The impact of interventions to promote healthier ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets open to the general public: a systematic review.

Running title: Promoting healthier food outlet meals

Frances C Hillier-Brown[1,2*], Carolyn D Summerbell[1,2], Helen J Moore[1,2], Ash Routen[3], Amelia A Lake[2,4], Jean Adams[5], Martin White[5,6], Vera Araujo-Soares[2,6], Charles Abraham[7], Ashley J Adamson[2,6,8] and Tamara J Brown[1,2]

[1] Obesity Related Behaviours Research Group, School of Medicine, Pharmacy & Health, Durham University, UK

[2] Fuse – UKCRC Centre for Translational Research in Public Health, UK

[3] School of Sport Exercise and Health Sciences, Loughborough University, UK.

[4] Centre for Public Policy & Health, School of Medicine, Pharmacy & Health, Durham University, UK

[5] UKCRC Centre for Diet and Activity Research (CEDAR), MRC Epidemiology Unit, University of Cambridge, UK

[6] Institute of Health & Society, Newcastle University, UK

[7] Psychology Applied to Heath, University of Exeter Medical School, University of Exeter, UK

[8] Human Nutrition Research Centre, Newcastle University, UK

* Corresponding author Dr Frances Hillier-Brown Obesity Related Behaviours Research Group, School of Medicine, Pharmacy & Health, Durham University,

Stockton-on-Tees TS17 6BH, UK; Email: frances.hillier@durham.ac.uk; Phone: 0044 1913340456

Author contributions

AA, JA, VAS, AAL, HM, CS and MW devised the concept for the research. CS was responsible for the management of the study. CS, FHB, TB, HM and AAL developed the study protocol and methods, with contributions from AA, JA, MW, VAS and CA. HM and FHB conducted the searches. FHB conducted the screening with assistance from HM, CS and AAL. All authors assisted with data extraction. TB, FHB, CS and AR conducted the data validation and TB, FHB and CS conducted the data analysis. TB, FHB, CS, CA, AA, JA, VAS and MW contributed to the interpretation of results. CA and VAS provided specialised advice (behaviour change theory). FHB, TB and CS drafted the manuscript. All authors have provided critical comments on drafts of the manuscript and have read and approved the final version.

Funding Statement

This study was funded as part of the UK 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, and the NIHR Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). 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, 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, HJM, WLW, AA, VAS and AAL are members of Fuse; and JA and MW are funded by the 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 (ESRC), Medical Research Council, the National Institute for Health Research and the Wellcome Trust, under the auspices of the UKCRC, and is gratefully acknowledged. AA is funded by the NIHR as a NIHR Research Professor.

The views expressed are those of the authors and not necessarily those of the above named funders.

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

Keywords: ready-to-eat-meals, takeaways, restaurants, food environments, diet, systematic review

Abstract

Introduction: Ready-to-eat meals sold by food outlets that are accessible to the general public are an important target for public health intervention. We conducted a systematic review to assess the impact of such interventions.

Methods: Studies of any design and duration that included any consumer or food outlet-level before-and-after data were included.

Results: Thirty studies describing 34 interventions were categorised by type and coded against the Nuffield intervention ladder: *Restrict choice* = trans-fat law (n=1), changing pre-packed children's meal content (n=1), food outlet award schemes (n=2). *Guide choice* = price increases for unhealthier choices (n=1), incentive (contingent reward) (n=1), price decreases for healthier choices (n=2). *Enable choice* = signposting (highlighting healthier/unhealthier options) (n=10), telemarketing (offering support for the provision of healthier options to businesses via telephone) (n=2). *Provide information* = calorie labelling law (n=12), voluntary nutrient labelling (n=1), personalised receipts (n=1). Most interventions were aimed at adults in US fast-food chains and assessed customer-level outcomes. More 'intrusive' interventions which restricted or guided choice generally showed a positive impact on food outlet and customer level outcomes. However, interventions which simply provided information or enabled choice had a negligible impact.

Conclusion: Interventions to promote healthier ready-to-eat meals sold by food outlets should restrict choice or guide choice through incentives/disincentives. Public

health policies and practice which simply involve providing information are unlikely to be effective.

Word count 200

Background

Ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets that sell ready-to-eat meals as their main business, are often more energy dense and nutrient poor compared with meals prepared and eaten at home.[1] Furthermore, the consumption of these ready-to-eat meals is associated with higher energy and fat, and lower micronutrient intake.[2] Eating takeaway or fast-food is associated with excess weight gain and obesity.[3, 4]

The popularity and availability of ready-to-eat meals has risen considerably over the last few decades in many high and middle income countries.[5-7] For example, around one fifth to one quarter of the UK population eat takeaway meals at home at least once per week.[7] There is some evidence that food outlets selling takeaway meals and fast-foods are clustered in areas of socio-economic deprivation.[8] Ready-to-eat meals sold by food outlets, particularly in deprived areas, are therefore an important target for public health intervention.[9]

In some countries, national and local government health departments have worked with national and regional food outlet chains to promote healthier ready-to-eat meals. Many of these interventions have used 'health by stealth' approaches, such as

reformulation (particularly salt reduction, the removal of trans fats, and energy reductions), and removing condiments from tables in sit-in eateries. Other interventions have focused on promoting smaller portion sizes and providing consumers with better nutritional information (for example calorie labelling on menus).[10]

Bowen et al[11] recently completed a critical literature review, guided by a socioecological framework, on the effects of different types of environmental and policy interventions on healthy eating, from a US perspective. They concluded that, whilst the evidence reviewed did not support menu labelling as an effective strategy to change purchasing patterns, additional strategies to enhance menu-labelling practices, and strategies beyond labelling (including implementation of nutritional standards), may be useful. The authors concluded that this literature requires further review.

The aim of this evidence synthesis was therefore to systematically review the international literature on the impact[a] of interventions to promote healthier ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets accessible to the general public.

[a] Impact in this paper is used to describe change in an outcome of interest associated with an intervention. In uncontrolled before-and-after (or pre/post) studies, impact was assessed as the change in the outcome of interest from baseline to post intervention. In randomised controlled trials (RCTs) and non-RCTs, impact was assessed as the difference in change in the outcome of interest in the intervention group compared with the controls. Of note, where we report impact, we do so alongside the methodological quality of the study (strong, moderate, or weak); studies without a control could only achieve a quality assessment of moderate or weak. We appreciate that impact results from uncontrolled studies should be treated with caution (e.g. http://handbook.cochrane.org/chapter_21/21_4_assessment_of_study_quality_and_risk_of_bias.htm). The absence of a comparison group makes it impossible to know what would have happened without the intervention. Some of the particular problems with interpreting data from uncontrolled studies include susceptibility to problems with confounding (including seasonality) and regression to the mean.

For the purposes of this review, we have defined ready-to-eat meals as complete meals that need no further preparation which are bought from food outlets, to eat in, to take away, or to be delivered. For example, a bought sandwich or salad box would be included in this definition. However, a packet of crisps/potato chips and a drink, or a chocolate bar, would not be considered a ready-to-eat meal, even if the person consuming them was doing so in replacement of a meal. We acknowledge that terminology in this field is challenging. The literature in this field often includes references to 'take-aways', 'fast food' and 'out of home eating'. In the US, the term 'take-out meals' is often used, and in Australia they speak of 'meals prepared outside the home'. In the absence of a globally agreed definition, we have used the term 'ready-to-eat meals' throughout, and it includes 'take-aways', 'fast food', 'out of home eating', 'take-out meals', and 'meals prepared outside the home'.

Methods

The systematic review was undertaken using established methods based on those used by the National Institute for Health and Care Excellence (NICE)[12] and the findings are reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[13] The review is registered with the International prospective register of systematic reviews (PROSPERO) (registration no. CRD42013006931) and the protocol is published.[14]

Inclusion criteria:

Setting: The specific food outlets we included were those that, as their main business, sold ready-to-eat meals, and were openly accessible to the general public. Supermarkets and general food stores selling ready-to-eat meals (e.g. salad boxes

and sandwiches) were not included, but cafes and restaurants within supermarkets and other retail stores selling ready-to-eat meals were. Food outlets that provided ready-to-eat meals free of charge (e.g. community based lunch clubs for the elderly or homeless) were excluded. We also excluded food outlets which are not openly accessible to the general public, including those based in schools, universities, workplaces, and health/social care institutions. This was for two reasons: first, the effects of interventions to promote the sale of healthier meals in these environments have previously been reviewed.[15 16 17] Second, the relationship between the provider (e.g. on behalf of the education authority or employer) and consumer (e.g. student or employee) of ready-to-eat meals in these institutions is somewhat different to that between a business and the general public (e.g. the meals may be subsidised).

