for unhealthy options
Guide choice: incentives	Regulations can be offered that guide choices by fiscal and other incentives	Contingent reward such as a toy
Guide choices: default policy	The default policy is change to one that is health promoting	Providing salad as the standard side dish and not chips
Enable choice	Enable individuals to change their behaviours	Provision of smaller portion meals
Provide information	Inform and educate the public	Meal calorie labelling
Do nothing	Do nothing or simply monitor the current situation.	NA

9.6 Future work

9.6.1 Nutritional epidemiology

Of particular interest was the synergistic relationship between SEP and frequency of consumption of takeaways in children. As a result of this interaction, the mean daily energy intake of children from the lower SEP was more positively related to a greater frequency of consumption of takeaway meals at home than those children from the higher SEP [Goffe et al. (2017) page 42] [53]. It would be interesting to explore this relationship to understand what might explain the larger mean daily energy intake associated with increased habitual takeaway consumption in children from more deprived households. Unfortunately, I did not have the data to investigate this, but the variation in portion sizes both within [page 181] and between different takeaway cuisines is substantial [46]. This is one potential explanation and would be worth exploring how takeaway cuisine choice and portion size differs with between demographic groups.

9.6.2 Potential policies to improve the nutritional profile of independent takeaways

In terms of potential policies that could be implemented, my work did not directly contribute greatly in this respect but perhaps indicates some possible areas for focus as

identified through my interviews with intervention deliverers [Goffe et al. (2018) page 97] [55]. The reluctance of central Government to regulate is not shared by some local authorities who instead use their local powers to bring about change, as evidenced through the implementation of hot food takeaway SPDs [page 83]. Could the impact of SPDs be expanded? For example, once an A5 business has closed, could the new FBO be made to reapply for the classification on the condition that they would adhere to certain nutritional conditions? This would require further work to detail and define the nutritional criteria relating to the 'healthiness' of takeaway meals. Appetite for such ideas was expressed by a range of stakeholders, including those in health promotion within local authorities, as well as the Fish & Chip industry. One potential consequence of the SPDs is that they likely consolidate the position of the established takeaways. Therefore, if the current nutritional offering is generally poor, it is unlikely to improve. Robust nutritional criteria that could be incorporated into future planning legislation may be of use for local authorities to regulate existing businesses and incentivise new businesses to enter the market. Warrington Borough Council' street vendors policy is an example of a financial incentive designed to encourage a healthier food offering. Street vendors receive a £100 discount on their licence if they met certain criteria related to nutrition [50]. As takeaway business attrition is high [page 94], creating the conditions that incentivise new healthier businesses to enter the market may lead to a more notable impact on the takeaway foodscape than schemes that focus on existing businesses.

9.6.3 Food business operator engagement

My work highlighted the challenging nature of identifying, let alone engaging with, independent takeaway FBOs. While I did speak with some, this was time consuming, particularly when I approached independent takeaways directly. Takeaway staff were proficient in the art of obfuscation and broadly unwilling to reveal details of their takeaway's FBO. While work with EHOs was more effective at gaining that first 'foot in the door', due in part to their position of authority, it was Henry Colbeck Ltd that proved to be the most effective gatekeeper to gaining both access and engagement with FBOs. A publication by Estrade et al. is the only notable contribution to the academic literature that exclusively details the FBO's perspective [185]. Future interventions would greatly benefit from increased input from this group of stakeholders; for example, the existing or previous

generalist catering awards which have shown little or no impact were developed with neither their input nor consideration of their setting. Such engagement will be challenging, but our work with Fish & Chip Shop FBOs shows that there are those who are interested in constantly improving their business and looking for new ways to give themselves a competitive advantage [Goffe et al. (Accepted Dec 2018) page 188] [59]. Unlike some public health interventions, such as a vaccination programme, a predetermined level of coverage is not required for an intervention to be successful. Successful new ideas and new cuisines spread rapidly in the independent takeaway sector [page 10], for example the Lite-BITE® boxes [236]. Therefore, the opportunity to develop a new intervention may not require a high number of FBOs, but the right FBOs that have a prominent profile, either within their community, or their specific cuisine sector.

