Effects of changes in the economic environment on diet- and physical activity-related behaviours and corollary outcomes: a large-scale scoping review

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Executive Summary

Background
Changing the economic environment has some potential to influence patterns of diet and physical activity and thereby improve population health and reduce inequalities. We conducted a systematic scoping review to identify and describe current evidence for the effects of either specific interventions that change prices or income, or general exposure to variations in prices or income, on diet- and physical activity-related behaviours, their proximal consequences (food, energy or nutrient intake or energy expenditure) and their more distal consequences (risk factors for non-communicable diseases).

Methods
Highly sensitive systematic electronic searches were conducted in parallel with snowball searches to capture the breadth and depth of relevant literature. Retrieved records were prioritised for manual screening using text-mining technologies. A core dataset was extracted from eligible full-text articles to inform assessment of the existing empirical evidence.

Results
Overview
1,053,908 unique records were retrieved, with 52,696 abstracts manually screened for eligibility. 880 full-text articles were included in the final review, of which 81% focused on high income country populations and 4% included a focus on UK populations. 22% of studies incorporated evidence relating to specific interventions, of which the large majority (89%) focused on diet-related outcomes.

Economic correlates and determinants of target outcomes
The literature on associations between prices or income and diet- or physical activity-related outcomes is difficult to interpret. These associations may often be non-linear, moderated by a wide range of other factors and mediated by complex mechanisms. In addition, many studies reported null associations or statistically significant associations in the opposite direction to that expected. This suggests that while evidence from observational studies could provide pointers for potential interventions, generalised propositions about the causal pathways linking economic
incentives, diet and physical activity must be treated with caution and extrapolations from economic theory need to be tested empirically.

Interventions

Four main categories of interventions were encountered across studies conducted in high income countries: price promotions (19%), taxes (33%), supply-side subsidies (26%) and transfer payments (47%). These interventions alter incentives by changing prices except for transfer payments, which alter incentives by changing income. In general, evidence for the effects of these interventions was mixed or equivocal, with few consistent overall patterns of findings. No eligible studies of direct (minimum or maximum) pricing legislation were identified. Personal financial incentives were not considered in this review. Studies used a variety of quasi-experimental and simulation designs that vary considerably in the degree to which they support causal inferences concerning the effects of interventions, and were heterogeneous with respect to the populations, interventions, comparators or counterfactuals, outcomes and moderators assessed.

The available evidence as reported by study authors (but not critically appraised in this review) is summarised by behavioural domain and intervention category as follows:

Diet

Price promotions: Studies typically assessed simple discounts applied to healthy foods and non-alcoholic beverages. One relatively homogeneous cluster of studies of simple discounts on healthy foods in vending machines or cafeterias in schools or workplaces consistently reported that reducing the unit retail prices of healthier foods and beverages was associated with increased purchasing of those foods. This finding provides prima facie evidence of the likely presence of a beneficial effect of simple discounts on purchasing of healthier foods. Few studies of other types of price promotion, such as multi-buy deals, price-pack deals, price deals, introductory pricing or rebates, were identified.

Taxes: Studies typically evaluated taxes on less healthy foods or non-alcoholic beverages, or specific nutrients (e.g. fats or sugars), usually by modelling the impacts of relatively small hypothetical tax changes rather than by studying real-world tax reforms. These studies typically predicted that taxes would lead to small or moderate reductions in levels of purchasing; a subset typically predicted negligible impacts on weight status. Several authors noted that higher tax rates might be needed to have a meaningful impact, and several
highlighted the potentially regressive nature of such taxes. Few studies modelled potential supply-side responses (such as product reformulation to avoid taxes). Those that did typically found that such responses attenuated the predicted benefits, suggesting that studies that had not modelled such effects may have overestimated the benefits of taxes.

**Supply-side subsidies:** Studies assessed supply-side subsidies applied to school meals (61%), healthy foods (27%), healthy non-alcoholic beverages (9%), specific nutrients (9%), agricultural subsidies or subsidy removal (3%), other meals (3%) or food transportation or delivery (3%). Both within and across studies of the US National School Lunch Program (NSLP) and the School Breakfast Program (SBP), mixed results were reported with respect to large sets of outcomes relating to food or nutrient intake and (or) body weight status. Primary studies of subsidies on healthier foods, healthier non-alcoholic beverages and specific nutrients typically used a similar modelling approach to that described above for taxes, incorporated similar assumptions and reported similarly equivocal findings.

**Transfer payments:** Transfer payments included restricted or unrestricted income transfers, welfare benefits or welfare assistance programs and tax credits. 90% of studies investigated the US Supplemental Nutrition Assistance Program (SNAP - formerly known as the Food Stamp Program) or the Special Supplemental Nutrition Program for Women Infants and Children (WIC). Mixed results were reported within and across these studies with respect to associations between SNAP or WIC participation or benefits and large sets of outcomes relating to food purchasing behaviours, shopping, mealtime and snacking behaviours, food or nutrient intake and (or) body weight status. Reviews typically reported similarly equivocal conclusions.

**Physical activity**

In line with findings from existing more focused reviews, no primary studies of price promotions or supply-side subsidies applied to physical activity-related products or services were identified. Few primary studies or reviews of the use of taxes, tax exemptions or transfer payments to promote physical activity were identified. The exceptions were studies of the physical activity-related outcomes of congestion charging, taxes on beer and cigarettes, employer-sponsored transfer payments to employees for use to visit health clubs or travel to work using public transport, and tax credits available to parents who enrolled their children in organised physical activity programmes.
Implications for research

This scoping review has identified two clear gaps in the evidence base that could be addressed through primary research. These concern the effects of fiscal policies designed to alter economic incentives to promote physical activity, and the effects of direct (minimum or maximum) pricing legislation on diet- or physical activity-related behaviours. In parallel, there is clear scope to measure actual behavioural responses to (pilot) interventions in the economic environment, such as taxes on less healthy soft drinks, using prospective field-based studies conducted in UK populations. This would complement and test current (largely non-UK) modelled evidence for predicted behavioural responses to such interventions, which inevitably rely on simplified representations of complex systems and a variety of assumptions.

While all types of intervention with substantive numbers of primary studies have been the subject of previous reviews, there is clear scientific scope for further and more rigorous evidence synthesis in all of these categories. In practice, current initiatives to improve methods for systematic reviews of quasi-experimental studies may need to progress further before the potential return on investment from new systematic reviews of such interventions can be realised. Unlike existing reviews in this field, future reviews should incorporate systematic appraisal of the quality of included studies and use explicit, systematic qualitative or quantitative methods to synthesise results.

Conclusion

This scoping review has made the following four key contributions to the evidence base:

i) Assembly and description of a large and heterogeneous body of evidence for the effects of changes in the economic environment on diet and physical activity-related behaviours and corollary outcomes, identifying in particular a paucity of research on physical activity-related outcomes;

ii) Description of provisional typologies of economic interventions and outcomes to guide future primary research and systematic reviews;

iii) Identification of a number of ways in which studies of economic incentives may be strengthened, including testing proposed causal pathways that link interventions with intended and unintended behavioural and health outcomes and the validity of underlying theoretical assumptions;
iv) Confirmation of the need for further development of methods to support the systematic review and synthesis of the considerable body of quasi-experimental evidence in this field.
Introduction

Global burden of non-communicable diseases

Non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, certain types of cancers and chronic respiratory diseases, are the leading cause of death globally (WHO 2011a). In 2008, NCDs caused over half a million deaths in the UK and accounted for 83% of years of life lost due to premature death (11% above the European region average) (WHO 2011a). The morbidity and mortality burden of NCDs affects people in all age groups, imposing large, increasing and avoidable costs in human, social and economic terms (Beaglehole 2011a, WHO 2011a, WHO 2011b).

Major physiological and metabolic risk factors for NCDs include overweight and obesity, raised blood pressure, raised blood glucose, and raised blood cholesterol. In 2008 62% of the UK population were overweight, 25% were obese, 38% had raised blood pressure, 7% had raised blood glucose and 63% had raised blood cholesterol (WHO 2011b). Such risk factors tend to cluster disproportionately amongst people in less affluent population sub-groups, reflecting a range of underlying socio-economic determinants, and may therefore both cause and entrench poverty (Beaglehole 2011, WHO 2011b).

Health-related behaviours and their consequences

Epidemiological research evidence implicates the central role of diet and physical activity in the aetiology and prevention of a range of NCDs (Department of Health 2011, US Office of Disease Prevention and Health Promotion 2008, WHO 2010, WHO 2003). This evidence corroborates the well-rehearsed public health case that if people purchased and ate healthier foods with a lower overall energy intake and were more physically active with increased energy expenditure and improved cardiorespiratory and muscular fitness, then the prevalence and burden of risk factors and NCDs would be much reduced (WHO 2009). The UN Draft Political Declaration of the High-level Meeting on the prevention and control of NCDs explicitly recognises unhealthy diet and lack of physical activity as common factors linked to the aetiology of the most prominent NCDs, alongside tobacco use and harmful use of alcohol (United Nations 2011).
Behaviours are the aggregate of an individual’s performative actions (i.e. ‘things people do’) in response to stimuli within social, physical and economic environments to which that individual is exposed, and which therefore also provide outputs to these environments (Dusenbery 2009). Mechanisms and pathways that mediate causal relationships between diet- and physical activity-related behaviours, proximal consequences of such behaviours (food, energy and nutrient intake; energy expenditure and cardiorespiratory and muscular fitness), their more distal consequences (physiological and metabolic risk factors for NCDs) and final health outcomes (morbidity and mortality associated with NCDs) are likely to be complex, non-linear and moderated by a wide range of interacting non-modifiable and modifiable determinants. However, it is widely accepted that food, energy and nutrient intake and energy expenditure which, in turn, influence major physiological and metabolic risk factors for NCDs, have important behavioural determinants that are in principle modifiable through behaviour change (WHO 2011a, WHO 2011b).

Changes in the economic environment

This paper reports principal findings of a scoping review of the effects of changes in the economic environment on diet- and physical activity-related behaviours and corollary outcomes. The term ‘corollary outcomes’ is used to encompass both proximal and distal consequences of such behaviours.

The economic environment to which populations are exposed encompasses monetised prices, non-monetised prices (principally, time) and individual or household income. Fiscal instruments such as taxes, supply-side subsidies and transfer payments (e.g. income transfers, welfare benefits, welfare assistance programs or tax credits), legislative instruments (e.g. minimum pricing legislation) and retail practices (e.g. consumer sales promotions) have the potential to change prices and income and hence to alter remunerative incentives to consume products and services associated with healthy or less healthy diet- and physical activity-related behaviours, or to perform such behaviours. Similarly, interventions that involve the provision of personal financial incentives – rewards or penalties with a monetary value, provided directly to individuals, contingent upon performance of one or more pre-specified diet- or physical activity-related behaviours or corollary outcomes – may influence health-related behaviours via price and income mechanisms. Personal financial incentives, which involve the direct provision of rewards or penalties contingent upon specific behaviours or outcomes, were considered to be outside the scope of this review, since at least two other systematic reviews of the effects of such interventions on health-related
behaviours (including diet and physical activity) are currently in preparation (Mantzari 2012, Giles 2012).