Interventions: Any type of intervention that aimed to change the practices of food outlets in order to promote healthier menu offerings was included. Interventions identified for review were assessed for type of intervention; 11 categories were identified. Box 1 describes each type of intervention category as defined by the review team and, for convenience, they are ordered by where they sit on the Nuffield ladder[18] (described below). Interventions which were categorised as 'Signposting' type studies were defined as those that highlighted to customers the healthier, or less healthy, menu options available. This was usually done using symbols next to menu items, but table signage and posters were other methods used. Signposting differs from calorie labelling on menus as it provides some indication of the 'healthfulness' of a menu items rather than just providing information. Interventions which were categorised as 'Telemarketing of healthy food choices' type studies were defined as those which involved a phone-based direct marketing strategy and a

192 variety of free services offered to businesses including menu guidelines for the
193 provision of healthy choices.
194
195 Box 1. Summary description of the intervention categories

Intervention category and description of interventions identified by review	Nuffield intervention ladder definition[a]
Trans-fat law: Restriction of all food service establishments, including both chain and non-chain food outlets, from using, storing, or serving food that contains partially hydrogenated vegetable oil and has a total of 0.5 g or more trans-fat per serving	*Restrict choice*
Changing pre-packed children's meal content: Pre-packed meal content changed to include healthier options, smaller portion sizes of less healthy options and/or removal of other less healthy options	*Restrict choice*
Food outlet award schemes: Interventions that include an assessment of food outlet practice(s) using pre-defined criteria, together with some sort of accreditation if the food outlet met the criteria	*Restrict choice (Variable depending on scheme, but those included in this review were all categorised as restrict choice)*
Price increases for unhealthier choices: Price increase applied to less healthy menu options	*Guide choice (disincentives)*
Incentive (contingent reward): A conditional reward is provided only after the target behaviour (e.g. choice of a healthier option) is performed	*Guide choice (incentives)*
Price reductions for healthier choices: Price reduction applied to healthier menu options	*Guide choice (incentives)*
Signposting: Interventions that highlighted to customers the healthier, or less healthy, menu options available	*Enable choice*
Telemarketing of healthy food choices: Phone-based direct marketing strategy; variety of free services offered to businesses including menu guidelines for the provision of healthy choices.	*Enable choice*
Calorie labelling law: Mandatory posting of calorie values of each option on menus in chain food outlets	*Provide information*
Voluntary calorie labelling: Voluntary posting of calorie values of each option on menus in chain food outlets	*Provide information*
Personalised receipts: Receipts that included personalised suggestions designed to reduce fat and calorie consumption	*Provide information*

[a]*Definition from the Nuffield ladder[18] starting with the most intrusive; eliminate choice, restrict choice, guide choice (disincentives), guide choice (incentives), guide choice (default policy), enable choice, provide information, do nothing)*,

Outcomes: Any outcome that included consumer or food outlet outcomes. Consumer outcomes could include dietary outcomes (e.g. energy intake), purchasing behaviour (e.g. sales data), and attitudes towards healthier menu choice and preferences. Food outlet outcomes could include changes in retail practices, process outcomes and profit.

Study design: A scoping search of the literature, which we conducted in advance of writing the protocol[14] estimated that there would be insufficient evidence from randomised controlled trials (RCTs) to allow us to answer our research question. However, those working in public health policy and practice need to know how best to improve the nutritional quality of ready-to-eat meals sold by food outlets. Thus, we took an overarching approach that is used by the National Institute for Health and Care Excellence,[12] to identify the best available evidence. Thus, studies of any ~~study~~ design that reported outcomes at least once pre and once post-intervention were included (also called uncontrolled before and after studies). Studies with and without comparators were included without restriction on the type of comparator.

Search

Searches identified studies published from January 1993 to October 2015 in the following databases (and interfaces): ASSIA (ProQuest), CINAHL (Ebscohost), Embase (Ovid), MEDLINE (Ovid), NHS EED (Wiley Cochrane) and PsycINFO

(Ebscohost). Searches were limited to articles written in English. Topic experts were contacted for information about any additional relevant interventions not identified by the electronic search. Key reviews[19-21] were searched as well as reference lists of included studies. Details of the search strategies can be found in the Supplementary File, Fig S1.

Initial screening of titles and abstracts were conducted by one reviewer (FHB) with a random 10% of the sample independently screened by a second reviewer (HM). Agreement between the reviewers was fair (kappa = 0.50) as a result of the second reviewer being more inclusive than the main reviewer. Disagreements between the reviewers were resolved through discussion and it was agreed that studies initially excluded by the main reviewer and included by the second reviewer were excluded at this stage. Full-text articles of potentially relevant studies were independently appraised by two researchers (FHB and CS). Agreement between the reviewers at this stage was excellent (kappa = 0.80). Any disagreements between reviewers were resolved by discussion.

Data extraction and quality assessment

Data extraction and quality assessment were conducted independently by two reviewers (all authors contributed), and any discrepancies between reviewers were resolved through discussion with a third reviewer (TB). Data were extracted on study characteristics, intervention type and outcomes. Study quality was assessed using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies[22] as recommended by the Cochrane Public Health Review Group[23]. This

was adapted for the purposes of this review, specifically in terms of the classification of study designs (see Table 1).

Table 1 Adapted typology of study designs and quality about here

Data on implementation, including context, collaboration, fidelity, sustainability and differential effects by population demographics (using the PROGRESS [place of residence, race/ethnicity/culture/language, occupation, gender/sex, religion, education, socioeconomic status, and social capital] framework[24]) were extracted, using a checklist for obesity related interventions[25] adapted from workplace interventions.[26] An implementation score (0-10) was assigned based on the number of categories information was reported for. Any cost effectiveness data were also extracted.

Data were extracted on the theoretical framework or behavioural model or strategy underpinning each intervention. Interventions were coded according to the Nuffield Intervention ladder in order to categorise the interventions in terms of their "intrusiveness" and impingement on personal autonomy.[18] We note that the Nuffield Ladder uses the term 'incentive' loosely. Incentive has been technically defined to mean a reward contingent on changing behaviour, which can be distinguished from a simple price increase or decrease.[27, 28] We have made these distinctions explicit in our intervention categories. Interventions were also coded in terms of intervention function and policy category using the Behaviour Change Wheel.[29]

Data synthesis

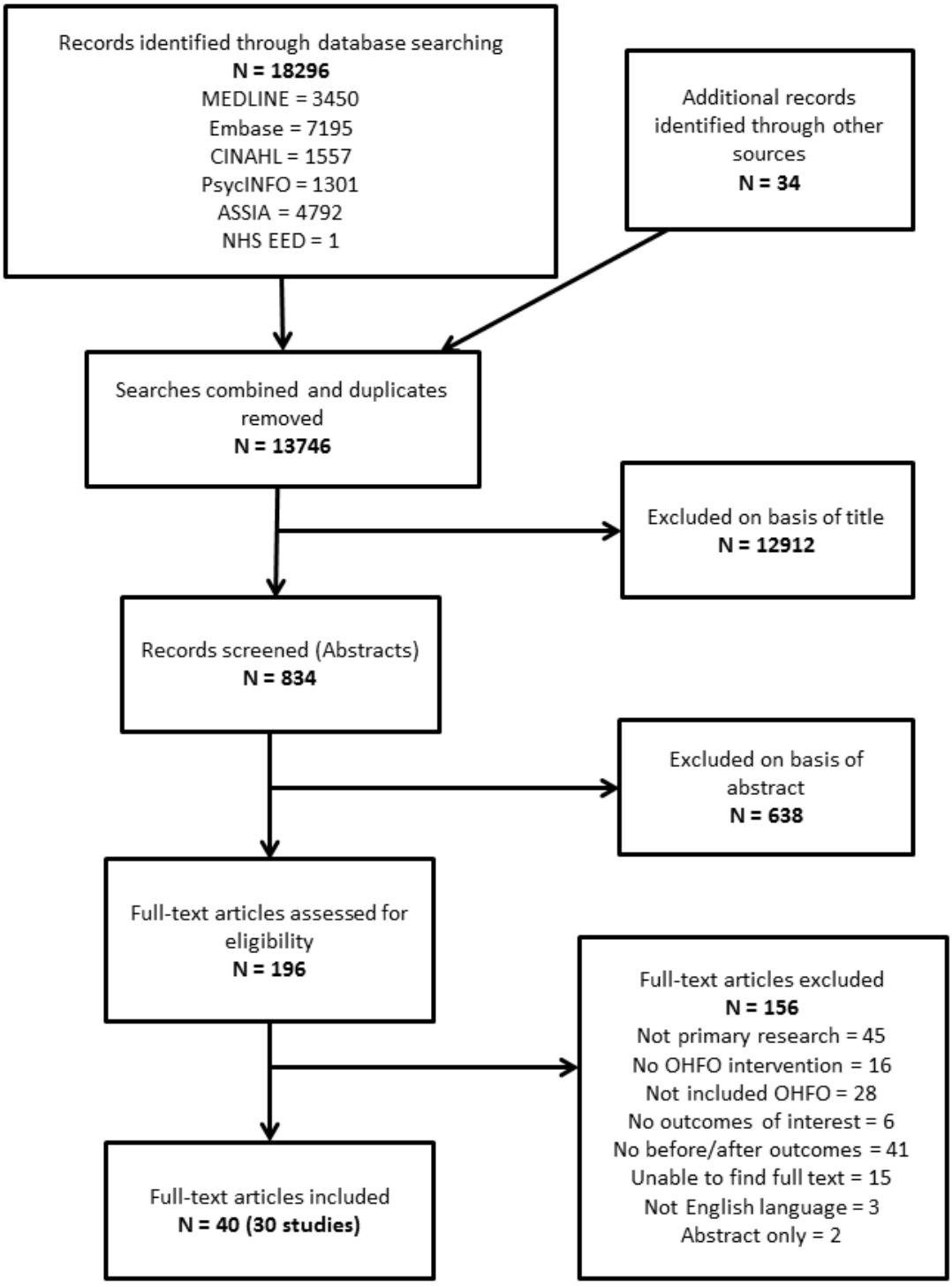
Given heterogeneity in study designs, intervention types and outcome measures, the results are presented as a narrative synthesis following the ESRC Narrative Synthesis Guidance.[30] A 'summary impact' of each study was reported (denoted by an arrow), alongside the global rating of study quality (strong, moderate, or weak). Studies were classed as 'effective' (↑); 'equally effective' as the comparison group (↔); 'effectiveness mixed' by outcome or gender (↕); or 'not effective' (↓). Studies without a control could only achieve a global quality of moderate or weak. Impact was based on change in mean energy purchased where possible (where a decrease in mean energy purchased signified a successful outcome of the intervention, denoted as ↑). Where energy purchased was not reported, impact was based on the primary outcome of the study (e.g. trans fat content of meal, healthy food purchases, catering practices, health promotion practices, or menu items available). Impact was assessed using the overall effect for the whole study sample and not by subgroup. Studies with a control group were assessed on change in outcomes between groups at follow-up; studies without a control group were assessed on change in outcomes from baseline to follow-up.