9.6.4 The power of community to deliver change

In Chapter 4, I detailed the specificity of 'communities' as a stakeholder in contributing to the food offering in independent takeaways in their locale [page 92]. Further work is required to understand how communities' collective power and influence could be harnessed [191]. A community-based campaign in Newcastle upon Tyne involving local residents' opposition of a proposed multinational fast-food restaurant, played a pivotal role in the multinational fast-food company withdrawing its appeal of the Council's decision to reject their planning application [245, 246]. The residents group gained rule 6 status providing them with parity with regards to assess to the appeal's evidence [247]. Through an advocacy-coalition framework [191] the group combined with public health bodies and the Council and were successful in their shared aim to prevent the opening of a 'two-storey drive thru' fast-food outlet [246]. Other community groups in Newcastle upon Tyne have used their collective power to distilled and vocalised their thoughts regarding how they would like to be involved in the shaping of their locale, inclusive of hot food takeaways [194-196]. Neighbourhood planning [248] might be one suitable mechanism, though their development depends greatly on local institutions and the capacity for communities to organise a collective response [249]. Currently, civic capacity varies across England, with more affluent areas better equipped to support neighbourhood plans [249]. Therefore, while in theory such plans could play a role, they might ultimately lead to increased health inequalities. Communities are also unlikely to be a single voice and clearly the spread and success of fast-

food is an indication that the meals are popular. However, alongside the existing foodscape there is an emerging market for healthier meals supported by new chains and independent takeaways. Novel ways to increase awareness and inform existing traders to the potential opportunities of healthier meals could be developed. For example, local weight-loss groups are large in number and provide guidance to their members with regards to selecting food at the chain fast-food outlets. Could such guidance be expanded to independent takeaways? Groups' collective purchasing power might incentivise independent takeaways to create and promote healthier meals on their menus.

9.6.5 Online exposure

While there is a substantial body of literature on the impact of physical exposure to takeaways [page 26], there is no published literature on the influence or the role of online access to takeaway meals. There is a rapidly growing market for those companies that act as intermediaries between independent takeaway outlets and their customers. Online ordering platforms (OOPs) facilitate the purchasing of meals from independent food outlets. They process a huge, and rapidly increasing, volume of orders. In the UK, the market is dominated by Just Eat (https://www.just-eat.co.uk/). According to their annual report, in 2016, Just Eat processed £2.5 billion of orders, an increase of 47% from 2015 (£1.7 billion) [250]. As an example of the ease of access, entering Newcastle University's central postcode, "NE1 7RU" (January 2018), into Just Eat's OOP provides access to, collection and/or delivery from 186 different outlets (154 active, 32 'off-line') [83]. OOPs are increasing the availability of a given takeaways food beyond its traditional localised customer base. While OOPs are further increasing the convenience of takeaway food, it is not known to what extent online access is creating a new market for businesses, or whether it is replacing existing methods of takeaway food purchasing. Arguably, the potential of OOPs to influence customers towards healthier choices is greater than that of the takeaways. A resident living in central Newcastle upon Tyne has access to numerous takeaways and cuisine types through a few clicks on a smartphone screen, whereas a customer in a Fish & Chip Shop can only choose from the in-store menu board and, in all likelihood, has made their meal choice prior to entering the takeaway. Research is required to provide an initial understanding of the use and application of OOPs, how they currently or could inform and guide choice, and their resultant influence

on our diets. Such knowledge would be of benefit to identifying potential mechanisms at national level that shift populations towards healthier options.

9.7 Conclusion

The UK has a large fast-food market. In 2017, it was estimated to be worth £16.8 billion, with independent traders estimated to account for 1.25 billion transactions (46.2% market share compared to the chain outlets) [85]. For many, hot food takeaways are a habitual component of their diet, a behaviour which is unlikely to reduce. Therefore, it is crucial that there is provision, within the sector, for healthy and nutritious food. While interventions that are reliant on the voluntary engagement of FBOs may yield modest improvements in a small number of outlets, it is legislative action that is most likely to be effective in significantly improving the UK hot food takeaway foodscape.

Postscript

Personal reflections on the research

The Foodscape project [1] provided me with a fantastic opportunity to research a specific and growing public health challenge. While this was not an exhaustive programme of work, it was certainly a detailed investigation. I have gained skills and experience through undertaking research using a range of methods including nutritional epidemiology, controlled laboratory experiments, cross-sectional studies, qualitative interviewing, and intervention feasibility testing. I have also been supported by a multidisciplinary, knowledgeable and skilled research team. It has been a rewarding training programme through which I have developed a network of contacts, in both research, public health practice and the public realm. The research has offered detailed insights into the workings of the commercial world, including independent takeaways and wholesalers, as well as the work of local authorities.