In the UK and other post-industrial societies, remunerative incentives to purchase and consume foods and beverages have overall increased over time, due to decreases in monetised and non-monetised prices of food purchasing and preparation and concurrent increases in disposable income and purchasing power. Progressively higher wages and longer hours spent in more sedentary forms of employment have simultaneously increased the opportunity costs of time spent on physical activity (i.e. costs associated with alternative potential uses of that time). Economic theory predicts these stimuli will guide rational individuals to gain weight (Faulkner 2010, Philipson 1999). Such trends may also be compounded by market failures related to information deficits, externalities and lack of rationality, with further deleterious effects on diet- and physical activity-related behaviours and the consequences of such behaviours (Cawley 2004). Interventions that affect changes in the economic environment may therefore in principle have a role to play in shifting population-level distributions of diet- or physical activity-related behaviours and corollary outcomes, by guiding choice through incentives that promote or reinforce healthy lifestyle choices, or though disincentives that discourage less healthy lifestyle choices.

Objectives

The primary objective of this scoping review was to identify and describe studies that comprise the current evidence-base for the effects of changes in the economic environment on healthy or less healthy diet- and physical activity-related behaviours and corollary outcomes. A secondary objective was to draw inferences from the design characteristics and methods applied in existing studies that can be used to frame and strengthen the design of further original primary research and systematic reviews on the effects of interventions in the economic environment.
Methods

Figure 1 shows an abridged version of the conceptual framework developed to frame this review. This includes a proposed typology of diet- and physical activity-related behaviours and represents simplified pathways linking behaviours with their proximal and distal consequences and final health outcomes.

Figure 1. Simple conceptual framework
Criteria for considering studies for this review

Criteria for considering studies for inclusion in this scoping review are summarised in Box 1. No restrictions were imposed with respect to study publication date, publication status, or setting.

Box 1: Study eligibility criteria

Types of studies

- Primary studies: Empirical research and modelling studies of any design.
- Reviews: Systematic or non-systematic literature reviews that include empirical research and modelling studies of any design. Encompasses reviews that include overviews of existing systematic reviews or non-systematic literature reviews, possibly alongside individual empirical research and modelling studies.

Types of populations

- Any study populations other than the following:
  - Non-human participants (animal studies).
  - Neonates or infants aged less than 6 months, or corresponding mother-neonate or mother-infant dyads.

Types of interventions or exposures

- **Price promotions** applied to final consumer products or services in retail settings.
- **Taxes** applied to commodities, intermediate goods or final consumer products or services.
- **Supply-side subsidies** applied to commodities, intermediate goods or final consumer products or services.
- **Direct pricing legislation** (minimum or maximum pricing legislation) introduced by government or other legislative authorities.
- **Transfer payments** (e.g. income transfers, welfare benefits or welfare assistance programs, tax credits).
- **Price** – studies of general exposure to variation in prices of final consumer products or services as correlates or determinants of diet- and physical activity-related behaviours or corollary outcomes.
- **Income** - studies of general exposure to variation in individual or household income as
a correlate or determinant of diet- and physical activity-related behaviours or corollary outcomes.

- **Time** - studies of general exposure to variation in time (available to be) allocated to target behaviours as a correlate or determinant of diet- and physical activity-related behaviours or corollary outcomes.

**Types of comparators**
- Any comparator (no restrictions).

**Types of outcomes**
- Diet- and/or physical activity-related behaviours:
  - Purchasing behaviour(s) with respect to diet- and/or physical activity-related final consumer products or services.
  - Other behaviour(s) (e.g. physical activity or sedentary behaviours, shopping behaviours, mealtime behaviours, snacking behaviours, food preparation behaviours).
- **Proximal consequences** of behaviours:
  - Dietary intake (e.g. food or nutrient intake).
  - Energy expenditure.
- **Distal consequences** of behaviours:
  - Body weight status (e.g. BMI, overweight, obesity).
  - Blood pressure, blood glucose, blood cholesterol.
  - Other physiological or metabolic biomarkers.

**Search methods**

Electronic searches were conducted to locate eligible studies. Two complementary approaches were developed and executed in parallel to capture the breadth and depth of eligible studies across several fields of applied research: systematic searches and snowball searches.

A highly sensitive systematic search strategy was designed, tested for its sensitivity to retrieve an initial reference set of 45 potentially eligible studies, adapted and executed in 11 electronic literature databases between 11 July and 11 August 2011: MEDLINE (Ovid); EMBASE (Ovid); PsycINFO (Ovid); EconLit (EBSCO); SPORTDiscus with Full Text (EBSCO); Applied Social
Sciences Index and Abstracts (CSA Illumina); Cochrane Database of Systematic Reviews (The Cochrane Library, Wiley Online Library); Database of Abstracts of Reviews of Effects (The Cochrane Library, Wiley Online Library); Health Technology Assessment Database (The Cochrane Library, Wiley Online Library); NHS Economic Evaluations Database (The Cochrane Library, Wiley Online Library); and Database of Promoting Health Effectiveness Reviews (EPPI-Centre). Final search strategies, search dates and yields are reported in Appendix 1.

In parallel, an initial corpus of articles reporting potentially eligible studies was assembled using both personal contacts within the review team and internet-based searches (comprising general keyword searches and targeted searches of key organisational websites, including those of the World Health Organisation, the National Bureau of Economic Research and the National Institute for Health and Clinical Excellence). Snowball search techniques (Greenhalgh 2005) were then applied to initial corpus articles (i.e. internet-based searches for relevant articles cited in their reference lists and forward electronic citation tracking using PubMed and Google Scholar) in order to identify further potentially eligible studies. Finally, a second ‘layer’ of potentially eligible studies was identified by applying the same snowball search techniques to those articles identified in the first ‘layer’.

**Study selection**

**Records identified using systematic searches**

All title and abstract records retrieved by systematic searches were imported into Endnote X4, exported to a standardized tag format (RIS files) and uploaded to EPPI-Reviewer 4 systematic review software (ER4), along with records of initial corpus articles. Text-mining technologies were used to prioritise records for manual screening (Thomas 2011). The methods used are reported in detail elsewhere (Shemilt In preparation) and summarised in brief below.

Manually screened title and abstract records were assigned one of the four mutually exclusive codes, depending on the perceived probability of inclusion in the final review (see Box 2). Coding decisions were in many cases revisited as a conceptual understanding of eligible interventions, exposures and outcomes evolved during the screening process.
Box 2. Title and abstract screening codes

- Category A: Record reports a study judged to have a high probability of meeting eligibility criteria.
- Category B: Record reports a study judged likely to be excluded but requiring careful consideration because study characteristics are judged close to a borderline of eligibility criteria with respect to interventions, exposures or outcomes.
- Category C: Record reports a study judged likely to be excluded but with insufficient information in the title and abstract to warrant definitive exclusion.
- Category D: Record reports a study judged likely to be excluded with sufficient information in the title and abstract to warrant definitive exclusion.

Duplicate manual screening of an initial text-mining prioritised sample of 500 title and abstract records was conducted by two researchers (IS and RN) in order to develop consensus and consistency in the assignment of screening codes to records. This preliminary stage included formal assessment of inter-rater reliability with respect to these judgments, ex post discussion of coding decisions between the two researchers and development of a coding guide to provide a consistent basis for coding decisions in subsequent phases of screening.

Next, a Baseline Inclusion Rate (BIR) was established. A BIR is the observed inclusion rate based on manual screening of a sample of records drawn at random from the full records set. The observed BIR is used to generate an ex ante estimate of the likely number of potentially eligible records present within the full records set. This allows monitoring of progress towards the objective of identifying all potentially eligible records present within the full records set. The formula used to estimate the size of the random sample of records that needs to be screened in order to establish a reliable BIR is analogous to that used in power calculations conducted to estimate the required sample size for randomised controlled trials.

One researcher (IS) manually screened a random sample of records of the designated size and calculated BIRs with respect to records coded as: Category A; Categories A or B; and Categories A, B or C. The observed BIR with respect to Category A records was just over a third of 1% (BIR

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This stage was included because it was envisaged at the outset that screening may be undertaken by two researchers (IS and RN) screening separate allocations of retrieved records. In practice, one researcher (IS) undertook all screening.
= 0.0035). It was therefore expected that approximately 3,658 title and abstract records present within the full records set would be assigned the Category A code.

Next, one researcher (IS) manually screened a series of record sets prioritised using text-mining technologies. Title and abstract screening was stopped once the time available to be allocated to this stage had elapsed. Category A records were prioritised for retrieval and manual screening of full-text articles.

Full-text articles were retrieved via internet-based searches and three universities’ electronic library resources (University of Cambridge, University of East Anglia and King’s College London). Manual screening of full-texts was undertaken by one researcher (IS). Potentially eligible articles that could not be retrieved in full-text and those retrieved full-text articles published in a language other than English were coded as ‘identified but not assessed’. All other retrieved full-text articles were assessed and assigned one of three mutually exclusive full-text screening codes (Box 3).

Articles reporting primary studies were assigned the Category 1 code if either the main focus of the study or at least one component of the study met eligibility criteria. Similarly, articles reporting reviews were assigned the Category 1 code if at least some of their included studies met eligibility criteria. All Category 1 articles were prioritised for classification and data collection. Those eligible full-text articles that comprised multiple reports of the same study were linked into a single study record.

**Articles identified using snowball search techniques**

Articles located using snowball search techniques were retrieved in full-text format from the outset. Full-texts were re-assessed against final eligibility criteria and those judged eligible for inclusion were prioritised for classification and data collection. Included articles located using snowball search techniques that duplicated those located using systematic searches were identified manually and removed. Those eligible full-text articles that comprised multiple reports of the same study were linked into a single study record.
Box 3. Full-text screening codes

- Category 1: Full-text reports a study judged to meet eligibility criteria.
- Category 2: Full-text reports a study judged likely to be excluded but requiring careful consideration because study characteristics are judged close to a borderline of eligibility criteria with respect to interventions, exposures or outcomes.
- Category 3: Full-text reports a study judged not to meet eligibility criteria and therefore excluded (primary reason for exclusion recorded as a subsidiary code).

Data collection and analysis

All included studies were classified based on: study population/setting (UK, Other HICs and/or LMICs) (The World Bank 2011); behavioural domain (’diet’, ‘physical activity’, ‘diet and physical activity’); intervention/exposure types (see ‘Results’); and outcome domains (’purchasing’, ‘other behaviours’, ‘proximal consequences’ and/or ‘distal consequences’). The provisional classification scheme was discussed within the review team with reference to a selection of prototypical and borderline examples, and subsequently refined to inform both the analysis and development of the typology of interventions presented in the ‘Results’ section of this article.

Studies of interventions conducted in UK and/or other high income country (HIC) populations and settings were prioritised for further, more detailed data collection. Conversely, a much larger set of (largely) observational studies that included only evidence for general exposure to variations in monetised prices, income or time (available to be) allocated to target behaviours as correlates or determinants of diet- and physical activity-related behaviours or corollary outcomes were assigned a low priority for detailed data collection. The latter set of studies is referred to as ‘studies of exposures’ throughout the remainder of this report. Likewise, studies conducted in low and middle income country (LMIC) populations and settings were assigned a low priority for further data collection.