Results

A total of 30 studies (reported in 40 articles), describing 34 interventions, were included; study flow is reported in a PRISMA flowchart (Figure 1). Supplementary file Table

S1 provides a list of included references. Details of studies that were excluded on screening full-text articles are listed in Supplementary file Table S2.

Figure 1 PRISMA Flowchart



Characteristics of included studies

Study characteristics are summarised in Supplementary File Table S3. Of the 30 included studies, 19 were repeat cross-sectional studies, seven with a comparison control group[31-37] and 12 without.[38-49] These studies were classified as cross-sectional because the outcomes of the study were mainly measured at the consumer level, so although the same food outlets were assessed at each time point, the customers were most likely to be different. In three of these studies[33, 44, 49] there were subgroup cohorts of customers nested within the repeat cross-sectional data. Five studies[50-54] were classified as cohort studies. Two studies were controlled before-after studies that reported outcomes in the same customers[55] or at the food outlet level in the same food outlets at baseline and follow-up,[56] and four studies were controlled trials.[57-60]

Twenty-seven of the 30 included studies were based in the USA; two studies were based in Australia,[44, 49] and one in the UK.[50] Twenty-two studies reported outcomes for adults; three for parents and their children[37, 55, 61] and one study reported child outcomes only.[48] For the four remaining studies, food outlets, rather than individuals, were the unit of observation and analysis. Study populations ranged from lower[34] to higher SES[31, 41, 55, 58] and more ethnically diverse samples[57] to mainly Caucasian samples.[39, 43, 45] Some studies targeted specific ethnic groups, including Mexican Americans,[53] low-income African-Americans[59] and low-income Latino-Americans.[46] Many of the studies did not report on population characteristics in detail.

In terms of the types of food outlets targeted; 18 studies focused on chain food outlets and 12 studies were set in other types of food outlet; including three studies

in non-chain food outlets;[45, 47, 60] and one study each in takeaway food outlets;[59] a delicatessen-style food outlet;[58] privately owned fast-food-style Mexican food outlets;[53] community food outlets which included both counter and table-service;[42] Latino family-owned food outlets;[46] licensed retail food outlets;[52] licenced hotels, clubs and nightclubs;[49] restaurants and cafes;[44] and small independent catering outlets.[50] Most of the chain food outlets were fast-food counter-service, but other food outlet types included table-service or take-away only. One study was set in food service areas of a large discount department store.[41]

Study samples of food outlets varied greatly in size, for example one study included just one outlet[58], and another included over 300.[31] Study duration ranged from minutes[54] to seven years[37] and data points ranged from two time points[34] to weekly purchase information for a 125-week period.[32]

Only four studies were assigned a global quality rating of 'strong', ten were rated as 'moderate' and 16 were rated 'weak' (Supplementary File Table S4). In terms of implementation, scores ranged from 3 to 9 (Supplementary File Table S6). Papers that described the study intervention in detail were more likely to score higher for implementation; however, low scores were not necessarily an indication of poor reporting just that a number of organisational and implementation factors were not used or explored for the intervention (e.g. theoretical underpinning, collaborative approaches to development and delivery, fidelity of intervention delivery, stakeholder support).

Tables 2a (for studies with customer level outcomes) and 2b (for studies with food outlet level outcomes) summarise the design, intervention type, context, and results for the included studies. Where a study included more than one intervention arm, the results for each have been reported separately (often in different intervention types). Some of the interventions focused on changing customer behaviour directly (e.g. signposting); and some on changing outlet behaviour in an attempt to change customer behaviour (e.g. awards). For more detailed information on study interventions see Supplementary File Table S4, and for study results see Supplementary File Table S5.

Tables 2a Summary of included studies with customer level outcomes (n=23) and 2b Summary of included studies with food outlet level outcomes (n=7) about here

Studies with customer level outcomes

Trans fat law (n=1)

Only one study (moderate quality, repeat cross-sectional) investigated the effects of the trans fat law introduced in New York City. Trans fat law was associated with a significant reduction in trans fat content per purchase along with a small, but significant, increase in saturated fat content per purchase. Results did not differ according to the poverty rate of the neighbourhood in which the food outlet was located. However, the effect of the law was inconsistent and varied between fast-food chain types.

Changing pre-packed children's meal content (n=1)

One repeat cross-sectional study (weak quality) investigated the effects of changing the side items included (decrease in portion size of fries and addition of apple slices) in pre-packed children's meals on energy purchased from these meals.[48] The intervention also included a slight change to in-restaurant and television promotions to include non-fat chocolate milk in addition to 1% fat plain milk. The study found a decrease in total energy purchased, which was mainly explained by the reduction in energy due to the change in side items. Sales of non-fat chocolate milk also increased, and sales of regular carbonated drinks decreased from baseline to follow-up, which resulted in a small but significant contribution to the overall decrease in energy. Of note, there was no change in the percentage of customers choosing the lowest energy option. Whilst there did not appear to be any compensatory effects in terms of other pre-packed meal components, compensatory effects in terms of additional foods were not reported.

Price increases for unhealthy choices (n=2)

One strong quality, controlled trial investigated the effects of two interventions that included price increases of unhealthy menu items: 1) price increase alone and 2) price increase with signposting of the unhealthy options.[60] The study found no intervention effect when only a price increase was applied, but when combined with signposting there was a decrease in unhealthy main dishes ordered.[60]

Incentives (contingent rewards) (n=1)

A moderate quality, brief, cohort study investigated the effects of offering a non-food incentive (entry to a $10, $50 or $100 lottery) with a smaller portion size option.[54] Customers who had intended to order a full sized sandwich were offered a half sized

sandwich plus lottery option (at the same price of the full sized sandwich). The proportion of customers who changed their menu choice from a full sized to a half sized sandwich varied by the size of the lottery prize from 5% ($10 lottery), 8% ($50 lottery) to 22% ($100 lottery).[54]

Price reductions for healthier choices (n=2)

One weak quality, controlled study investigated the effects of two price reduction interventions to promote purchases of healthier options: 1) price reduction alone and 2) price reduction alongside health promotion techniques to highlight the healthier options to customers). Both interventions resulted in a proportional increase in sales of healthier items compared to other items.[58]

Signposting (n=8)

Eight studies investigated the effects of nine interventions that involved signposting. In three studies signposting was implemented alone[41, 46, 60]; in two studies signposting was incorporated with menu changes[45, 59], and three studies were of health promotion or social marketing campaigns which included signposting.[31, 42, 58]

One controlled trial (strong quality), found that, overall, adding a symbol to menus that identified 'unhealthy' main dishes resulted in a decrease in the number of unhealthy main dishes ordered.[60] However, when gender effects were explored, it was found that this effect was driven predominately by women.

A repeat cross-sectional study (weak quality) showed that sales of some healthier items increased after the addition of 'healthy' signposting, but for some, sales

decreased or were not affected, resulting in no significant overall change in sales of all 'healthy' items.[41] However, study authors report that the items that showed decreased sales may have been prone to seasonal effects. Another repeat cross-sectional study (weak quality) found no effect of healthy signposting on the purchase of healthy main meals when added to an existing award intervention.[46] This intervention was also culturally tailored; Latino community members helped to translate the messages on small menu stickers into Spanish and provided specific examples of culturally used saturated fats and other ingredients to tailor the national dietary guidelines.

Two studies investigated effects of signposting plus menu changes. One controlled trial (strong quality) found that an intervention promoting new healthier choices was effective in increasing sales of healthy food items.[59] However, a repeat cross-sectional study (weak quality) found that an intervention of table signage promoting new alternative healthier options had no effect on the purchase of healthy choices.[45] In the first study,[59] food outlets were given support with monetary value in the form of initial stock. In addition, both the menu items and intervention materials aimed to be culturally appropriate through formative research with African-American customers and building rapport with the Korean-American and African-American takeaway owners, for example by using and learning greetings in Korean.

Four studies investigated the effects of interventions that primarily aimed to increase customer awareness of healthy options in the participating food outlets. As well as simple menu signposting these interventions used social marketing or health promotion campaigns to achieve this.[31, 42, 53, 58] The intervention investigated by

Acharya and colleagues using a repeat cross-sectional design with control groups (moderate quality) found a significant, small effect on the purchase of healthy menu items compared with controls.[31] Holders of campaign discount coupons were 17% more likely to purchase healthy menu items.

A weak quality repeat cross-sectional study investigated an intervention delivered in community food outlets that also included 'persuasion' intervention functions (advertisements and articles in local newspaper and newsletters, and promotional material).[42] A trend towards a slight increase in the percentage of healthy items sold was observed but this did not reach significance. A culturally tailored social marketing campaign, conducted in Mexican American food outlets, which included the provision of guidelines and training to food outlet owners, incentives (for outlet staff and customers) and newspaper advertising, increased the number of healthier food options provided in the majority of the participating outlets (cohort study; weak quality).[53] In this study all materials were given to food outlet owners in English and Spanish, and were image-oriented, or comprised simple checklists. Finally, a weak quality, controlled trial found that displaying in-store posters listing healthier options led to increases in sales of the healthier options.[58]

Calorie labelling law (n=10)

The highest number of studies (n=10) assessed the effects of mandatory calorie labelling on menus. Four of these assessed the King County nutrition labelling law;[36, 39, 43, 55] four assessed the New York City calorie labelling law;[33, 34, 40, 57] one study assessed the Philadelphia calorie labelling law[35] and one study assessed calorie labelling laws across 18 US states and localities.[37]

One repeat cross-sectional study with control (rated strong for quality) showed a statistically significant decrease in average energy purchased following menu calorie labelling in one large coffee chain (Starbucks) compared to control.[33] One repeat cross-sectional study (weak quality) described an increase in the number of customers who reported seeing and acting on the calorie information following introduction of mandatory menu labelling.[39] The remaining studies (one weak, five moderate and one strong quality) reported no association between introduction of mandatory menu calorie labelling and average energy purchased.[34-37, 40, 43, 55]

One controlled study (moderate quality) investigated the effects of providing customers with calorie recommendation information before and after the New York City calorie labelling law was implemented.[57] The study found that calorie recommendations did not significantly affect food purchases.