Positionality statement

Here, I present my positionality. It consists of an overview of my academic training and my relationship to my field of study.

I graduated in 2002 from The University of Edinburgh with a B.Sc. in Biological Sciences with Honours in Ecology. I gained a Certificate in Teaching English to Speakers of Other Languages (CELTA), then taught English overseas for two years, before returning to England to complete an M.Sc. in Geographical Information Systems (GIS) at the University of Leeds. After graduating in 2005, I worked as a GIS professional for two and a half years, predominately as an assistant consultant for the environmental and engineering consultancy, Entec UK Ltd.

I joined Newcastle University as a researcher in 2008 on a landscape ecology project, working primarily in GIS and remote sensing. In 2010, I took an interest health research and environmental epidemiology and by 2012 I was working full time on health projects using quantitative skills in the Institute of Health & Society. In 2014, I became a researcher on the Foodscape project.

I commenced my PhD studies with a strong background in spatial analysis and the ability to interrogate related data. This provided me with a good understanding of the limitations of certain data, which I was able to apply to my analysis of NDNS data. However, I had no previous experience of qualitative research or qualitative research methods.

Prior to my PhD studies, my only experience of the catering sector was that of a consumer. Through this research, I have had the good fortune to learn from environmental health officers, and from those working in local authorities to administer and enforce legislation related to environmental health. This has included shadowing practitioners carrying out hygiene inspections across various out-of-home food outlets, including takeaways. I have also engaged with owners, managers and staff of a range of out-of-home food outlets, and conducted many semi-structured interviews. This has given me an insight into the issues of running takeaway fast-food businesses, as well as a greater understanding of the regulatory framework and food hygiene law.

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Appendix A: Information and Consent Forms

Below are information and consent forms associated with the primary data collection for my research. These include:

- Information and consent for interviews with takeaway customers
- Information and consent for interviews with takeaway FBOs
- Information and consent for interviews with intervention deliverers
- Information and consent for participants involved in shaking salt from salt shakers
- Information for Fish & Chip Shop customer survey
- Information and consent for stakeholder interviews for Masterclass and Fish & Chip Shop portion control interventions

YouCook
Cooking and healthy eating study

Information Sheet & Consent Form – Interviews (Outlet Users)

What will this study involve?

Researchers from Newcastle University and Durham University are working to understand behaviours around the use of out of home food outlets such as takeaways and cafés. We would like to interview you about your use of such outlets. The interview should take around 10-15 minutes and will be conducted at a time convenient to you. It will be recorded, anonymised, transcribed and analysed. It will not be possible to identify anyone within the results. This is part of a wider study looking at out of home food outlets.

What will happen to the information obtained?

All information which is collected about you during the course of this study will be kept strictly confidential. Study procedures will ensure that all data will be coded so that it is anonymous and does not identify individuals.

Would you like to take part?

If you would like to take part, please complete and sign the consent form below.

Durham University Newcastle University fuse

YouCook
Cooking and healthy eating study

Consent form – interviews outlet users

Date .....

ID No:

Have you read the information sheet about the study?	Yes / No
Have you talked to the researcher about the study?	Yes / No
Do you feel you understand what taking part in the study involves?	Yes / No
Do you understand that you can leave the study at any time, without giving a reason?	Yes / No
Do you know that all you tell us will be private?	Yes / No
I would like to take part in the study?	Yes / No

Please **sign** your name here: .....

Please **write** your name here: .....

Researcher .....

Human Nutrition Research Centre
Newcastle University
M1.151 William Leech Building
Medical School
Framlington Place
Newcastle upon Tyne NE2 4HH
Telephone 0191 208 5276
Email [study email address]

Durham University

Newcastle University

fuse

YouCook
Cooking and healthy eating study

Information Sheet & Consent Form – Interviews (Outlets)

What will this study involve?