A pre-specified data collection framework was applied to intervention studies conducted in UK and/or other HIC(s). This comprised details of selected study characteristics (e.g. study design, populations, interventions, counterfactuals or comparison groups (if applicable), outcomes assessed), relevant principal findings and authors’ conclusions. For studies comprising multiple linked reports, data were collected from the report designated as the ‘primary reference’ for that
study (see ‘References’) unless it was clear that report(s) designated as ‘secondary reference(s)’ included additional details of key study characteristics, findings or conclusions not reported in the ‘primary reference’ (e.g. details of additional intervention components or of additional outcomes or analyses). Descriptive results (frequencies) are presented in tables and figures, supplemented by a narrative commentary. Whilst no formal evidence synthesis was undertaken, narrative summary statements were developed to describe the reported effects of each type of intervention based on assessments of principal findings and study authors’ conclusions across studies.
Results

Search results

Figure 2 shows the flow of studies through each stage of the scoping review. Systematic searches executed in 11 electronic literature databases retrieved a total of 1,426,114\(^2\) title and abstract records. Following automatic removal of duplicates, 1,053,908 records were available for title and abstract screening.

A total of 52,696 title and abstract records were screened manually (46,100 of these records had been prioritised using text-mining), of which 1,464 Category A records were selected for full-text screening. This indicates (based on the estimated BIR) that, within available resources, the title and abstract screening process identified approximately 40% of the total number of records within the full records set that were \textit{ex ante} expected to be selected to proceed to the full-text screening stage (1,464 of 3,658), having manually screened approximately 5% of the full records set (52,696 of 1,053,908). If manual screening had been undertaken using conventional methods (e.g. working through a list of records ordered alphabetically by lead author name), approximately 40% of the full record set (i.e. in excess of 420,000 records) would have needed to be screened to identify the same number of potentially eligible records. Results pertaining to the performance of text-mining technologies in this scoping review are reported elsewhere (Shemilt 2013). At the full-text screening stage, 148 full-texts articles were excluded, 47 were classified as reporting ‘borderline eligible’ studies, 120 further duplicates were identified and removed, 374 potentially eligible articles were classified as ‘identified but not assessed’ and the remaining 774 articles met eligibility criteria.

Parallel snowball searches identified a total of 290 eligible full-text articles. After removal of duplicate articles between systematic searches and snowball searches, and linking of multiple reports of the same study, 880 eligible studies were selected for inclusion in the final analysis, of which 181 were studies conducted in UK and/or other HIC(s) that incorporated evidence for the effects of interventions on target outcomes (or evidence for associations between interventions and target outcomes).

\footnote{This total includes 82 title and abstract records of ‘initial corpus’ articles that were concurrently uploaded to ER4.}
Figure 2. PRISMA flow diagram

Initial corpus -
Eligible or borderline eligible full-text reports identified using non-systematic internet searches and personal contacts:
(n = 82)

Records identified using systematic searches:
(n = 1,428,114)

Duplicate records identified automatically and discarded:
(n = 372,206)

Records entering title-abstract screening:
(n = 1,053,908)

Provisionally eligible full-text reports identified using snowball searches:
(n = 290)

Title and abstract records screened manually:
(n = 52,896)

Records excluded based on title-abstract:
(n = 50,335)

Provisionally eligible records entering full-text screening:
(n = 1,464)

Full-text reports excluded:
(n = 198)
- Neonates or infants: (n = 1)
- Not empirical research: (n = 28)
- No eligible interventions or exposures: (n = 92)
- No eligible outcomes: (n = 23)
- Borderline eligible: (n = 47)
- Duplicates discarded: (n = 120)
- Could not be assessed: (n = 374)
  - Unable to retrieve: (n = 328)
  - Non-English language: (n = 46)

Eligible full-text reports:
(n = 774)

Duplicate study reports identified manually and discarded:
(n = 118)

Eligible studies included:
(n = 880)
Description of included studies

Overview
The large majority of the 880 included studies focused on high income country (HIC) populations (81%, 716 of 880 - Figure 3), of which relatively few included a specific focus on UK populations (4%, 39 of 880 - Figure 3). The large majority of included studies were studies of exposures only (78%, 682 of 880 - Figure 3)\(^3\) as opposed to studies that evaluated the effects of interventions (22%, 192 of 880) or the acceptability of interventions (1%, 6 of 880).

Evidence for economic correlates and determinants of target outcomes
Figure 4 shows a breakdown of those included studies of exposures by type\(^4\). The largest subset of studies of exposures comprised those that included evidence for general exposure to variation in income (n = 734), followed by price (n = 146) and time (n = 10).

The literature on the associations between prices or income and diet- or physical activity-related outcomes is difficult to interpret, due to heterogeneity of study designs and of populations, exposures, outcomes, and covariates assessed. However, a clear, but to some extent unexpected, impression that emerges from such studies is that such associations were often non-linear, moderated by a wide range of modifiable and non-modifiable factors and mediated by complex, but ill-described mechanisms. In addition, many studies reported null associations or statistically significant associations in the opposite direction to those expected.

This suggests that while this type of correlational evidence may provide some useful pointers for policy design, it primarily serves to highlight that hasty generalisation about causal pathways linking economic incentives to behavioural and health outcomes via price and income mechanisms would be unwise. Such causal pathways should be tested empirically using well-designed intervention studies.

The few studies of general exposure to variations in time (available) to be allocated to target behaviours that were identified all assessed associations between different measures of time and target outcomes. As such, no general inferences can be drawn from these studies.

\(^3\) Including the 86 intervention studies that also include evidence associations between general exposure to variations in income, price and/or time and target outcomes, 87% of eligible studies (768 of 880) included evidence for associations between general exposure to such variations and target outcomes.

\(^4\) These figures include those intervention studies conducted in HICs that also include evidence for associations between general exposure to variations in income, price and/or time and target outcomes.
Evidence for interventions

The 181 studies described in this section were all conducted in HIC populations (6% including a focus on UK populations) and incorporated evidence for (at most) the effects of interventions on target outcomes, or (at least) associations between interventions and target outcomes. They comprised 141 primary studies, 11 systematic reviews and 29 non-systematic literature reviews published between 1974 and 2011 (median 2007). The large majority of these studies focused on associations between interventions and diet-related behaviours and/or corollary outcomes (89%, 161 of 181).

Of the 141 primary studies, 37 undertook collection of primary data for the specific study whilst 104 involved secondary analysis of existing (usually large-scale survey) datasets. The large majority of primary studies used quasi-experimental or simulation study designs. Field- or laboratory-based randomised controlled trials were rare. Only five primary studies incorporated analysis of the impact of interventions on costs or a formal economic evaluation component (Dong 2009, Jensen 2007, Lin 2010a, Sacks 2011, Wang 2010); two of these (Jensen 2007, Sacks 2011) were classified as full economic evaluations (Drummond 2005).

None of the 40 included reviews incorporated quantitative synthesis of the results of included primary studies, none reported use of explicit qualitative synthesis methods (Noyes 2011), and few incorporated systematic assessments of the quality of, or risk of bias in, included studies. All included reviews presented a narrative synthesis or summary of the characteristics and results of included studies, often supplemented by tables comprising selected details of each study.
Figure 3. Included studies by broad study type and population(s)
Figure 4. Studies of exposures by study population(s)
Table 1 classifies the 181 included study populations by country, target population and study type. The large majority of these studies were undertaken in the United States (US) (87%, 158 of 181 - Table 1). The majority of primary studies focused on population sub-groups (i.e. sub-groups defined by age, gender, ethnicity, income status etc.) rather than general adult or household populations (65%, 92 of 141 - Table 1). It is also important to note that there was substantial overlap between primary studies identified by this scoping review and the same primary studies included in the reviews.

Table 1. Intervention study populations by country, target population and study type

<table>
<thead>
<tr>
<th>Country</th>
<th>Primary study – general adult or household population</th>
<th>Primary study – population subgroup</th>
<th>Systematic review</th>
<th>Non-systematic literature review</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Denmark</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>France</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Norway</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Sweden</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>United States</td>
<td>30</td>
<td>88</td>
<td>3</td>
<td>16</td>
<td>137</td>
</tr>
<tr>
<td>UK</td>
<td>6</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>UK and other HICs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Multiple other HICs</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>92</strong></td>
<td><strong>11</strong></td>
<td><strong>29</strong></td>
<td><strong>181</strong></td>
</tr>
</tbody>
</table>

Tables 2 and 3 present typologies of interventions that affect change in the economic environment to promote diet (Table 2) and physical activity (Table 3) and show the numbers of studies that fall into each category or subsidiary type (UK and/or HIC studies only). Four main categories of interventions were encountered across 181 included studies: price promotions; taxes; supply-side subsidies; and transfer payments. No eligible studies of
direct pricing legislation (minimum or maximum pricing) applied to diet- or physical activity-related products or services were identified.

**Table 2: Studies of interventions to promote diet**

<table>
<thead>
<tr>
<th>Intervention category</th>
<th>Subsidiary intervention type</th>
<th>Primary studies (n)</th>
<th>Reviews (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price promotions (n=34)</td>
<td>Simple discounts - price restructuring in discrete settings</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Multi-buy deals</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Price-pack deals</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Price deals</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Introductory pricing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Couponing</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rebates</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Taxes (n=56)</td>
<td>Agricultural commodity tax</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Fat tax</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Snack tax</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Calorie tax</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Soft drinks tax</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Sugar tax</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tax exemptions</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Supply-side subsidies (n=47)</td>
<td>Agricultural commodities</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Agricultural commodities – subsidy removal</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>School meals</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Other meals</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Healthy foods</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Healthy non-alcoholic beverages</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Specific nutrients</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Food transportation or delivery</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Direct pricing legislation (n=0)</td>
<td>Minimum pricing legislation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Maximum pricing legislation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transfer payments (n=80)</td>
<td>Restricted income transfers, welfare benefits or welfare assistance programs</td>
<td>62</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Unrestricted income transfers, welfare benefits or welfare assistance programs</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Tax credits</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Table 3: Studies of interventions to promote physical activity

<table>
<thead>
<tr>
<th>Intervention category</th>
<th>Subsidiary intervention type</th>
<th>Primary studies (n)</th>
<th>Reviews (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price promotions (n=3)</td>
<td>Any type of price promotion</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Simple discounts - price restructuring in discrete settings</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Multi-buy deals</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Price-pack deals</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Price deals</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Introductory pricing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Couponing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rebates</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Taxes (n=3)</td>
<td>Tax exemptions</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Congestion tax</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Supply-side subsidies (n=1)</td>
<td>Physical activity products</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Physical activity services (programs)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Direct pricing legislation (n=0)</td>
<td>Minimum pricing legislation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Maximum pricing legislation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transfer payments (n=5)</td>
<td>Restricted income transfers, welfare benefits or welfare assistance programs</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Unrestricted income transfers, welfare benefits or welfare assistance programs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tax credits</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Findings pertaining to each main category and subsidiary types of interventions included in the typology are presented below. Figure 5 shows the main categories of interventions evaluated by included primary studies by the broad domains of outcomes they assessed. Due to the degree of overlap between primary studies identified by this scoping review and the same primary studies included in the reviews, the narrative summary focuses mainly on primary studies.
Figure 5. Primary studies of interventions: intervention category by outcome domain
**Price promotions**


The majority of primary studies focused on simple discounts (various percentage or absolute reductions of unit retail prices, marked on (or adjacent to) the package) applied to healthy or less healthy foods and/or non-alcoholic beverages in discrete settings such as cafeterias or vending machines in schools, universities, worksites, supermarkets or restaurants (Block 2010, Curhan 1974, French 2010, French 2001a, French 1997b, French 1997a, Ho 1998, Horgen 2002, Jeffery 1994, Michels 2008, Mishra 2011, Ni Mhurchu 2010, Richards 2009).