Voluntary calorie labelling (n=1)

A moderate quality repeat cross-sectional study found that voluntary nutrient (calories, fat, sodium and carbohydrates) labelling in non-chain food outlets resulted in significant decreases in energy, fat and sodium content of customer purchases, with no change in carbohydrate content[47]. The study also found that 71% of customers surveyed reported noticing the nutrition information, with 20% (of all customers) stating that this resulted in choosing a lower energy main meal and 17% reported ordering a lower fat main meal.

Personalised receipts (n=1)

One study (repeat cross-sectional; weak quality) assessed a receipt-based intervention.[32] The receipts consisted of three components: information, motivation and recommendations. The personalised receipts were associated with an increase in healthier item substitutions that were encouraged by the messages, such as substituting ham for sausage in a breakfast sandwich, or substituting frozen yogurt for ice cream. However, there was no significant change in total energy or total fat per transaction. The intervention was also associated with a small increase in revenue (3.2%).

Studies with food outlet level outcomes

Award schemes (n=2)

Two studies explored the effects of award scheme type interventions where food outlets received some kind of recognition or certificate for meeting pre-defined criteria.[50, 52] The criteria in each award scheme covered a range of intervention features and both included restricted choice (e.g. recipe reformulation, default healthy drinks with children's meals). Both studies followed cohort study designs (weak quality) and observed increases in healthier catering practices and healthy options available. However, Bagwell et al[50] found that only a small number of changes were needed for outlets to achieve the award.

Signposting (n=1)

One weak quality study investigated the effects of a social campaign which included the intervention team working with food outlets to encourage them to add, and signpost, healthier options to their menus.[53] The majority of food outlets changed practices either by simply distributing health education materials (94% of 16 food

outlets) or introducing or promoting healthier side options (81%), whilst half began promoting healthier main meal options.

Telemarketing of healthy food choices (n=2)

Two Australian studies[44, 49] appear to be related to one telemarketing health promotion intervention which included an element of healthy food provision; with one paper focusing on outcomes for hotels, clubs and nightclubs[49] and the other paper on outcomes for restaurants and cafes.[44] Both studies used a repeat cross-sectional study design, with the same cohort of premises evaluated at both time points, and were rated weak for quality. Licata et al[44] found no significant change in the percentage of restaurants and cafes undertaking nutrition-related health promotion practices between 1997 and 2000, in either the cross-sectional or cohort samples. However, Wiggers et al[49] found the prevalence of healthy food choices increased significantly in hotels, clubs and nightclubs, in both cross-sectional and cohort samples.

Calorie labelling law (n=2)

Two studies investigated the effects of the King County, USA, calorie labelling law on food outlet level outcomes. In one cohort study (weak quality), there was a significant decrease in the energy content of main meals available in fast-food chain food outlets following the introduction of calorie labelling.[51] One strong quality controlled study found no association between the introduction of mandatory menu calorie labelling and the 'healthfulness' of menus.[56]

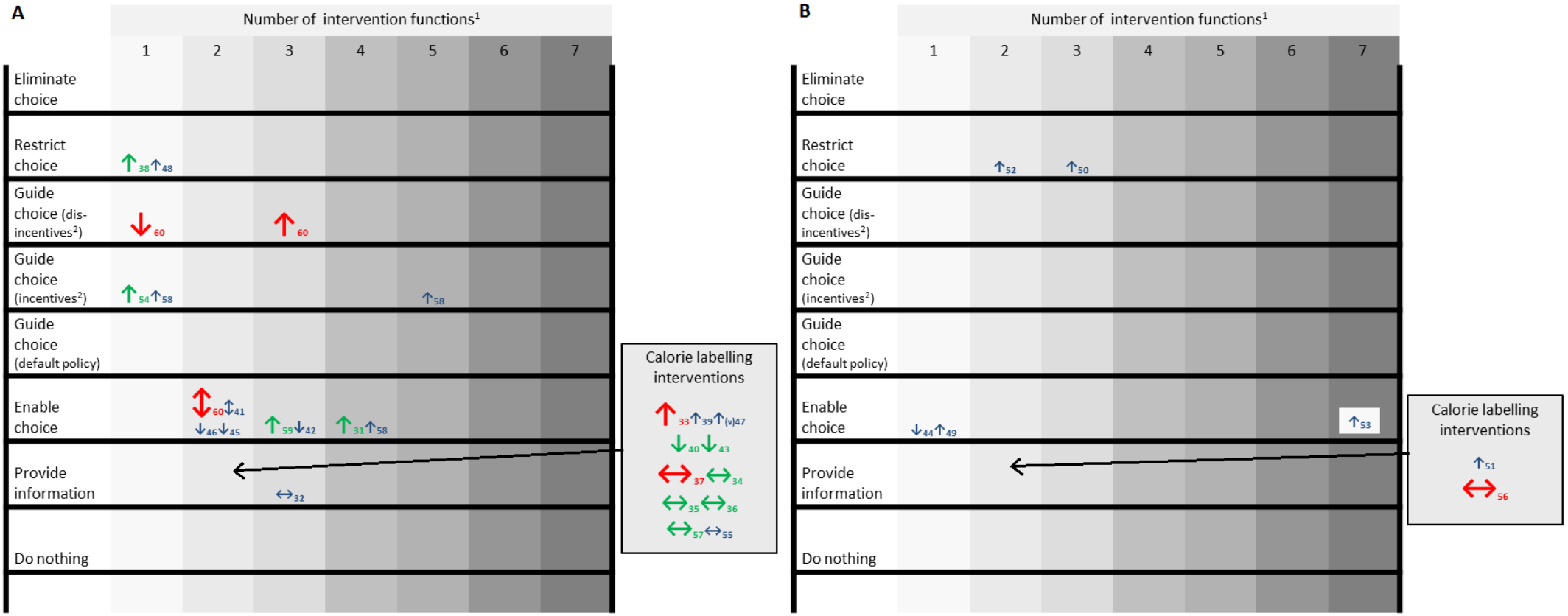
Analysis of theoretical framework / behavioural model

548 Only seven of the 30 studies reported using a theoretical framework or behavioural
549 model; including a consumer behaviour model based on the Theory of Reasoned
550 Action,[31] an asset-based community development approach where community
551 members are active agents of change,[53] participatory research[46] and creating
552 'supportive environments'.[49] One study[58] reported using the Health Belief Model, and
553 a matching model,[62] which predicts that, because the interval between food choice
554 and eating is short, the proximal satisfaction of a tasty meal would prevail over the
555 distal goal of good health.[63] Two studies [45, 59] reported using Social Cognitive Theory;
556 one of these studies also reported using a Social Marketing approach using the Four
557 Ps: Product, Price, Place, and Promotion.[59] Our review protocol[14] included plans to
558 code the use of behaviour change techniques in included interventions, but this
559 endeavour was abandoned *post hoc* because the necessary detail to allow us to do
560 this was only available for seven interventions.[31, 45, 46, 49, 53, 58, 59] Attempts were made
561 to contact authors for further information, but only six authors responded to the
562 requests (see Figure S1). This conclusion was arrived at by experts (VAS and CA)
563 with considerable expertise in developing and coding behaviour change techniques
564 in systematic reviews.
565
566 Figure 2 illustrates the findings from each intervention in the context of the
567 intervention coding according to the Nuffield intervention ladder,[18] and the number of
568 intervention functions involved as coded from the Behaviour Change Wheel.[29] There
569 is a cluster of interventions lower down the intervention ladder, particularly around
570 providing information, and this mainly includes the calorie labelling law interventions.
571 Evidence for these interventions from the lower end of the Nuffield ladder is mixed.
572 Evidence from the small number of studies higher up the intervention ladder

573 ***Figure 2: Intervention impact summary by Nuffield intervention ladder category and number of intervention functions for***

574 ***customer level outcomes (A) and outlet level outcomes (B)***

575



Key: effective (↑); equally effective as the comparison group (↔); effectiveness mixed by outcome or gender (↕); not effective (↓) Red arrow = strong quality study, green arrow = moderate quality study, blue arrow = weak quality study

[1]Intervention function coded from Michie et al (2011) Behaviour Change Wheel

[2] Incentive and dis-incentive are presented here as used in the Nuffield Ladder. Incentive includes both price reductions and contingent rewards. Disincentive includes price increases and contingent penalties.

suggests more consistent evidence of effectiveness. The only exception is seen when choices are guided through using price increases, where positive effects were only observed when in conjunction with other intervention elements (that sit further down the ladder). Overall, however, the number of intervention functions does not appear to influence intervention effectiveness.

Cost effectiveness of interventions

There was no cost-effectiveness evidence reported in any of the included studies.