Researchers from Newcastle University and Durham Universities are working to understand the food preparation and production processes within kitchens such as the one you own/ manage/ work in. We would like to interview you about the practicalities of developing health related interventions from the kitchen and service staff's perspective, to explore your everyday kitchen and service practices, and the barriers and enablers to them changing practices. The interview should take around 20 minutes and will be conducted at a time convenient to you. It will be recorded, anonymised, transcribed and analysed. It will not be possible to identify anyone within the results. This is part of a wider study looking at food outlets such as the one you own/ work in.

What will happen to the information obtained?

All information which is collected about you during the course of this study will be kept strictly confidential. Study procedures will ensure that all data will be coded so that it is anonymous and does not identify individuals. We cannot offer to feedback any individual information on any aspects of the study.

Would you like to take part?

If you would like to take part, please complete and sign the consent form below.

Durham University

Newcastle University

fuse

YouCook
Cooking and healthy eating study

Consent form – interviews outlet

Date .....

ID No:

Have you read the information sheet about the study?	Yes / No
Have you talked to the researcher about the study?	Yes / No
Do you feel you understand what taking part in the study involves?	Yes / No
Do you understand that you can leave the study at any time, without giving a reason?	Yes / No
Do you know that all you tell us will be private?	Yes / No
I would like to take part in the study?	Yes / No

Please **sign** your name here: .....

Please **write** your name here: .....

Researcher .....

Human Nutrition Research Centre
Newcastle University
M1.151 William Leech Building
Medical School
Framlington Place
Newcastle upon Tyne NE2 4HH
Telephone 0191 208 5276
Email [study email address]

Durham University Newcastle University fuse

YouCook
Cooking and healthy eating study

Information Sheet & Consent Form – Interviews (Delivering Interventions)

What will this study involve?

Researchers from Newcastle University and Durham University are working to develop health related interventions in the out of home food environment. We would like to interview you about the practicalities of developing health related interventions in out of home food outlets. We are interested in your experience of developing and delivering interventions as well as your perspectives on different types of interventions and the feasibility of delivery of such interventions. The interview should take around 20 - 40 minutes and will be conducted at a time convenient to you. It will be recorded, anonymised, transcribed and analysed. It will not be possible to identify anyone within the results. This is part of a wider study funded by the NIHR School of Public Health Research looking at out of home food outlets.

What will happen to the information obtained?

All information which is collected about you during the course of this study will be kept strictly confidential. Study procedures will ensure that all data will be coded so that it is anonymous and does not identify individuals. We cannot offer to feedback any individual information on any aspects of the study.

Would you like to take part?

If you would like to take part, please complete and sign the consent form below.

Durham University

Newcastle University

fuse

YouCook
Cooking and healthy eating study

Consent form – interviews outlet

Date .....

ID No:

Have you read the information sheet about the study?	Yes / No
Have you talked to the researcher about the study?	Yes / No
Do you feel you understand what taking part in the study involves?	Yes / No
Do you understand that you can leave the study at any time, without giving a reason?	Yes / No
Do you know that all you tell us will be private?	Yes / No
I would like to take part in the study?	Yes / No

Please **sign** your name here: .....

Please **write** your name here: .....

Researcher .....

Human Nutrition Research Centre
Newcastle University
M1.151 William Leech Building
Medical School
Framlington Place
Newcastle upon Tyne NE2 4HH
Telephone 0191 208 5276
Email [study email address]

Durham University Newcastle University fuse

Appendix 1: Participant information sheet

Salt shaker research study: information for participants

We are inviting you to take part in the Salt Shaker research study that is exploring the amount of salt delivered by two different shakers. This research has been funded by the National Institute for Health Research's School of Public Health Research. The project is being carried out by a team of researchers from Newcastle University, the University of Durham and the University of Cambridge.

We would like both men and women of a range of ages to take part in the research.

What is the purpose of the research?
This project is part of larger programme of work exploring whether we can encourage take-aways to offer healthier food. One potential way to do this is by putting less salt on fish and chips. Eating too much salt is associated with high blood pressure and strokes. Most people in the UK eat more salt than recommended. This project is investigating different ways that fish and chip shops can put salt on food for customers.

What will taking part involve?
If you decide that you would like to take part in this research, we would like you to visit the NUFood laboratory in Newcastle University's Agriculture Building. Here we will record you age and gender. Then you will be asked to shake salt from different containers and the amount of salt that comes out will be noted. This is all that taking part will involve. We will not record your name or any other personal details about you. The information we collect will be anonymous.