One of these studies assessed both simple discounts and multi-buy deals (‘Special’, ‘Combo’ and ‘Buy One Get One Free’) applied to fast foods (Richards 2009). A second included investigation of the impacts of ‘value size pricing’ (classified as a form of multi-buy deal in which larger portion sizes are offered at a lower unit retail price compared with smaller portion sizes) applied to fast food restaurant meals, with or without calorie labelling (Harnack 2008). A third investigated the effects of coupons redeemable against the purchase of a set of groceries including food and non-alcoholic beverages products (Schindler 1992). This scoping review did not identify any studies focused on the effects (associations) of price-pack deals, price deals, introductory pricing, or rebates on (with) target outcomes.
Outcomes assessed most frequently across the 16 identified primary studies of price promotions relate to food purchasing behaviour. Two studies included assessment of shopping frequency (other behaviours) (Bell 1999, Ho 1998) and three included assessment of food or nutrient intake (proximal consequences of behaviour) (French 2010, Harnack 2008, Ni Mhurchu 2010).

No primary studies of the effects (associations) of price promotions on (with) purchasing of physical activity-related final consumer products or services (or other target outcomes) were identified. This finding is consistent with those of identified reviews that included a focus on both diet and physical activity and had price promotions within their scope (Brownson 2006, Madore 2007, Matson-Koffman 2005).

Taxes

The large majority of included studies evaluating taxes considered food-related taxes (i.e. those imposed on specific foods and/or non-alcoholic beverages, or on components of their
The majority of primary studies of food-related taxes involved simulating predicted impacts of hypothetical tax or subsidy policy scenarios based on demand elasticities derived from purchasing data. Exceptions to this general approach include a primary study that used an interrupted time series with comparison group design (Oaks 2005) and two lab-based studies with experimental designs that utilised, respectively, a virtual online supermarket (Nederkoorn 2011) and a series of tasks that aimed to simulate supermarket purchasing (Epstein 2010).

The sub-set of tax scenarios most frequently evaluated in studies identified by this review comprises those imposed on soft drinks. However, the tax scenarios considered within this subset of studies were also heterogeneous with respect to both the rates considered and the range of soft drinks categories they covered. Other frequently studied food and non-alcoholic beverage tax scenarios were those classified as fat taxes, snack taxes, calorie taxes and sugar taxes (Table 2). Three studies modelled scenarios that included tax exemptions applied to healthy foods (fruits and/or vegetables Gustavsen 2004, Jensen 2007; or wholesome bread and breakfast cereals Nordstrom 2009).


This scoping review did not identify any primary studies that evaluated tax exemptions applied to physical activity-related products or services in order to promote physical
activity; this finding is consistent with that of an included review that focused on both diet and physical activity and that encompassed such taxes within its scope (Madore 2007). This scoping review did, however, identify two primary studies of the effects (associations) of congestion taxes on (with) target outcomes, which analysed data collected in Sweden (Bergman 2010) and the UK (TfL 2008). The Swedish study measured behavioural outcomes in terms of self-reported time spent in physical activity (at different intensities), whilst the UK study presented descriptive data on annual changes in the number of pedal cycles entering the central London charging zone during charging hours before and since the introduction of the congestion charge.

Primary studies of taxes imposed on other types of products identified by this scoping review (not shown in Tables 2 or 3) comprised three studies that evaluated cigarette taxes (McInnes 2009, Mellor 2011, Rashad 2006a), of which one also considered a gasoline tax (Rashad 2006a) and one also considered a tax on beer (McInnes 2009). The target outcomes assessed in these studies were: various measures of vigorous physical activity (other behaviours) (McInnes 2009); and BMI and obesity (distal consequences of behaviour) (Mellor 2011, Rashad 2006a).

All 26 primary studies of taxes identified by this review included assessment of one or more outcomes relating to purchasing behaviour. A substantial proportion of these studies also included assessment of one or more outcomes relating to distal consequences of behaviour (17 of 26); mainly measures relating to body weight status (typically BMI, overweight and/or obesity).

**Supply-side subsidies**

A supply-side subsidy is a payment or reimbursement made from public funds to either producers of commodities or intermediate goods (i.e. subsidies paid on inputs), or to retailers or providers of related final consumer products or services (i.e. subsidies paid on products or services) with the intention of stimulating an increase in quantities produced and offered for purchase and a corollary decrease in the unit retail prices. As such, supply-side subsidies change the composition of production and consumption, but have little or no effect on the total quantities of goods or services produced within a whole economy.

The largest corpus of primary studies that investigated supply-side subsidies were US studies that evaluated subsidies paid to school meals providers – specifically those paid to support provision of the National School Lunch Program (NSLP) and/or the School Breakfast Program (SBP) (n = 20). A separate, smaller corpus of primary studies evaluated subsidies applied to retail prices of healthier foods (e.g. fruits and/or vegetables, wholesome bread and breakfast cereals; n=9), healthier non-alcoholic beverages (e.g. diet soft drinks, fruit juices; n=3), and/or nutrients in foods or beverages (specifically fibres; n=3).

This scoping review did not identify any primary studies that investigated subsidies of physical activity-related products or services. One review included coverage of subsidies of physical activity-related services within its scope, but did not locate any such studies (Madore 2007).

The most commonly assessed outcomes across those primary studies that evaluated supply-side subsidies were measures of body weight status (distal consequences of behaviour). Twelve primary studies evaluated the effects (associations) of supply-side subsidies on (with) purchasing behaviour. Twelve studies included assessment of the effects (associations) of supply-side subsidies on (with) proximal consequences of behaviour; various objective measures of food intake, or energy, nutrient and/or micronutrient intake (typically a large set of measures are used within each study), or overall quality of dietary intake.
Direct pricing legislation

This scoping review did not identify any studies (primary studies or reviews) that evaluated the effects (associations) of direct pricing legislation on (with) target outcomes (i.e. legislation enacted by government or other legislative authorities that imposes either a minimum or a maximum unit retail price to be paid by consumers for a category or set of final consumer products or services, e.g. minimum prices imposed on less healthy foods or non-alcoholic beverages, or maximum prices imposed on healthy foods or non-alcoholic beverages).

Transfer payments

Transfer payments are transfers of public or private funds to members of defined population sub-groups. Subsidiary types of transfer payments include income transfers, welfare benefits or assistance programs, and tax credits (Table 2). The key distinction between transfer payments and supply-side subsidies is that the former are not intended to change relative quantities of final consumer products or services that are produced and offered for consumption (purchase).

By far the largest body of evidence identified by this scoping review was that concerned with restricted income transfers, welfare benefits or welfare assistance programs (67 primary studies and 13 reviews). The large majority of studies within this set evaluated participation in (and/or the monetary values of benefits received via participation in) one or both of two large US federal food assistance programs: the Supplemental Nutrition Assistance Program (SNAP – formerly known as the Food Stamp Program) and the Special Supplemental Nutrition Program for Women Infants and Children (WIC).

Only two primary studies evaluated an income transfer/benefit scheme restricted for use to purchase physical activity-related products or services. This cross-sectional study evaluated the impact on leisure-time and work-break physical activity of an employer-sponsored benefits/income transfer scheme made available to employees, to be redeemed against use of health clubs (Lucove 2007). Another cross-sectional study assessed the impact on walking of an employer-sponsored benefits/income transfer scheme that provided employees with a transit-pass redeemable against use of public transport (Lachappelle 2009).

Only two primary studies were identified that focused exclusively on the effects (associations) of unrestricted income transfer/welfare benefits on (with) target outcomes. One was a Norwegian study that evaluated increased income support payments (Gustavsen 2004) and the other is a UK study that modelled the impacts of receipt of (unspecified) welfare benefit payments (versus non-receipt) on intake of fruits and vegetables (Billson 1999). One further US study compared the effects of participation in each of two unrestricted income transfer/welfare assistance programmes with participation in SNAP on intake of specific types of foods, BMI and risk of obesity (Leung 2011).

Only one primary study was identified that investigated the association between tax credits and target outcomes. This was a Canadian study that assessed the association between uptake (versus non-uptake) of a Children’s Fitness Tax Credit (i.e. a tax credit provided to parents who had enrolled their children in organised physical activity programs, such as
dance and sports programs) and parents’ self-reported assessment of change in children’s levels of physical activity (other behaviour) (Spence 2010).

The types of outcomes assessed most frequently in primary studies of transfer payments related to proximal consequences of behaviour (invariably, a set of measures of food, or energy, nutrient or macronutrient intake, and/or overall quality of dietary intake) and/or to distal consequences of behaviour (invariably, various measures of body weight status). Fifteen primary studies of transfer payments assessed purchasing behaviour outcomes. Unlike the other interventions covered in preceding sections, a sizeable number of primary studies in this set evaluated transfer payments in terms of their impact on (association with) one or more behavioural outcomes other than purchasing; specifically, outcomes relating to physical activity (Cole 2004, Fox 2004a, Lachappelle 2009, Lucove 2007, Parks 2011, Spence 2010), meal time behaviours (Binkley 2006, Burstein 2000, Cole 2004, Fox 2004a, Hoynes 2007, Jilcott 2011b), shopping behaviours (Gleason 2000, Wilde 2000b) and/or snacking behaviours (Siega-Riz 2004).

**Summary of evidence for intervention effects**

The large majority of included primary studies of interventions focused on diet rather than physical activity. Few were conducted in UK populations or population sub-groups. The majority of primary studies of interventions investigated effects or associations between interventions and outcomes within targeted population sub-groups rather than general individual or household populations.

Interventions encountered in this scoping review comprise those intended to alter incentives via a price mechanism (price promotions, taxes, supply-side subsidies) and those intended to alter incentives via an income mechanism (transfer payments). Table 4 presents a top-level summary of evidence for each intervention type encountered in eligible studies identified by this scoping review. In general, evidence for (at most) the effects of eligible interventions on target outcomes, or (at least) associations between those interventions and outcomes, was mixed or equivocal with few consistent overall patterns of reported findings.