Impact of intervention by PROGRESS

Eight studies reported on differential effects of the intervention by population demographics on purchasing behaviour, six of which focussed on the impact of calorie labelling. One high quality study of mandatory calorie labelling in Starbucks restaurants showed a larger decrease in energy per transaction in 'zip' codes with higher income and more educated residents.[33] This was also the only study of mandatory calorie labelling that showed a statistically significant decrease in terms of energy purchased post-labelling (approximately 15 calories per purchase). One study found a differential effect of calorie labelling by gender: women but not men significantly reduced mean energy purchased in coffee chains post labelling[43]. Some evidence suggests that *awareness* of calorie labelling is highest amongst women and white, higher SES (income and education) and older adults.[39, 40]

Two other studies also found differential effects by gender. In a study using a lottery incentive to encourage customers to choose a smaller portion size, women were less

likely to take up the offer. There were no effects by age, BMI or hunger level.[54] In another study, women appeared to respond strongly to signposting, whereas for men decreases in unhealthy items purchased were only found when a price increase was added to the signposting.[60]

Overall, the limited evidence suggests there are no consistent differential effects (for better or worse) of mandatory calorie labelling in terms of food purchases by gender, age, race and SES. No studies reported data on differential effects of the intervention by occupation, culture/faith/religion, or social capital.

DISCUSSION

Summary of main findings

Thirty studies describing 34 interventions were identified which met the inclusion criteria. Most of these studies (n=27) only collected customer level outcome information. Indeed, the evidence is mainly from studies that collected data on meals purchased by adults buying food in specific fast-food chains within the USA, which limits the generalisability of the results. Information on the impact of interventions at a food outlet level was scarce and weak in quality. We did not find any information on the impact of interventions on food consumption, either by meal or total daily food intake. The quality of evidence was generally poor, with few high quality designs, which limits the strength of the results. Overall, the impact of interventions appears negligible and inconsistent. However, when the impact of interventions was assessed by the level of their intrusiveness[b], patterns emerged. The findings from

[b] *as defined by the Nuffield ladder[18] starting with the most intrusive; eliminate choice, restrict choice, guide choice (disincentives), guide choice (incentives), guide choice (default policy), enable choice, provide information, do nothing)*,

this review provide useful insight from the best available evidence which will help to inform future policy and intervention efforts.

Four interventions focussed on restricting choice and all had a positive impact on customer level (n=2) and food outlet level (n=2) outcomes. These types of interventions are sometimes termed ‘health by stealth’, and there is good evidence that such interventions are effective and equitable.

Incentivisation, as defined in the Nuffield Ladder,[18] may be a promising approach to encouraging the choice of healthier menu items. Two studies that used a price decrease for healthier options found positive effects on the purchase of healthier food items. Three of four interventions that included price decreases in addition to other intervention functions (targeted at customers and/or the food outlet) found positive effects on healthier food purchases. However, it is unclear what proportion of these positive effects can be attributed to the price changes in these studies. Price increases of unhealthy foods alone were ineffective overall but, when combined with signposting, resulted in a decrease in the purchase of unhealthy items. Eyles et al[64] have reviewed the literature around food pricing strategies and whether they encourage healthy eating habits. Based on modelling studies, they found that taxes on carbonated drinks and saturated fat and subsidies on fruits and vegetables would be associated with beneficial dietary change, with the potential for improved health. WHO have also concluded that there is the potential to influence consumer purchasing in the desired direction through price policies that address affordability and purchasing incentives; taxes on sugar sweetened beverages and targeted subsidies on fruit and vegetables emerge as the policy options with the greatest

potential to induce positive changes in consumption. Although there is a dearth of evidence around the effect of policy strategies which aim to promote healthier ready-to-eat meals, the results for pricing interventions observed in this review fit with the broader literature.[65]

Signposting interventions showed mixed findings. Three signposting-only studies found mixed or no effect. Six signposting-plus other intervention components varied in effectiveness according to study quality. Studies assessed as moderate or strong quality tended to show positive intervention effects, whilst the weak quality studies tended to show no or mixed effects. Again, it is unclear what proportion of the effect in these studies can be attributed to the signposting-only component.

Calorie labelling appears to be associated with an increase in awareness (approximately half customers notice labels) and an increase in knowledge of the energy content of fast-food menu items. The proportion of customers that notice and act on calorie labelling do tend to purchase fewer calories, but this proportion remains low (less than a third), and no information was available on their subsequent purchases or the impact on overall energy intake.

Results suggest that it is the level of intrusiveness of an intervention, rather than the type of policy function, which determines the impact of the intervention. More 'intrusive' interventions (e.g. restrict choice, manipulate price) appear more effective than less intrusive interventions that simply include providing information and enabling choice (e.g. calorie labelling law).

Strengths and weaknesses of the studies included in the review

There was a dearth of high quality studies identified that met the inclusion criteria for this systematic review. The fact that most of the included studies were conducted in chain food outlets in the USA, focussed on customer level outcomes for adults only, and were of low to moderate in quality means that caution is required in generalising and interpreting the results. We appreciate that this type of real world public health evaluation is complex, but would encourage more researchers and funders to support this type of research, and when doing so to conduct evaluations which can provide information on the cost effectiveness and the equity impact of interventions. Although we included every type of outcome in this review, most of those reported were not direct measures of dietary intake or health. Some of the studies reported on the energy value count of food items purchased, but this may not necessarily translate into energy consumed (e.g. during to food sharing and waste), and it cannot be assumed that there were no compensatory effects in food intake at other times in the day. Data on food wastage, food sharing, or the act of keeping a proportion of the uneaten food for another meal (e.g. in a 'doggy bag') was not collected or reported in the studies we included for review; there is evidence that this is common practice, at least in the USA.[66]

The difficulties in identifying behaviour change techniques employed in the studies included in this review may reflect two problems. First, descriptions of interventions in published reports are often poor. This means that the research identified is not replicable and offers limited options for evidence synthesis. This is a widely acknowledged problem[67] and has resulted in the development of the TIDieR guidelines for the reporting of interventions.[68] Second, because current taxonomies

of behaviour change techniques have been inspired by individual behaviour change interventions, it is possible that environmental interventions (e.g. changes to information provided in the menus), like the ones included in this review, are not as well reflected in these taxonomies, making coding difficult.

Strengths and weaknesses of the review

The primary strength of this systematic review is its scope, in that it assessed the international literature for evidence on this topic, without substantial restriction to any particular intervention, study design or outcome. This novel approach allowed us to comprehensively draw together the best available evidence relating to interventions which promote healthier ready-to-eat meals sold by specific food outlets open to the general public. This evidence base can contribute to local and national public health policy given the increasing consumption popularity of ready-to-eat meals and international cuisines in many countries.[7, 69] That said, this resulted in the assembly of a heterogenous group of interventions which have a number of different targets for change; some intended to change food outlet practices and others aimed to change customer behaviour. Previous reviews have focused on calorie labelling[19, 20, 70] or community-based interventions only.[21] Our findings regarding the impact of calorie labelling on sales are in line with these recent systematic reviews[19, 20, 70] which found inconsistent and negligible changes in 'real-world' food outlet settings. Two of these reviews[19, 20] included experimental-type studies conducted in laboratory and training restaurants, which we did not include (because they were not open to the general public). Calorie labelling in these experimental (efficacy) studies was found to be efficacious. It would appear that these effects are not translated to 'real world' settings (effectiveness).

Meaning of the study: possible mechanisms and implications for practitioners and policymakers

We found a preponderance for interventions lower down the Nuffield Ladder – particularly in the provide information and enable choice 'rungs'. This reflects the suggestion made by others that public health policymakers and practitioners may favour those interventions that are less intrusive.[71] Unfortunately, our findings, and those of others,[71-74] suggest that these interventions are likely to be less effective and equitable than those higher up the ladder.

The Nuffield Ladder was originally developed to help public health practitioners and policymakers determine what level of intervention was 'proportionate' for a particular 'problem. 'Intrusiveness', evidence of effectiveness and the extent of the 'problem' addressed are all identified as being important considerations.[18] Our findings suggest that interventions higher up the Nuffield Ladder are likely to be justified as ones lower down seem of limited effectiveness. We also found some evidence that price and incentive-based interventions may be particularly promising. However, overall there is very little evidence on interventions on 'rungs' above 'enable choice', and further effort is required both to develop and evaluate new approaches.

We also found evidence that less intrusive interventions lower down the Nuffield ladder were more likely to be associated with less equitable effects. The tendency for less intrusive interventions to be less equitable has been discussed by others.[71, 75-78] Whilst this could be interpreted as a limitation, it also serves to highlight that different interventions are required for different population groups and that a range of

749 interventions are required to achieve change across the whole population.[71]
750 Although some interventions included in this review included a number of different
751 components, we are not aware of any substantial, multi-sectorial attempts to achieve
752 wholesale improvement in the healthfulness of the out-of-home food sector.
753
754 Whole system change across the out-of-home food sector would require concerted
755 and joined up action across a range of private and public sector organisations. Such
756 action is dependent on political will which is, in part, dependent on public perceptions
757 of the seriousness of the problem addressed and the effectiveness of the solutions
758 offered.[79] Recent changes in the public acceptability of, for example, smokefree
759 legislation[80] and taxes on sugar sweetened beverages,[81] suggest that public opinion
760 on public health topics is amenable to change.
761
762 **Unanswered questions and future research**
763 We found limited evidence of interventions across the full spectrum described in the
764 Nuffield Ladder. Further work is required to develop, and evaluate, a wider range of
765 interventions, particularly those higher up the ladder that may be more effective and
766 achieve more equitable effects. This should be conducted in partnership with those
767 working in public health policy and practice.
768
769 The quality of evidence included in the review was generally low, limiting the
770 conclusions that can be drawn. Those developing, delivering and evaluating
771 interventions should make greater efforts to ensure that higher quality evaluations
772 are conducted, particularly in terms of capturing longitudinal data on outcomes that
773 can be directly related to diet and health. This may require focusing evaluative