You may change your mind about taking part in the research at any time. If you decide you do not want to continue, just say.

What happens to the information that is collected?
If you take part in the research, the information we collect will be written up and used, along with information from other people, to form the basis of a report. No personal details (name, address etc.) will be disclosed in the reports we will write.

All paper documents relating to the research will be held securely at Newcastle University in accord with the Data Protection Act (1998). Only staff directly involved in this research will have access to the information. All information will be held in the university for three years. The information we collect will be confidential.

What happens next?
If you have any questions or queries about the research study please contact Louis Goffe on 0191 208 7739 or louis.goffe@ncl.ac.uk and he will be happy to talk to you.

Appendix 1: consent form

Salt shaker research study: consent form

Please take the time to read the statements below. If you are happy to take part in the study please initial each box, fill in the bottom of the sheet and return to the researcher.

	Initials
I have read and understood the information sheet and have had the opportunity to ask questions.	
I understand that taking part in the research is voluntary.	
I understand that I can stop taking part at any time without having to give a reason.	
I understand that any information I give today will be anonymous and confidential and that no personal information that may identify me will be used in the final written reports.	
I understand that all paper documents relating to my participation will be held securely at Newcastle University in accord with the Data Protection Act (1998). All information collected will be held at the university for a minimum of 3 years.	
I agree to take part in the research.	

_____ _____ _____

Name (participant) Date Signature

_____ _____ _____

Name (researcher) Date Signature

Information Sheet – Customer survey

What will this study involve?

Researchers from Newcastle University, Durham University, University of Cambridge and Exeter University are working to understand the feasibility, acceptability and short-term effects of interventions to support business owners and customers in providing and making healthier food options and choices in takeaways. We would like to ask you a few questions about your fish and chip purchasing behaviour.

What will happen to my information?

No personal information will be recorded. Therefore, it will not be possible to identify anyone within the results. All information that is collected will be kept strictly confidential. Study procedures will ensure that any information does not identify individuals.

What are the benefits of taking part?

Information from the discussions will be used to further develop initiatives to support food business owners and customers in providing and making healthier options and choices, and inform definite evaluations.

Would you like any more information?

Please ask the person who gave you this sheet any questions. If you would like any further information please contact:

Louis Goffe, Newcastle University
0191 2087739, louis.goffe@newcastle.ac.uk
Frances Hillier-Brown, Durham University
0191 3340456, frances.hillier@durham.ac.uk

Thank you for taking the time to read through this information sheet and please answer the questions from the researcher if you are happy to participate.

Appendix

Information Sheet & Consent Form – Foodscape Stakeholder Interviews

What will this study involve?

Researchers from Newcastle University, Durham University, University of Cambridge and Exeter University are working to understand the feasibility, acceptability and short-term effects of interventions to support business owners and customers in providing and making healthier food options and choices in takeaways. We would like to interview you about your experience of and opinions on interventions to support business owners and customers in providing and making healthier food options and choices in takeaways. The interview should take around 20 minutes and will be conducted at a time convenient to you.

What will happen to my information?

All interviews will be audio recorded, anonymised, transcribed and analysed. It will not be possible to identify anyone within the results. All information that is collected about you during the course of this study will be kept strictly confidential. Study procedures will ensure that any information does not identify individuals.

What are the benefits of taking part?

Information from the discussions will be used to further develop initiatives to support food business owners and customers in providing and making healthier options and choices, and inform definite evaluations.

Who you like any more information?

Please ask the person who gave you this sheet any questions. If you would like any further information please contact Louis Goffe (0191 2087739, louis.goffe@newcastle.ac.uk) at Newcastle University or Frances Hillier-Brown (0191 3340456, frances.hillier@durham.ac.uk) at Durham University.

Would you like to take part?

If you would like to take part, please complete and sign the consent form below.

Thank you very much for taking the time to read through this information.

Foodscape project – Stakeholder interviews

Consent Form

Date ……

Please initial in the boxes to confirm your agreement with these statements

I have read the information sheet about the study	
I understand what taking part in the study involves	
I understand that I can leave the study at any time, without giving a reason	
I understand that all information I give will be kept confidentially	
I would like to take part in the study	

Please **sign** your name here: ……

Please **write** your name here: ……

Researcher name: ……

Researcher signature: ……