Primary studies of interventions used a variety of quasi-experimental and simulation study designs that vary considerably in the degree to which they may be judged capable of
supporting causal inferences about the observed or predicted effects of interventions (as opposed to evidence for associations between interventions and outcomes). Within each category of intervention, primary studies were heterogeneous with respect to characteristics of the populations, interventions, comparators or counterfactuals, outcomes and moderators they assessed. All such characteristics represent potential moderators of observed or predicted effects or associations and the extent to which such variables were controlled or adjusted for in analyses was highly variable. Further, included studies frequently assessed large numbers of outcomes (e.g. food and nutrient purchasing or intake with respect to large sets of foods and nutrients) and measures of similar types of outcomes were heterogeneous between studies. All these factors combined to make it unlikely that clear patterns of findings by type of intervention could be reliably discerned in advance of systematic review and synthesis of results at the level of specific outcomes.
### Table 4. Intervention types identified and brief summaries of evidence

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>Summary of studies identified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price promotions</strong></td>
<td>Range of interventions encountered:</td>
</tr>
<tr>
<td></td>
<td>• Simple discounts (price restructuring) applied to healthier foods, including low-fat snack food and fruits and vegetables, in discrete settings such as schools, universities, worksites (usually cafeterias or vending machines), supermarkets or restaurants.</td>
</tr>
<tr>
<td></td>
<td>• Simple discounts and/or multi-buy deals applied to fast foods.</td>
</tr>
<tr>
<td></td>
<td>• Coupons redeemable against the purchase of food and non-alcoholic beverages products.</td>
</tr>
<tr>
<td><strong>Summary:</strong></td>
<td>Primary studies focused exclusively on price promotions applied to foods or non-alcoholic beverages. No primary studies focused on price promotions applied to physical activity-related products or services.</td>
</tr>
<tr>
<td></td>
<td>Intervention type studied most frequently was simple discounts applied to healthier foods in discrete settings (usually accompanied by minimal or no promotional signage). In some studies, simple discounts were implemented concurrently with other intervention components (e.g. calorie labelling, health messages, nutrition education). A finding reported consistently across this relatively homogenous cluster of studies was that reducing the unit retail prices of healthier foods relative to less healthy foods in discrete settings was independently associated with increased levels of purchasing of healthier foods. This finding was consistent across the range of discrete settings.</td>
</tr>
</tbody>
</table>
studied. It was also consistent with conclusions reported in reviews that included assessment of this cluster of primary studies.

Few primary studies in this category assessed food or nutrient intake alongside purchasing; those that did reported no association between price promotions and intake of healthy foods or nutrients. Little or no evidence was found for other forms of price promotion.

<table>
<thead>
<tr>
<th>Taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category comprises taxes imposed on food commodities, intermediate goods or diet- or physical activity-related final consumer products or services.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range of interventions encountered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Taxes imposed on less healthy foods and non-alcoholic beverages: Calorie taxes, Snack taxes, Soft drinks taxes.</td>
</tr>
<tr>
<td>• Taxes imposed on nutrient components of foods and non-alcoholic beverages: Fat taxes, Sugar taxes.</td>
</tr>
<tr>
<td>• Tax exemptions applied to healthier foods.</td>
</tr>
<tr>
<td>• Congestion taxes imposed on motorised vehicle use in a defined geographical area.</td>
</tr>
<tr>
<td>• Taxes imposed on gasoline.</td>
</tr>
<tr>
<td>• Taxes imposed on cigarettes.</td>
</tr>
<tr>
<td>• Taxes imposed on alcoholic beverages.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large majority of included studies considered taxes imposed on less healthy foods, non-alcoholic beverages and/or nutrients. Primary studies which investigated taxes that had actually been imposed in real-world settings were rare. Studies typically used econometric modelling techniques to</td>
</tr>
</tbody>
</table>
estimate food demand systems, which derive price and other demand elasticities for use as the basis to simulate the effects of multiple tax scenarios (ad valorem or per unit taxes).

These studies were characterised by considerable between- and within-study heterogeneity in terms of the tax scenarios considered (e.g. coverage, form and magnitude), data sources, analytical methods and modelling assumptions. Collectively they assessed a large and diverse set of specific outcomes.

Estimated own-price elasticities of foods, non-alcoholic beverages or nutrients were always greater than zero; it was therefore inevitable that studies predicted taxes would affect reductions in average levels of purchasing of targeted products. In general, magnitudes of reductions in purchasing were predicted to be small or moderate. These studies typically incorporated an assumption that 100% of the tax burden is ‘passed through’ to consumers in the form of commensurate increases in unit retail prices. This assumption is unlikely to be realistic and therefore likely to lead to overestimation of predicted impacts on levels of purchasing. The few primary studies that incorporated modelling of supply-side responses, including pricing strategies that limit ‘pass through’ and product reformulation to avoid taxes, invariably reported that such responses attenuated predicted beneficial impacts of taxes on purchasing behaviours.

Several of these studies extrapolated from impacts on food, beverage or nutrient purchasing to impacts on outcomes relating to body weight status. These studies typically predicted small or negligible beneficial impacts. However, they typically incorporated an assumption that 100% of the foods, non-alcoholic beverages or nutrients purchased are consumed (intake). This assumption is
unlikely to be realistic and therefore likely to lead to overestimation of predicted impacts on outcomes relating to body weight status. Although most primary studies of food-related taxes modelled compensatory purchasing, whereby consumers substitute between taxed and untaxed products, the range of substitutes or complements incorporated into analyses was invariably limited relative to the vast array of potential alternative food and beverage products available to consumers.

Tax rates considered in most simulated scenarios were relatively small in magnitude. Several authors concluded that higher tax or subsidy rates than those considered in their studies might need to be imposed to have a meaningful impact on target outcomes. Several authors highlighted, but had rarely demonstrated, the potentially regressive nature of food-related taxes and several studies predicted differential responses across study population sub-groups (grouped according to various characteristics, including socio-economic status, levels of consumption, body weight status). Several studies included estimation of modelled impacts on tax revenues and invariably predicted an increase in such revenues.

Few studies of tax exemptions that might promote physical activity or taxes that might discourage sedentary activity were identified. This finding is consistent with reviews.

<table>
<thead>
<tr>
<th>Supply-side subsidies</th>
<th>Range of interventions encountered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category comprises payments or reimbursements made from public funds to producers, retailers or providers of</td>
<td>• Agricultural commodity subsidies</td>
</tr>
<tr>
<td></td>
<td>• Removal of agricultural commodity subsidies</td>
</tr>
<tr>
<td></td>
<td>• School meals subsidies</td>
</tr>
</tbody>
</table>
diet- and/or physical activity-related final consumer products or services with the intention of stimulating an increase in quantities produced and offered for purchase and a corollary decrease in the unit retail prices.

<table>
<thead>
<tr>
<th>Subsidy Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Other meals subsidies</td>
</tr>
<tr>
<td>• Healthier foods subsidies</td>
</tr>
<tr>
<td>• Healthier non-alcoholic beverages subsidies</td>
</tr>
<tr>
<td>• Specific nutrient subsidies</td>
</tr>
<tr>
<td>• Food transportation or delivery subsidies</td>
</tr>
</tbody>
</table>

**Summary:**

All primary studies within this category considered food-related subsidies. None investigated subsidisation of physical activity-related products or services (this finding is consistent with reviews). The largest corpus of primary studies within this category investigated participation in the US National School Lunch Program (NSLP) and/or the School Breakfast Program (SBP). Evidence appeared equivocal with respect to associations between NSLP and/or SBP participation and typically large sets of outcomes relating to food or nutrient intake and/or body weight status. For food or nutrient intake, primary studies typically reported mixed patterns of results and results with respect to specific outcomes appeared inconsistent across studies. For body weight status, reported results appear similarly inconsistent or equivocal across studies, including many null findings. Reviews that included coverage of such studies typically reported similarly equivocal conclusions. In addition to their use of a variety of quasi-experimental study designs and observational datasets with different structures (cross-sectional, time series or panel), this corpus of primary studies used a range of analytic methods to control for potential selection-bias with respect to programme participation and observable characteristics. Sets of observable...
characteristics included as covariates in the analyses differed between studies. Between-study differences in reported results with respect to specific outcomes are in part likely to reflect this heterogeneity in covariates assessed.

A smaller corpus of primary studies investigated supply-side subsidies applied to healthier foods, non-alcoholic beverages or nutrients. These studies typically used the same general modelling approach described above with respect to studies of taxes (indeed some studies modelled both tax and subsidy scenarios; in some cases tax and subsidy scenarios were combined in ‘revenue neutral’ scenarios, with tax revenues hypothecated to fund the subsidies). They also incorporated the same types of assumptions and reported similarly equivocal results with respect to a diverse range of outcomes.

<table>
<thead>
<tr>
<th>Direct pricing legislation</th>
<th>Range of interventions encountered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category comprises minimum pricing legislation applied to less healthy diet- and/or physical activity-related final consumer products or services and maximum pricing legislation applied to healthy diet- and/or physical activity-related final consumer products or services.</td>
<td>None.</td>
</tr>
</tbody>
</table>

**Summary:**
No studies identified of effects of direct pricing legislation on target outcomes.

<table>
<thead>
<tr>
<th>Transfer payments</th>
<th>Range of interventions encountered:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Category comprises transfers of public or private funds paid to defined population sub-groups.

- Restricted income transfers, welfare benefits or welfare assistance programs
- Unrestricted income transfers, welfare benefits or welfare assistance programs
- Tax credits

Summary:
Large majority of studies within this category concern effects of (or associations between) transfer payments restricted for use to purchase foods on (and) diet-related behaviours and corollary outcomes. The largest corpus of primary studies of transfer payments investigated participation (and/or the monetary value of benefits received via participation) in one or both of two large US federal welfare assistance programmes with benefits restricted for use to purchase foods and non-alcoholic beverages: the Supplemental Nutrition Assistance Program (SNAP – formerly known as the Food Stamp Program) and/or the Special Supplemental Nutrition Program for Women Infants and Children (WIC). Overall, evidence appears equivocal with respect to associations between SNAP and/or WIC participation/benefits and typically large sets of assessed outcomes relating to food purchasing behaviours, shopping, mealtime and snacking behaviours, food or nutrient intake and/or body weight status.

No clear patterns of results could readily be discerned across these studies with respect to these outcomes and individual studies typically reported mixed or equivocal results. Reviews that included coverage of such studies typically reported similarly equivocal conclusions. Differences in reported results across studies with respect to specific outcomes are in part likely to reflect heterogeneity between study design characteristics. The nature of this heterogeneity was similar in
| both nature and extent to that described above with respect to studies that assessed participation in the NSLP and/or SBP. |
Taking these caveats into account, one finding that was reported consistently across a cluster of primary studies was that applying simple discounts (% or absolute price reductions) to healthier foods in discrete settings, including school and worksite cafeterias and vending machines, was independently associated with increased levels of purchasing of those foods. The cluster of primary studies of simple discounts that inform this observation were relatively homogeneous (compared with clusters of studies within other intervention types) with respect to both their use of similar experimental or quasi-experimental field study designs and their focus on similar types of foods. This finding was consistent across the range of discrete settings and participant populations studied. It is also consistent with conclusions reported in reviews that included assessment of this cluster of primary studies.

While this finding is encouraging, its implications should not be overstated. These studies did not typically assess corollary impacts of purchasing on dietary intake or more distal outcomes concerning body weight status or other NCD risk factors. It is also feasible that people may have compensated increased purchasing and intake of discounted healthier foods with increased purchasing and intake of less healthy foods on other occasions not captured by study measures, or that they might have compensated a healthier overall diet with reduced physical activity.