774 resources on answering very specific questions well, rather than more diffuse
775 questions less well.[82-84]
776
777 We also found that many interventions were very poorly described. Guidance is now
778 available on describing interventions, and intervention components, to facilitate
779 replication and syntheses.[68, 85] Researchers and journal editors should make greater
780 efforts to ensure more consistent use of these tools.
781
782 Finally, whilst we found some evidence of differential effects of interventions across
783 population sub-groups, such analyses were mostly absent. Many evaluation studies
784 may have been under-powered to explore such effects. However, there is good
785 theoretical, and growing empirical, evidence that some interventions – particularly
786 those lower down the Nuffield Ladder – are likely to be less effective in those with
787 fewer access to resources.[71, 75-78] Researchers should consider where differential
788 effects may be most likely to occur and design evaluations in such a way that they
789 are able to draw firm conclusions on whether or not such effects occurred.
790
791

CONCLUSIONS

Most interventions identified focused on providing information aimed at adults in US fast-food chains and collected only customer level outcomes; some of these interventions included a function of enabling choice. Overall, most studies were of low or moderate quality. More ‘intrusive’ interventions which restricted or guided choice generally showed a positive impact on food outlet and customer level outcomes. However, interventions which simply provided information or enabled choice had a negligible impact. Qualitative findings were reported for many studies, particularly around acceptability and process, and these provide useful learning to inform the development of interventions. Interventions involving incentives, and more ‘intrusive’ interventions (functions further up the Nuffield ladder, e.g. restrict choice, ‘incentives’) generally showed consistent positive effects on catering practices and the energy value of foods purchased by customers.

References

1 Jaworowska A, Blackham T, Davies IG, Stevenson L. Nutritional challenges and health implications of takeaway and fast food. *Nutr Rev* 2013; **71:** 310-318.

2 Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obes Rev* 2012; **13:** 329-346.

3 Summerbell C, Douthwaite W, Whittaker V*, et al.* The association between diet and physical activity and subsequent excess weight gain and obesity assessed at 5 years of age or older: a systematic review of the epidemiological evidence. *Int J Obes* 2009; **33:** S1-S92.

4 Rosenheck R. Fast food consumption and increased caloric intake: a systematic review of a trajectory towards weight gain and obesity risk. *Obes Rev* 2008; **9:** 535-547.

5 Riley M. Marketing eating out. The influence of social culture and innovation. *Br Food J* 1994; **96:** 15-18.

6 Hawkes C. Marketing activities of global soft drink and fast food companies in emerging markets: a review. *Globalization, Diets and Noncommunicable Diseases*. World Health Organization: Geneva, Switzerland 2002

7 Adams J, Goffe L, Brown T*, et al.* 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). *Int J Behav Nutr Phys Act* 2015; **12:** 51.

8 Maguire ER, Burgoine T, Monsivais P. Area deprivation and the food environment over time: A repeated cross-sectional study on takeaway outlet density

and supermarket presence in Norfolk, UK, 1990–2008. *Health Place* 2015; **33:** 142-147.

9 Lytle LA. Measuring the Food Environment: State of the Science. *Am J Prev Med* 2009; **36:** S134-S144.

10 Jebb SA. The Public Health Responsibility DealFood Network. *Nutr Bull* 2012; **37:** 355-358.

11 Bowen D, Barrington W, Beresford S. Identifying the effects of environmental and policy change interventions on healthy eating. *Annu Rev Public Health* 2015; **18:** 289-230.

12 National Institute for Health and Clinical Excellence. Methods for the development of NICE public health guidance (third edition). National Institute for Health and Clinical Excellence: London 2012.

13 Liberati A, Altman DG, Tetzlaff J*, et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ* 2009; **339:** b2700.

14 Hillier-Brown FC, Moore HJ, Lake AA*, et al.* The effectiveness of interventions targeting specific out-of-home food outlets: protocol for a systematic review. *Syst Rev* 2014; **3**.

15 Ni Mhurchu C, Aston LM, Jebb SA. Effects of worksite health promotion interventions on employee diets: a systematic review *BMC Public Health* 2010; **10:** 62

16 Brown T, Summerbell C. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence. *Obes Rev* 2009; **10:** 110-141.

17 Glanz K, Bader M, Iyer S. Retail grocery store marketing strategies and obesity: An integrative review. *Am J Prev Med* 2012; **42:** 503-512.

18 Policy Process and Practice. *Public Health: Ethical Issues*. Nuffield Council on Bioethics London 2007; pp 29-47.

19 Long MW, Tobias DK, Cradock AL, Batchelder H, Gortmaker SL. Systematic review and meta-analysis of the impact of restaurant menu calorie labeling. *Am J Public Health* 2015; **105:** e11-e24.

20 Sinclair SE, Cooper M, Mansfield ED. The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. *J Acad Nutr Diet* 2014; **114:** 1375-1388.e1315.

21 Gittelsohn J, Lee-Kwan SH, Batorsky B. Community-Based Interventions in Prepared-Food Sources: A Systematic Review. *Prev Chronic Dis* 2013; **10:** e180.

22 Effective Public Health Practice Project. (2009). Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies. http://www.ephpp.ca/tools.html

23 Armstrong R, Waters E, Doyle J. Chapter 21: Reviews in public health and health promotion In: Higgins J, Green S (eds.). *Cochrane Handbook for Systematic Reviews of Interventions Version 510 [updated March 2011]*. The Cochrane Collaboration, 2011

24 Evans T, Brown H. Road traffic crashes: operationalizing equity in the context of health sector reform. *Inj Control Saf Promot* 2003; **10:** 11-12.

25 Bambra C, Hillier-Brown FC, Cairns JM, Kasim A, Moore HJ, Summerbell CD. How effective are interventions at reducing socio-economic inequalities in obesity amongst children and adults? Two systematic reviews. *Public Health Res* 2015; **3:** 1.

879 26 Egan M, Bambra C, Petticrew M, Whitehead M. Reviewing evidence on
880 complex socialinterventions: appraising implementation in systematic reviews of the
881 health effects of organisational-level workplace interventions. *J Epidemiol*
882 *Community Health* 2009; **63:** 4-11.
883 27 Adams J, Giles EL, McColl E, Sniehotta FF. Carrots, sticks and health
884 behaviours: a framework for documenting the complexity of financial incentive
885 interventions to change health behaviours. *Health Psychol Rev* 2014; **8:** 286-295.
886 28 Giles EL, Robalino S, McColl E, Sniehotta FF, Adams J. The effectiveness of
887 financial incentives for health behaviour change: systematic review and meta-
888 analysis. *PLoS One* 2014; **9:** e90347.
889 29 Michie S, van Stralen MM, West R. The behaviour change wheel: A new
890 method for characterising and designing behaviour change interventions. *Implement*
891 *Sci* 2011; **6:** 42.
892 30 Popay J, Roberts H, Sowden A, Petticrew M, Rodgers M. Guidance on the
893 Conduct of Narrative Synthesis in Systematic Reviews. A Product from the ESRC
894 Methods Programme. Lancaster University: Lancaster 2006.
895 31 Acharya RN, Patterson PM, Hill EP, Schmitz TG, Bohm E. An Evaluation of
896 the "TrEAT Yourself Well" Restaurant Nutrition Campaign. *Health Educ Behav* 2006;
897 **33:** 309-324.
898 32 Bedard K, Kuhn P. Making Nutritional Information Digestible: Effects of a
899 Receipt-Based Intervention on Restaurant Purchases. National Bureau of Economic
900 Research Working Paper No. 19654. National Bureau of Economic Research:
901 Cambridge, MA 2013.
902 33 Bollinger B, Leslie P, Sorensen T. Calorie Posting in Chain Restaurants. *Am*
903 *Econ J: Econ Pol* 2011; **3:** 91-128.

34 Elbel B, Kersh R, Brescoll VL, Dixon LB. Calorie labeling and food choices: a first look at the effects on low-income people in New York City. *Health Aff* 2009; **28:** w1110-1121.

35 Elbel B, Mijanovich T, Dixon LB*, et al.* Calorie labeling, fast food purchasing and restaurant visits. *Obesity* 2013; **21:** 2172-2179.

36 Finkelstein EA, Strombotne KL, Chan NL, Krieger J. Mandatory Menu Labeling in One Fast-Food Chain in King County, Washington. *Am J Prev Med* 2011; **40:** 122-127.

37 Namba A, Auchincloss A, Leonberg BL, Wootan MG. Exploratory analysis of fast-food chain restaurant menus before and after implementation of local calorie-labeling policies, 2005-2011. *Prev Chronic Dis* 2013; **10:** e101.

38 Angell SY, Cobb LK, Curtis CJ, Konty KJ, Silver LD. Change in Trans Fatty Acid Content of Fast-Food Purchases Associated With New York City's Restaurant RegulationA Pre–Post Study. *Ann Intern Med* 2012; **157:** 81-86.

39 Chen R, Smyser M, Chan N, Ta M, Saelens BE, Krieger J. Changes in Awareness and Use of Calorie Information After Mandatory Menu Labeling in Restaurants in King County, Washington. *Am J Public Health* 2015; **105:** 546-553.

40 Dumanovsky T, Huang CY, Nonas CA, Matte TD, Bassett MT, Silver LD. Changes in energy content of Lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. *BMJ* 2011; **343:** d4454.

41 Eldridge AL, Snyder MP, Green Faus NG, Kotz K. Development and Evaluation of a Labeling Program for Low-Fat Foods in a Discount Department Store Foodservice Area. *J Nutr Educ* 1997; **29:** 159-161.

928 42 Fitzgerald CM, Kannan S, Sheldon S, Eagle KA. Effect of a promotional
929 campaign on heart-healthy menu choices in community restaurants. *J Am Diet*
930 *Assoc* 2004; **104:** 429-432.
931 43 Krieger JW, Chan NL, Saelens BE, Ta ML, Solet D, Fleming DW. Menu
932 Labeling Regulations and Calories Purchased at Chain Restaurants. *Am J Prev Med*
933 2013; **44:** 595-604.
934 44 Licata M, Gillham K, Campbell E. Health promotion practices of restaurants
935 and cafes in Australia: changes from 1997 to 2000 using an annual telemarketing
936 intervention. *Health Prom Int* 2002; **17:** 255-262.
937 45 Nothwehr FK, Snetselaar L, Dawson J, Schultz U. Promoting Healthy Choices
938 in Non-Chain Restaurants: Effects of a Simple Cue to Customers. *Health Promot*
939 *Pract* 2013; **14**.
940 46 Pandya. Examining the effects of a healthy restaurant intervention on
941 customers' purchases of healthier food options in Latino family-owned restaurants.
942 University of Kansas: Lawrence, KS 2013.
943 47 Pulos E, Leng K. Evaluation of a voluntary menu-labeling program in full-
944 service restaurants. *Am J Public Health* 2010; **100:** 1035-1039.
945 48 Wansink B, Hanks AS. Calorie reductions and within-meal calorie
946 compensation in children's meal combos. *Obesity* 2014; **22:** 630-632.
947 49 Wiggers J, Considine R, Hazell T, Haile M, Rees M, Daly J. Increasing the
948 Practice of Health Promotion Initiatives by Licensed Premises. *Health Educ Behav*
949 2001; **28:** 331-340.
950 50 Bagwell S. Healthier catering initiatives in London, UK: an effective tool for
951 encouraging healthier consumption behaviour? *Critical Public Health* 2014; **24:** 35-
952 46.

51 Bruemmer B, Krieger J, Saelens BE, Chan N. Energy, Saturated Fat, and Sodium Were Lower in Entr,es at Chain Restaurants at 18 Months Compared with 6 Months Following the Implementation of Mandatory Menu Labeling Regulation in King County, Washington. *J Acad Nutr Diet* 2012; **112:** 1169-1176.

52 Gase LN, Kaur M, Dunning L, Montes C, Kuo T. What menu changes do restaurants make after joining a voluntary restaurant recognition program? *Appetite* 2015; **89:** 131-135.

53 Hanni KD, Garcia E, Ellemberg C, Winkleby M. Steps to a Healthier Salinas: Targeting the Taqueria: Implementing Healthy Food Options at Mexican American Restaurants. *Health Promot Pract* 2009; **10:** S91-S99.

54 Reimann M, Bechara A, MacInnis D. Leveraging the happy meal effect: Substituting food with modest nonfood incentives decreases portion size choice. *J Exp Psychol Appl* 2015; **21:** 276-286.

55 Tandon PS, Zhou C, Chan NL*, et al.* The Impact of Menu Labeling on Fast-Food Purchases for Children and Parents. *Am J Prev Med* 2011; **41:** 434-438.

56 Saelens BE, Chan NL, Krieger J*, et al.* Nutrition-Labeling Regulation Impacts on Restaurant Environments. *Am J Prev Med* 2012; **43:** 505-511.

57 Downs JS, Wisdom J, Wansink B, Loewenstein G. Supplementing menu labeling with calorie recommendations to test for facilitation effects. *Am J Public Health* 2013; **103:** 1604-1609.

58 Horgen KB, Brownell KD. Comparison of price change and health message interventions in promoting healthy food choices. *Health Psychol* 2002; **21:** 505-512.

59 Lee-Kwan SH, Goedkoop S, Yong R*, et al.* Development and implementation of the Baltimore healthy carry-outs feasibility trial: process evaluation results. *BMC Public Health* 2013; **13:** 638.

60 Shah AM, Bettman JR, Ubel PA, Keller PA, Edell JA. Surcharges plus unhealthy labels reduce demand for unhealthy menu items. *J Marketing Res* 2014; **51:** 773-789.

61 Elbel B, Gyamfi J, Kersh R. Child and adolescent fast-food choice and the influence of calorie labeling: A natural experiment. *Int J Obes* 2011; **35:** 493-500.

62 Baum WM, Rachlin HC. Choice as time allocation. *J Exp Anal Behav* 1969; **12:** 861-874.

63 Rosenstock IM, Strecher VJ, Becker MH. Social Learning Theory and the Health Belief Model. *Health Educ Behav* 1988; **15:** 175-183.

64 Eyles H, Ni Mhurchu C, Nghiem N, Blakely T. Food Pricing Strategies, Population Diets, and Non-Communicable Disease: A Systematic Review of Simulation Studies. *PLoS Med* 2012; **9:** e1001353.

65 World Health Organization. Using price policies to promote healthier diets. WHO Regional Office for Europe: Copenhagen, Denmark 2015.

66 Gattone L. (2016). If you respect food, ask the restaurant for a doggy bag for leftovers. http://www.lifegate.com/people/lifestyle/france-food-restaurants-doggy-bag

67 Dombrowski SU, Sniehotta FF, Avenell A, Coyne JC. Current issues and future directions in Psychology and Health: Towards a cumulative science of behaviour change: Do current conduct and reporting of behavioural interventions fall short of best practice? *Psychol Health* 2007; **22:** 869-874.

68 Hoffmann TC, Glasziou PP, Boutron I*, et al.* Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ* 2014; **348**.

69 Szűcs V, Szabó E. Chow Mein and Halva in Europe? Consumption Frequency of Different Cuisines in Europe. *Int Proc Chem Biol Environ Eng* 2016; **95:** 50-56.

70 Nikolaou C, Lean M, Hankey C. Can calorie labelling alter customer purchasing patterns? *Obes Rev* 2014; **15:** 185.

71 Adams J, Mytton O, White M, Monsivais P. Why Are Some Population Interventions for Diet and Obesity More Equitable and Effective Than Others? The Role of Individual Agency. *PLoS Med* 2016; **13:** e1001990.

72 Capewell S, Graham H. Will cardiovascular disease prevention widen health inequalities? *PLoS Med* 2010; **7:** e1000320.

73 Cappuccio FP, Capewell S, Lincoln P, McPherson K. Policy options to reduce population salt intake. *BMJ* 2011; **343:** d4995.

74 Frieden TR. A framework for public health action: the health impact pyramid. *Am J Public Health* 2010; **100:** 590-595.

75 Beauchamp A, Backholer K, Magliano D, Peeters A. The effect of obesity prevention interventions according to socioeconomic position: a systematic review. *Obes Rev* 2014; **15:** 541-554.

76 Lorenc T, Petticrew M, Welch V, Tugwell P. What types of interventions generate inequalities? Evidence from systematic reviews. *J Epidemiol Community Health* 2013; **67:** 190-193.

77 Sumar N, McLaren L. Impact on social inequalities of population strategies of prevention for folate intake in women of childbearing age. *Am J Public Health* 2011; **101:** 1218-1224.

78 White M, Adams J, Heywood P. How and why do interventions that increase health overall widen inequalities within populations? . In: Babones S (ed.). *Social inequality and public health*. Policy Press: Bristol 2009; pp 65-82.

79 Diepeveen S, Ling T, Suhrcke M, Roland M, Marteau TM. Public acceptability of government intervention to change health-related behaviours: a systematic review and narrative synthesis. *BMC Public Health* 2013; **13:** 1-11.

80 Hargreaves K, Amos A, Highet G*, et al.* The social context of change in tobacco consumption following the introduction of 'smokefree' England legislation: A qualitative, longitudinal study. *Soc Sci Med* 2010; **71:** 459-466.

81 Thomas-Meyer M, Mytton O, Adams J. Public responses to proposals for a tax on sugar-sweetened beverages: a thematic analysis of online reader comments posted on major UK news websites. *PLoS One***:** under review.

82 Craig P, Cooper C, Gunnell D*, et al.* Using natural experiments to evaluate population health interventions: new Medical Research Council guidance. *J Epidemiol Community Health* 2012; **66:** 1182-1186.

83 Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ* 2008; **337**.

84 Roberts K, Cavill N, Rutter H. Standard Evaluation Framework for dietary interventions. National Obesity Observatory: Oxford 2012.

85 Michie S, Richardson M, Johnston M*, et al.* The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Ann Behav Med* 2013; **46:** 81-95.