Some intervention types, such as taxes, were dominated by modelled evidence for predicted effects as opposed to observed evidence for measured effects. Very few intervention studies incorporated formal economic evaluation or budget impact analyses, although several studies of taxes did estimate impacts on tax revenues. Whilst several studies of some intervention types (e.g. subsidised school meals, or transfer payments restricted for use to purchase foods) incorporated assessments of effects by population sub-groups, distributional effects were less frequently assessed for other intervention types. For example, studies of taxes on foods, beverages or nutrients sometimes highlighted, but had rarely demonstrated, the potentially regressive nature of such taxes. Across all intervention types, no studies assessed potential trade-offs between effectiveness (or efficiency) and health or economic equity.

Some clear differences were identified between primary studies of different intervention types with respect to types of outcomes assessed. Studies of price promotions tended (unsurprisingly) to have assessed outcomes related to purchasing behaviour. Studies of
taxes tended to have assessed outcomes related to purchasing behaviour and/or those that related to body weight status (distal consequences of behaviour). Studies of supply-side subsidies also tended to have assessed outcomes related to purchasing behaviour and/or body weight status, but additionally those related to food, energy and nutrient intake (proximal consequences of behaviour). This apparent difference between studies of taxes and studies of supply-side subsidies was largely accounted for by the inclusion of US studies of federally subsidised school meals in this category, which typically focused on assessment of outcomes relating to food, energy and/or nutrient intake. Studies of transfer payments tended to have assessed outcomes related to food, energy and nutrient intake and those related to body weight status. The latter group of studies was also distinct from the other groups in that a substantial proportion assessed outcomes related to diet-related behaviours other than purchasing, including shopping behaviours, mealtime behaviours and snacking behaviours.

All intervention types with substantive numbers of primary studies have been the subject of at least one existing review. Based on the range of primary studies identified by this scoping review, it was judged unlikely that published reviews had failed to locate major clusters of relevant primary studies. However, it was observed that different reviews of the same intervention types in some cases reported interpretations of evidence derived from largely coterminous sub-sets of included primary studies that were incongruent with one another, with the result that policy-relevant inferences drawn by authors were either divergent between studies, or were accompanied by more or less cautious caveats.

**Summary of evidence for the acceptability of interventions**

Six primary studies were identified that included a substantive focus on the acceptability of one or more intervention types considered in this review (Glanz 1995, Lake Snell Perry and Associates 2003, Millstone 2007a, Ni Mhurchu 2011, Steenhuis 2009, Waterlander 2010a). Five studies focused on interventions that target diet-related behaviours or corollary outcomes (Glanz 1995, Lake Snell Perry and Associates 2003, Millstone 2007a, Ni Mhurchu 2011, Waterlander 2010a) and one study focused on interventions that target physical activity-related behaviours (Steenhuis 2009). All studies used qualitative research methods.
Two studies (conducted in New Zealand and The Netherlands respectively) investigated the public acceptability of pricing strategies designed to encourage purchasing of healthy foods, either alone (Ni Mhurchu 2011) or in combination with those designed to discourage purchasing of less healthy foods (Waterlander 2010). Both found that pricing strategies to encourage healthy eating were acceptable, and the study that also considered pricing strategies to discourage unhealthy eating found that these had lower public acceptability than those designed to encourage healthy eating. One small study investigated the acceptability of pricing strategies to incentivise physical activity amongst low-income Dutch adults (Steenhuis 2009). This study identified the following specific pricing strategies as acceptable: discounted and time-limited free-trial subscriptions to fitness or sports clubs and free entrance to swimming pools once a week. Whilst these studies did not specify how changes in unit retail prices might be funded, the available policy options encompass taxes, subsidies, direct pricing legislation or voluntary action by producers or retailers.

Three studies investigated the acceptability of taxes imposed on high-fat or obesity-promoting foods and/or supply-side subsidies on healthy foods, respectively amongst members of the public (2 US studies: Glanz 1985, Lake Snell Perry and Associates 2003) and representatives of 21 stakeholder groups (pan-European: Millstone 2007a). All of these studies found that these policy options have low overall levels of acceptability, with some variations amongst sub-groups of participants.
Discussion

Strengths, limitations and challenges

This scoping review has assembled and described a large and heterogeneous body of research evidence for the effects of changes in the economic environment on diet- and physical activity-related behaviours and corollary outcomes. A major strength of the review is its broad scope. Eligibility criteria adopted by previous reviews in this area are not as inclusive as the current review in terms of study designs and across all elements of the PICOS framework and none have adopted such a sensitive, broad-based approach to locating and selecting eligible studies.

The value of this approach is that it has enabled us to investigate the breadth and depth of a large evidence base that encompasses a variety of relevant interventions and exposures and crosses research-disciplinary boundaries in ways that few studies have managed before. The design and implementation of behaviour change programmes have been seriously hampered in the past by their locatedness in single disciplines.

The methods applied have also allowed us to explore and start to refine a more nuanced conceptual understanding of the economic environment, the various mechanisms by which aspects of this environment mediate pathways between interventions and behavioural and health outcomes, and the wide range of interdependent determinants of behaviour and health that may interact with altered remunerative incentives to moderate such relationships. The evident complexity of these relationships emphasises the need to test proposed causal pathways that link interventions with behavioural and health outcomes and the validity of underlying theoretical assumptions (Kelly 2011).

In parallel, the review process has delineated typologies of interventions and outcome sets in ways that can bolster future research efforts. The return on this investment is likely to accrue as we begin to synthesise and generate evidence for the effects and other aspects of specific interventions using more focused systematic reviews and primary research, and as

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5 PICOS: Populations, Interventions or exposures, Comparators or counterfactuals, Outcomes, Settings.
the findings from such studies begin to inform the design and implementation of policies and programmes that aim to shift overall distributions of diet- and physical activity-related behaviours to improve population health and reduce inequalities.

This scoping review has also highlighted a potential tension in the conduct of large-scale scoping reviews that aim to maximise both breadth (i.e. identifying the full range of eligible studies, where this range is not clear at the outset) and depth (i.e. locating all eligible studies). The strategy we adopted to address this issue involved executing highly sensitive systematic searches in a range of electronic databases that cut across research-disciplinary boundaries, in combination with snowball search techniques. The practical implication of this approach is that searches retrieved a record set that would have been too large to screen using conventional methods. This points to a second major strength of this scoping review: it has demonstrated the feasibility of applying innovative methods to manage study screening and selection processes within very large record sets. Specifically, we have developed the use of text-mining technologies to prioritise records for manual screening and thereby reduce manual screening workload. This methodology is transferable to other scoping and systematic reviews of public health and other evidence. It is likely to prove most useful for reviews in which: systematic search strategies are (necessarily) highly sensitive; a conceptual understanding of interventions and other phenomena of interest is an intended output rather than a pre-specified starting point of the review process; reports of potentially eligible studies span several applied fields of research; and/or reports of potentially eligible studies are judged unlikely to describe the intervention or other study characteristics using consistent terminology or theoretical constructs. More generally, the integrated evaluation of text-mining performance in this scoping review has also contributed to an emerging body of empirical evidence for the use of text-mining to support screening and study selection in reviews.

From another perspective, the broad scope of this review represents a limitation. It is estimated that approximately 40% of those title and abstract records that were ex ante expected to be selected as potentially eligible, to be retrieved for full-text screening, were identified within the time and resources available to be allocated to manual title and abstract screening. Therefore, whilst we can be cautiously optimistic that the large corpus of eligible studies assembled reflects the true distribution of all available evidence, the extent to which
identified studies are fully representative is unknown. What is clear is that we were not able to identify all potentially eligible studies. This limitation may be judged acceptable in a scoping review that aims primarily to capture the conceptual breadth of relevant research literature in terms of the types of interventions, exposures and outcomes that have been studied.

Further, the large number of potentially eligible records that were identified necessitated a series of decisions to prioritise specific sets of studies for full-text screening, data collection and analysis. This has further limited the potential of the scoping review to achieve maximum depth and fulfil the ideal objective to describe all eligible studies in detail; this limitation applies in particular to those studies that investigated general exposure to variations in prices or income as correlates or determinants of target outcomes. However, such compromises may be judged inevitable in a scoping review with a starting point of in excess of 1 million records (which to our knowledge makes it the largest scoping or systematic review ever attempted).

Additionally, the almost limitless potential scope of what constitutes an ‘intervention in the economic environment’ (‘economic incentive’) meant an inevitable need to set some initial parameters for eligibility. Whilst initial parameters were set to ensure a focus on those interventions and exposures of central interest, they may also be considered arbitrary to some extent. For example, this scoping review does not consider labour market or educational, training or professional development interventions that may increase employment rates or lead to changes in population-level distributions of occupational types or levels, with potential corollary impacts on levels and distribution of individual or household income. Nor does it consider reforms of the wider taxation system (i.e. outside of taxes imposed on goods and services) that may also lead to income change and redistribution. Interventions in the physical or built environment that may change distance (and therefore influence journey time) to amenities were also excluded. These examples do not constitute an exhaustive list of interventions that fall outside the initial parameters set for this scoping review. However, they do illustrate the range of excluded interventions that were not considered central to the heart of the research question for the review.
A final limitation is that this scoping review did not set out to assess the quality or risk-of-bias of included studies or to synthesise their results. This reflects a distinction between the primarily descriptive aims of scoping reviews and the primarily evaluative aims of systematic reviews. The key implication is that this scoping review was neither intended nor configured to generate a synthesis of evidence for the effects of interventions for use to inform policy decisions.

Findings

This scoping review found that the distribution of extant research evidence for economic environment interventions is heavily skewed in its focus on diet rather than physical activity. This may be explained in part by the consideration that, unlike the majority of diet-related behaviours, physical or sedentary activity does not necessarily involve the consumption or use of a product or service. However, many physical or sedentary activities do involve the consumption or use of products and services and, as such, the disparity may be due in part to other factors.

One possible further explanation is that the net contribution of diet-related behaviours and their proximal consequences (energy and nutrient intake) to the accumulation of risk factors for NCDs (e.g. overweight and obesity, raised blood pressure, raised blood glucose and raised blood cholesterol) may be greater than the contribution of sedentary behaviours and their proximal consequences (reduced energy expenditure and cardio-respiratory and muscular fitness) (Bleich 2008). In parallel, major population-level shifts from more to less physically active forms of employment during transitions to post-industrial society, and the concurrent proliferation of labour-saving technologies, have contributed to corresponding population-level declines in levels of physical activity that may be perceived as particularly difficult to reverse (Lakdawalla 2005). Such factors may have combined to influence a perception that behaviours that determine energy and nutrient intake might be a more promising and potentially efficacious target of intervention than behaviours that determine energy expenditure.

This scoping review identified considerable congruence between identified primary studies and reviews with respect to the interventions they assess. All types of intervention with substantive numbers of primary studies have been the subject of previous reviews. It is not
surprising to have found that reviews tend to focus on interventions for which relatively large numbers of primary studies are available. Based on the range of primary studies identified by this scoping review, it was judged unlikely that existing reviews have failed to locate important clusters of relevant primary studies. However, it was observed that separate reviews of the same intervention type in some cases produced incongruent interpretations of evidence derived from largely coterminous sets of included primary studies, with the result that policy-oriented inferences either diverged or were accompanied by more or less cautious caveats.