Table 2 Adapted typology of study designs and quality

Study design	Study design quality score
Repeat cross-sectional	Weak
Repeat cross-sectional with control	Moderate
Repeat cross-sectional with cohort subgroup	Moderate
Cohort	Moderate
Repeat cross-sectional with control and controlled cohort subgroup	Strong
Controlled before-after (same participants)	Strong
Controlled trial	Strong

Table 2a Summary of included studies with customer level outcomes (n=23)

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
Trans fat law (n=1)							
Angell 2012[38]**	Repeat cross-sectional	11 fast-food chains, NYC, USA	Restrict choice	Environmental restructuring	Environmental/social planning; legislation	5	↑ (moderate)
Changing pre-packed children's meal content (n=1)							
Wansink 2014[48]	Repeat cross sectional	McDonald's restaurants (fast-food chain), USA	Restrict choice	Environmental restructuring	Environmental/social planning; communication/ marketing	3	↑ (weak)
Price increases for unhealthier choices (n=2)							
Price increases for unhealthier choices only							
Shah 2014[60] *(sin tax menu arm)*	Controlled clinical trial	One moderately priced restaurant, which specialised in 'small plates' to share, USA	Guide choice (disincentives)	Coercion	Fiscal	5	↓ (strong) unhealthy items ordered by men and women
Price increases for unhealthy choices + signposting							
Shah 2014[60] *(unhealthy label + sin tax menu arm)*	Controlled clinical trial	One moderately priced restaurant, which specialised in 'small plates' to share, USA	Guide choice (disincentives)	Environmental restructuring; education; coercion	Communication/ marketing; environmental/ social planning; fiscal	5	↑ (strong) decrease in unhealthy items ordered by men and women
Incentives (contingent rewards) (n=1)							
Reimann 2015[54]	Cohort	Chain sandwich restaurant, USA	Guide choice (incentives)	Incentives	Unclear (customers	7	↑ (moderate) customers

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
					offered half portions for same price as full portion, plus a lottery ticket)		choosing half sized portions
Price reductions for healthier choices (n=2)							
Price reduction for healthier choices only							
Horgen & Brownell 2002[58]	Controlled clinical trial	Delicatessen-style restaurant (cafeteria), USA	Guide choice (incentives)	Incentives	Fiscal	6	↑ (weak) healthy food purchase
Price reduction for healthier choices + health promotion							
Horgen & Brownell 2002[58]	Controlled clinical trial	Delicatessen-style restaurant (cafeteria), USA	Guide choice (incentives)	Environmental restructuring; education; incentives; persuasion; enablement	Communication/ marketing; environmental/social planning; fiscal	6	↑ (weak) healthy food purchase
Signposting (n=8)							
Signposting only							
Shah 2014[60] *(unhealthy label menu arm)*	Controlled clinical trial	One moderately priced restaurant, which specialised in 'small plates' to share, USA	Enable choice	Environmental restructuring; education	Communication/ marketing; environmental/ social planning;	5	↕ (strong) decrease in unhealthy items ordered
Eldridge 1997[41]	Repeat cross-	Food service areas of large discount department	Enable choice	Environmental restructuring;	Communication/ marketing;	6	↕ (weak) sales of 'healthier' food

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
	sectional	store chain, USA		education	environmental/ social planning;		items
Pandya 2013[46]	Repeat cross-sectional	Latino family-owned restaurants, Kansas, USA	Enable choice	Environmental restructuring; education	Communication/ marketing; environmental/social planning	7	↓ (weak) healthy food purchases
Sign posting + menu changes							
Nothwehr 2013[45]	Repeat cross-sectional	Non-chain owner-operated full menu, sit-down restaurants with typical Midwestern fare, Iowa, USA	Enable choice	Environmental restructuring; education	Communication/ marketing; environmental/social planning;	8	↓ (weak) healthy food purchases
Lee-Kwan 2013[59]	Controlled clinical trial	Non-franchised small local food establishments that sell ready-to-eat food and beverages for off-premise consumption, Baltimore, USA	Enable choice	Environmental restructuring; education; incentives	Communication/ marketing; environmental/social planning;	8	↑ (moderate) healthy food purchases
Signposting + health promotion/social marketing campaign							
Fitzgerald 2004[42]	Repeat cross-sectional	Community restaurants varied from counter service to table-service, USA	Enable choice	Environmental restructuring; education; persuasion	Communication/ marketing; environmental/social planning;	6	↓ (weak) sales of 'heart healthy' menu items
Acharya 2006[31]	Repeat cross-sectional with control	Restaurant chains (fine-dining and moderately priced, family-style restaurants (Mexican,	Enable choice	Environmental restructuring; education; incentives;	Communication/ marketing; environmental/social planning;	6	↑ (moderate) healthy food purchases

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
		upscale pizza, and 40s-style diner), California, USA		persuasion			
Horgen & Brownell 2002[58] *(health promotion condition)*	Controlled clinical trial	Delicatessen-style restaurant (cafeteria), USA	Enable choice	Environmental restructuring; education; persuasion; enablement	Communication/ marketing; environmental/social planning	6	↑ (weak) healthy food purchase
Calorie labelling law (n=10)							
Calorie labelling law only							
Bollinger 2011[33]	Repeat cross-sectional with control plus subgroup cohort	Starbucks Cafes, New York City (NYC), USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	5	↑ (strong)
Chen 2015[39]	Repeat cross sectional	Regulated chain or fast food restaurants in King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	5	↑ (weak) saw and used calorie information
Dumanovsky 2011[40]**	Repeat cross-sectional	11 fast-food chains, NYC, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning;	5	↓ (moderate)

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
					legislation		
Krieger 2013[43]***	Repeat cross-sectional, retrospective	Restaurants from 10 chains Subway; McDonald's; Taco del Mar; Taco Time; Starbuck's; Quizno's; Tully's; Jack in the Box; Burger King; Taco Bell. King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	4	↓ (moderate)
Namba 2013[37]	Repeat cross-sectional with control	Large chain fast food restaurants, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	3	↔ (strong) adults and children
Elbel 2009[34]	Repeat cross-sectional with control	Chain restaurants with >15 establishments - McDonald's, Burger King, Wendy's, KFC in NYC, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	4	↔ (moderate) adults and children
Elbel 2013[35]	Repeat cross-sectional (pre and post legislation) with control	Fast food restaurants (McDonald's and Burger King) in Philadelphia (which implemented calorie labelling policies) and Baltimore (which did not and acted as a	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	5	↔ (moderate)

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
	cohort *(difference in difference design)*	matched comparison city), USA					
Finkelstein 2011[36]	Repeat cross-sectional with control	Mexican fast-food restaurant chain - Taco Time Northwest, King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	3	↔ (moderate)
Tandon 2011[55]	Controlled before and after study (same participants)	Chain restaurants, King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	4	↔ (weak) children
Calorie labelling law + nutritional recommendation information							
Downs 2013[57]	Controlled clinical trial	2 McDonalds restaurants in NYC, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/ social planning;	4	↔ (moderate)
Voluntary calorie labelling (n=1)							
Pulos & Leng 2010[47]	Repeat cross-sectional	Full service locally owned (non-chain) restaurants; 'casual, midrange', USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/ social planning	6	↑ (weak) energy, fat and sodium levels of foods purchased
Personalised receipts (n=1)							
Bedard & Kuhn 2013[32]	Repeat cross-	Burgerville restaurants (fast-food chain),	Provide information	Environmental restructuring;	Communication/ marketing	4	↔ (weak)

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)[2]
	sectional with control	California, USA		education; persuasion			

[1] Implementation score was determined using a checklist for obesity related interventions[25] adapted from workplace interventions[26]
[2]energy purchased unless otherwise stated, Key: effective (↑); equally effective as comparison group (↔); effectiveness mixed by outcome or gender (↕); or not effective (↓); **Dumanovsky 2011 and Angell 2012 used same data set; ***Krieger 2013 used the same data set as Saelens 2012 (food outlet level outcomes, Table 3)

Table 2b Summary of included studies with food outlet level outcomes (n=7)

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)
Award schemes (n=2)							
Gase 2015[52]	Cohort	Licensed retail restaurants, Los Angeles County, USA	Restrict choice	Restriction; Environmental restructuring	Regulation; Environmental/social planning	6	↑ (weak) reduced-sized portions available and 'healthier' children's meals
Bagwell 2014[50]	Cohort	Small independent catering outlets, London, UK	Restrict choice	Restriction; Environmental restructuring; Education	Communication/ marketing; Regulation; Environmental/social planning	2	↑ (weak) 'healthy' criteria met by businesses (inc. catering practices, 'healthy' options, health promotion)
Signposting (n=1)							
Signposting + health promotion/social marketing campaign							
Hanni 2009[53]	Cohort	Taquerias - privately owned, fast-food-style Mexican restaurants, USA	Enable choice	Environmental restructuring; education; incentives; persuasion; enablement; training; modelling	Communication/ marketing; environmental/social planning; guidelines	9	↑ (weak) promoting 'healthier' food items
Telemarketing of healthy food choices (n=2)							
Wiggers 2001[49]**	Repeat cross-	Licenced hotels, clubs and nightclubs, New South	Enable choice	Education	Communication/ marketing;	6	↑ (weak) serving healthier food

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)
	sectional plus subgroup cohort	Wales, Australia			environmental/social planning; service provision		options
Licata 2002[44]**	Repeat cross-sectional plus subgroup cohort	Restaurants and cafés, New South Wales, Australia	Enable choice	Education	Communication/ marketing; environmental/social planning; service provision	6	↓ (weak) nutrition-related health promotion practices
Calorie labelling law (n=2)							
Calorie labelling law only							
Bruemmer 2012[51]	Cohort	Chain restaurants with >4 establishments (sit down and fast food).Burgers (e.g., McDonalds, Burger King), pizza (e.g.,Pizza Hut, Dominos), sandwich/sub (e.g., Subway, Blimpie), or Tex-Mex (e.g., Taco Time, Taco del Mar). King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning; legislation	3	↑ (weak) energy content of main meals
Saelens 2012[56]***	Controlled before and after study (retrospecti	Fast food chain restaurants, King County, USA	Provide information	Environmental restructuring; education	Communication/ marketing; environmental/social planning;	4	↔ (strong) 'healthfulness' of adult and children's menus

Study ID	Study design	Food outlet type	Nuffield intervention ladder	Intervention function	Policy category	Implementation score[1]	Summary impact ↓↑↔↕ (global quality assessment score)
	ve)				legislation		

[1] Implementation score was determined using a checklist for obesity related interventions[25] adapted from workplace interventions[26]
Key: effective (↑); equally effective as the comparison group (↔); effectiveness mixed by outcome or gender (↕); or not effective (↓)
**Licata 2002 and Wiggers 2001 used same data pool and split by different settings; ***Saelens 2012 used the same data set as Krieger 2013 (customer level outcomes, Table 2)