The heterogeneity of included primary studies in all characteristics and their general reliance on more or less sophisticated quasi-experimental and simulation study designs poses considerable methodological challenges for reviews that aim to aggregate evidence intervention effects across studies. Existing reviews identified by this scoping review used more or less systematic methods to identify and select studies but none reported having assessed risk-of-bias in (or the methodological quality of) included primary studies and none reported the use of explicit qualitative or quantitative methods to synthesise evidence for intervention effects. All these factors may to some extent help explain inconsistencies between existing reviews in the interpretation of evidence.

**Implications for research**

The paucity of evidence for interventions designed to alter economic incentives in ways that promote physical activity represents a clear gap in the evidence-base that could be addressed through new primary research. More generally, the findings that primary studies of interventions typically used quasi-experimental and simulation study designs and that they are heterogeneous with respect to characteristics of the populations, interventions, counterfactuals, outcomes and moderators they assessed highlight the limitations of the overall evidence-base in terms of its applicability to inform policy, and thus the significant scope for future primary research.

In parallel, the predominance of modelled evidence for some types of interventions (e.g. taxes on less healthy foods, beverages or nutrients and subsidies of healthier foods, beverages or nutrients), coupled with the dearth of UK-based studies, highlights the clear scope for more primary studies that measure actual behavioural responses to economic
environment interventions using field-based prospective experimental or robust quasi-experimental study designs in UK populations. This would provide a counterpoint to current (largely non-UK) modelled evidence for predicted behavioural responses to such interventions, which inevitably rely on simplified representations of complex systems and a variety of more or less plausible assumptions. Alongside (or possibly in combination with) research on taxes and subsidies, new field-based primary research may be justified to address the current lack of evidence for the effects of direct pricing legislation (minimum or maximum pricing) applied to diet- and physical activity-related products or services. The prospect for conducting more field-based studies of these types of fiscal policies in UK populations is clearly predicated on the implementation of (pilot) interventions in UK settings.

The general lack of economic evaluation of interventions (and of their budgetary impacts) may need to be addressed in further research if future policy is to be informed by considerations of how to maximise population health within available resources. Also, our findings suggest that future primary studies (and systematic reviews) would be strengthened by explicit assessments of the distributional effects of interventions and of potential trade-offs between average effectiveness and reducing health or economic inequalities (e.g. the distributional effects of taxes on food and non-alcoholic beverage purchases, including the assessment of how regressive (or not) such policies are in practice).

While all types of intervention with substantive numbers of primary studies have been the subject of previous reviews, there is clear scientific scope for further and more rigorous evidence synthesis of price promotions, taxes, supply-side subsidies and transfer payments. In practice, current initiatives to improve methods for systematic reviews of evidence from quasi-experimental studies may need to progress further before the potential return on investment from new systematic reviews of such interventions can be realised.

Unlike existing reviews of economic environment interventions, future systematic reviews in this area should incorporate systematic appraisal of the quality of included studies and risk of bias, and use explicit, systematic qualitative and (or, if feasible and appropriate) quantitative or mixed methods to synthesise results. Future reviews might also seek to exploit clusters of primary studies that present disaggregated results by sub-groups to place
an equity lens on the synthesis of evidence for effects using established methods (Main 2008). Finally, consideration could be given to the potential value of further systematic reviews of evidence for prices and income as economic correlates and determinants of behavioural and corollary outcomes.

The typology of outcome domains developed as an output of this scoping review reflect our proposition that there is a need for increased clarity in the research literature in distinguishing between impacts or outcomes at the different levels of proposed causal pathways. In particular, there is a need for greater consistency with respect to the classification of outcomes that measure behaviours, as distinct from those that measure the proximal or distal consequences of behaviours. We recognise the potential trade-offs between assessing direct behavioural impacts of interventions (which is important for credible inference of causal attribution) and/or their proximal consequences (e.g. dietary intake, energy expenditure) and measuring indirect, more distal (but clinically relevant) impacts on health, such as risk factors for non-communicable diseases (e.g. overweight and obesity, blood pressure, blood glucose, blood cholesterol) and/or final health outcomes (e.g. specific cause mortality and morbidity). The ideal study design to evaluate the effects of an intervention that is primarily intended to bring about substantial and enduring health-related behaviour change might incorporate measurement of outcomes in each of these domains, although we acknowledge that in practice this may prove unfeasible in studies restricted to short-term follow-up or those constrained by the available data within existing datasets. It is at least notable, though, that many studies of interventions primarily intended to influence health-related behaviour(s) do not assess or measure behaviour at all. In the most general terms, given the complex pathways and mechanisms by which behaviour change interventions are likely to influence health-related outcomes (and the myriad factors that may moderate these relationships), credible causal inference is much less likely in studies of behaviour change interventions that assess outcomes relating to distal consequences of behaviour and/or final health outcomes but fail to assess preceding impacts on behaviour. These considerations reiterate the need for future primary research and systematic reviews to test proposed causal pathways that link interventions with intended and unintended behavioural and health outcomes and the validity of underlying theoretical assumptions.
Conclusion

This scoping review has made the following four key contributions to the evidence base for economic environment interventions:

i) Assembly and description of a large and heterogeneous body of evidence for the effects of changes in the economic environment on diet and physical activity-related behaviours and corollary outcomes, identifying in particular a paucity of research on physical activity-related outcomes;

ii) Description of provisional typologies of economic interventions and outcomes to guide future primary research and systematic reviews;

iii) Identification of a number of ways in which studies of economic incentives may be strengthened, including testing proposed causal pathways that link interventions with intended and unintended behavioural and health outcomes and the validity of underlying theoretical assumptions.

iv) Confirmation of the need for further development of methods to support the systematic review and synthesis of the considerable body of quasi-experimental evidence in this field.
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**Grujic 2009**

**Guevremont 2008**

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**Gundersen 2008**

**Guo 2009**

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Hall 2009

Hallal 2006

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Hamermesh 2006


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Hamilton 1985

Han 2011

Hann 2001

Harnack 2008

Harrell 1998

Harro 2006

Hasab 1999

Haste 1990
Hawkes 2009a

Hawkes 2009b

Hay 1998

He 2004

Heien 1998

Helmert 1997

Helmert 1990

Herbst 2009

Herman 2008

Hernandez 2011

Hjartaker 2001
Ho 1998

Hoddinott 2003

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Holsten 2008

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Janicki-Deverts 2009

Jansen 1977

Jeffery 1996

Jeffery 1994

Jekanowski 2001

Jensen 2010
Jensen 2007

Jensen 1998


Jenum 2001

Jha 2006


Jiang 2007a

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Jilcott 2011b

Jo 2009

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**Joliffe 2007**

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**Le Grand 2009**

**Lee 2010**
Lee 2009

Leis 2010

Leon 2007

Lera-López 2005

Leroy 2010

Leung 2010

Levi 2010

Levy 2011a

Levy 2011b

Li 2010

Lima-Costa 2003

**Lin 2010a**

**Lin 2010b**

**Lin 2007**

**Lin 2004**

**Lindsey 2006**

**Linn 1989**

**Lino 2002**

**Linz 2005**

**Liu 2007a**

**Liu 2006**

**Lo 2009**

Logan 2006

Longmuir 2011

Longo 2009

Lopez 2012

Lopez 2007

Lordan 2011

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Makinen 2009

Mancino 2007

Manrique 1998

Martin 2008

Martin 2007

Matson-Koffman 2005

Matthews 2002

Maurer 1984

Mazur 2003

McCracken 1987

McDonald 2008
McGrath 2006

McInnes 2009

McNutt 1997

Meeks 1990

Mehta 2008

Melgar-Quinonez 2004

Mellor 2011

Meltzer 2009

Meltzer 2010

Mendez 2004

Mendez 2005
Menezes 2008

Mergenthaler 2009

Metcalf 2007

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Monteiro 2003

Monteiro 2002

Moore 2008


Moreira 2006

Moschonis 2010

Moshfegh 1999

Muennig 2007

Mullie 2010

Mungreiphy 2010
Murasko 2011

Murasko 2008

Mushirove 1985

Mushirove-Brunt 2007

Mylllykangas 1995

Mytton 2007

Nagata 2009

Najdi 2011

Nayga 1996a

Nayga 1996b

Nayga 1994

Nazmi 2008

**Nebeling 1997**

**Nederkoorn 2011**

**Nelson 2002**

**Nelson 2000**

**Ng 2010a**

**Ng 2010b**

**Ni Mhurchu 2011**

**Ni Mhurchu 2010**

**Nies 2002**

**Nikolaou 2008**
Niskar 2003

Nnoaham 2009

Nocon 2007

Noppa 1980


Nordström 2011

Nordström 2009

Nube 1998

Oaks 2005

O'Dea 2008

O'Dea 2006
Oksuz 2008

Oliveira 2000

Oliver 2008

Olsen 2000

Oreffice 2010

Oyewole 2007

Paeratakul 2002

Pan 2009

Pan 2008

Papandreou 2008
Park 2009

Park 1997

Park 1996

Parks 2011

Parks 2003

Pascual 2007

Patt 2004

Patterson 1988

Paulin 2000

Pearson 2005

Peixoto 2007

Perez-Escamilla 2000
Perrin 2005

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Pont 2009

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**Pouyanne 2005**

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**Powell 2010**

**Powell 2009a**

**Powell 2009b**

**Powell 2009c**

**Powell 2009d**

**Powell 2009e**

**Powell 2009f**
Powell 2007

Power 2005

Pradeepa 2003

Prasad 2008

Pratt 1999

Proper 2007

Pudaric 2000

Raberg 2010

Rabin 2006

Radimer 2000

Raffensperger 2010
Raine 2005

Ramachandran 2002

Ramezani 1995

Ranjit 2007

Ransdell 1998

Rashad 2009


Rashad 2006a


Rashad 2006b

Rasmussen 2006

Ree 2008
Reed 2010

Reedy 2010

Rehkopf 2010

Rehm 2008

Resnicow 2001

Ricciuto 2006


Richards 2009

Riediger 2008

Riediger 2007

Risica 2009
Robert 2004

Robinson 2011

Robinson 2009

Robinson 2007

Rodrigues 2008

Roos 2008

Rose 2004

Rose 1998

Rose 1995

Roskam 2008

Roy 2001
Ruhm 2005


Ruiz-Arranz 2006


Rundle 2008

Rush 1988

Sabanayagam 2009

Sabanayagam 2007

Sabri 2005

Sabri 2004

Sabzghabaee 2010

**Sacks 2011**


**Sahn 1988**

**Sakamoto 2001**

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**Salonen 2009**

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**Shankar 2010**

**Shapo 2003**

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Sharpe 2003

Shimokawa 2008

Shrewsbury 2008

Sichieri 1994

Sidney 1996

Siega-Riz 2004

Siegel 1995

Simon 1993

Simons-Morton 2000

Singh 2011

Singh 2010


Sisson 2009

Siu 2010

Skoufias 2009

Smed 2007


Smeets 2007

Smith 2010

Smith 2007

Smith 1992
Spence 2010

Spinney 2010

St. John 2008

Stamatakis 2009

Stamatakis 2005

Staudigel 2011

Steenhuis 2009

Stelmach 2004

Stewart 2008

Stewart 2004

Steyn 2011
Stookey 2001

Stookey 2000

Storey 2003

Story 2008

Strauss 1999

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Sturm 2011

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**Todd 2010**

**Tomey 2005**
TfL 2008


Trinh 2008

Trost 2002

Truong 2005

Tucker 1995

Tucker-Seeley 2009

Turran 2007

Turrell 2009
Turrell 2003


Turrell 1996

Tzormpatzakis 2007

van Lentehe 2000

van Rossem 2010

Vandegrift 2004

Variyam 2002

Vatanparast 2010

Ver Ploeg 2009

Ver Ploeg 2008

Ver Ploeg 2007

Vermeersch 1984

Veugelersn 2005

Viebig 2009

Vieweg 2007

Villa-Caballero 2006

Viner 2005

von Laer Tschudin 2009

von Tigerstrom 2011

Wamala 1997

Wang 2011
Wang 2010

Wang 2009

Wang 2008

Wang 2006

Wang 2002a

Wang 2002b

Washburn 1997

Washburn 1992

Waterlander 2010a

Waterlander 2010b

Webb 2008

Wendt 2010

Wendt 2009

Whitaker 1994

Whitfield 1982

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**Xie 2003**
Xu 2005

Yang 2010

Yarnoff 2010

Yen 2010

Yen 2004

Yen 2003

Yen 2002

Yen 1992

Yip 1993

Yoon 2006

Yu 2000
Yu 1997

Zagorsky 2009

Zeithaml 1985

Zenk 2005

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**Additional references** (Cited in Introduction, Methods or Discussion)


Appendix 1. Search Strategies, Search Dates and Yields


1. exp diet/
2. exp diet therapy/
3. exp food/
4. exp beverages/
5. food habits/
6. food preferences/
7. fasting/
8. adolescent nutritional physiological phenomena/
9. elder nutritional physiological phenomena/
10. exp food industry/
11. exp hunger/
12. exp appetite regulation/
13. exp appetite/
14. exp digestion/
15. exp eating/
16. exp eating disorders/
17. exp child nutrition disorders/
18. exp infant nutrition disorders/
19. nutritional requirements/
20. nutritional status/
21. nutrition assessment/
22. nutrition disorders/
23. exp nutritive value/
24. (nutri$ or calori$ or diet$ or food$ or eat$ or meal$ or snack$ or cook$ or restaurant$ or supermarket$ or cafe$).ti,ab.
25. ((drink$ or beverage$) not alcohol$).ti,ab.
26. or/1-25
27. physical exertion/
28. exp human activities/
29. exp leisure activities/
30. exp locomotion/
31. exp physical education/
32. lifestyle/
33. sedentary lifestyle/
34. yoga/
35. fitness centers/
36. motor activity/
37. (physical$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
38. (aerobic adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
39. (strength$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
40. (flexib$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
41. (balanc$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
42. (exercise$ adj5 (train$ or activit$ or fit$ or endur$)).ti,ab.
43. ((occupation$ or work$ or recreation$2 or leisure or play or household or home or domestic or commut$3 or transport$) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
44. ((walk$3 or hike or hiking or climbing or run$3 or jog$3 or swim$1 or swimming or bicycl$3 or cycl$3 or bike$1 or biking or gym$ or rowing or canoe$ or kayak$ or sailing or windsurf$3 or surf$3 or diving or sport$3 or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or (jump$3 adj rope$1) or (lift$3 adj weight$1) or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
45. (led walk$ or health walk$).ti,ab.
46. ((leisure or fitness) adj5 (centre$ or center$ or facilit$)).ti,ab.
47. (fitness adj class$).ti,ab.
48. (fitness adj (regime$ or program$)).ti,ab.
49. cardiorespiratory fitness.ti,ab.
50. aerobic capacity.ti,ab.
51. (intensity adj2 (rest or quiet or light or moderate or vigorous)).ti,ab.
52. ((car or cars or bus or buses or train or trains or transport$) and (energ$ or activit$ or exercis$)).ti,ab.
53. (active adj (travel$4 or transport$ or commut$)).tw.
54. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 gym$).ti,ab.
55. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 physical activit$).ti,ab.
56. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (circuit$ or aqua$)).ti,ab.
57. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (exercis$ or exertion or keep fit or fitness class or yoga or aerobic$)).ti,ab.
58. ((decreas$ or reduc$ or discourag$) adj5 (sedentary or deskbound or inactiv$)).ti,ab.
59. (exercis$ adj aerobic$).tw.
60. (physical$ adj5 (fit$ or train$ or activ$ or endur$)).tw.
61. (exercis$ adj5 (train$ or physical$ or activ$)).tw.
62. ((lifestyle or life-style) adj5 physical$).tw.
63. ((lifestyle or life-style) adj5 activ$).tw.
64. or/27-63
65. 26 or 64
66. (risk$ adj4 (non-communicable or non communicable or chronic)).ti,ab.
67. blood pressure/
68. hypertension/
69. blood glucose/
70. hyperglycemia/
71. cholesterol/
72. cholesterol, dietary/
73. cholesterol, hdl/
74. cholesterol, ldl/
75. cholesterol, vldl/
76. cholesterol esters/
77. hypercholesteremia/
78. exp hyperlipidemias/
79. exp body weight changes/

1. exp diet/
2. exp diet therapy/
3. exp food/
4. exp beverage/ not alcoholic beverage/
5. exp feeding behavior/
6. exp dietary intake/ not alcohol consumption/
7. exp food intake/
8. exp child nutrition/
9. exp food handling/
10. exp food processing/
11. exp hunger/
12. exp digestion/
13. exp eating disorder/
14. exp nutritional disorder/
15. nutritional requirement/
16. nutritional status/
17. nutritional assessment/
18. nutritional value/
19. (nutri$ or calori$ or diet$ or food$ or eat$ or meal$ or snack$ or cook$ or restaurant$ or supermarket$ or cafe$).ti,ab.
20. ((drink$ or beverage$) not alcohol$).ti,ab.
21. or/1-20
22. exp exercise/
23. exp physical activity/
24. exp human activities/
25. exp recreation/
26. exp leisure/
27. exp locomotion/
28. exp physical education/
29. exp lifestyle/
30. sedentary lifestyle/
31. exp fitness/
32. health center/
33. yoga/
34. motor activity/
35. (physical$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
36. (aerobic adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
37. (strength$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
38. (flexib$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
39. (balanc$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
40. (exercise$ adj5 (train$ or activit$ or fit$ or endur$)).ti,ab.
41. ((occupation$ or work$ or recreation$2 or leisure or play or household or home or domestic or commut$3 or transport$) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
42. ((walk$3 or hike or hiking or climbing or run$3 or jog$3 or swim$1 or swimming or bicycl$3 or cycl$3 or bike$1 or biking or gym$ or rowing or canoe$ or kayak$ or sailing or windsurf$3 or surf$3 or diving or sport$3 or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or (jump$3 adj rope$1) or (lift$3 adj weight$1) or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
43. (led walk$ or health walk$).ti,ab.
44. ((leisure or fitness) adj5 (centre$ or center$ or facilit$)).ti,ab.
45. (fitness adj class$).ti,ab.
46. (fitness adj (regime$ or program$)).ti,ab.
47. cardiorespiratory fitness.ti,ab.
48. aerobic capacity.ti,ab.
49. (intensity adj2 (rest or quiet or light or moderate or vigorous)).ti,ab.
50. ((car or cars or bus or buses or train or trains or transport$) and (energ$ or activit$ or exercis$)).ti,ab.
51. (active adj (travel$4 or transport$ or commut$)).tw.
52. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 gym$).ti,ab.
53. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 physical activit$).ti,ab.
54. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (circuit$ or aqua$)).ti,ab.
55. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (exercis$ or exertion or keep fit or fitness class or yoga or aerobic$)).ti,ab.
56. ((decreas$ or reduc$ or discourag$) adj5 (sedentary or deskbound or inactiv$)).ti,ab.
57. (exercis$ adj aerobic$).tw.
58. (physical$ adj5 (fit$ or train$ or activ$ or endur$)).tw.
59. (exercis$ adj5 (train$ or physical$ or activ$)).tw.
60. ((lifestyle or life-style) adj5 physical$).tw.
61. ((lifestyle or life-style) adj5 activ$).tw.
62. or/22-61
63. 21 or 62
64. (risk$ adj4 (non-communicable or non communicable or chronic)).ti,ab.
65. blood pressure/
66. hypertension/
67. glucose blood level/
68. hyperglycemia/
69. cholesterol/
70. cholesterol intake/
71. high density lipoprotein cholesterol/
72. low density lipoprotein cholesterol/
73. very low density lipoprotein cholesterol/
74. hypercholesterolemia/
75. exp hyperlipidemia/
76. weight change/
77. harm reduction/
78. exp overnutrition/
79. exp obesity/
80. (overweight or over weight).ti,ab.
81. adipos$.ti,ab.
82. fat overload syndrome$.ti,ab.
83. (overeat or over eat).ti,ab.
84. weight cycling.ti,ab.
85. weight reduc$.ti,ab.
86. weight losing.ti,ab.
87. weight maint$.ti,ab.
88. weight decreas$.ti,ab.
89. weight watch$.ti,ab.
90. weight control$.ti,ab.
91. weight gain.ti,ab.
92. weight loss.ti,ab.
93. weight chang$.ti,ab.

94. (bmi or obes$ or overweight or (blood adj pressure) or hypertensi$ or (blood adj glucose) or hyperglycemi$ or cholester$ or hypercholester$ or hyperlipidemi$).ti,ab.
95. or/64-94
96. (economic$ or financ$ or cost or costs or costing or pric$ or monetis$ or income$ or wage$ or salar$ or (expenditure$ not energy) or time$).ti,ab.
97. (tax$ or subsid$ or credit$ or (((cash or income) adj2 transfer) or payment) or (welfare adj benefit$) or incentiv$ or disincentiv$ or remunerat$ or retail$ or sale$ or promo$ or consumer$ or consumption$ or purchas$ or shop$ or buy$).ti,ab.
98. ((product or good or service or market) adj (innovat$ or develop$ or efficien$ or quality)).ti,ab.
99. or/96-98
100. 63 and 99
101. 95 and 99
102. 100 or 101
103. animal/
104. human/ and animal/
105. 103 not 104
106. 102 not 105


1. exp diets/
2. exp food/
3. "beverages (nonalcoholic)"/
4. food preferences/
5. food intake/
6. eating behavior/
7. drinking behavior/
8. nutrition/
9. exp appetite/
10. digestion/
11. dietary restraint/
12. binge eating/
13. eating attitudes/
14. "rumination (eating)"/
15. satiation/
16. exp nutritional deficiencies/
17. exp eating disorders/
18. dietary supplements/
19. (nutri$ or calori$ or diet$ or food$ or eat$ or meal$ or snack$ or cook$ or restaurant$ or supermarket$ or cafe$).ti,ab.
20. ((drink$ or beverage$) not alcohol$).ti,ab.
21. or/1-20
22. exp physical activity/
23. physical health/
24. physical education/
25. physical fitness/
26. physical endurance/
27. physical strength/
28. physical agility/
29. physical dexterity/
30. leisure time/
31. exp recreation/
32. exp lifestyle/
33. locomotion/
34. exp motor processes/
35. "activities of daily living"/
36. daily activities/
37. exp sports/
38. sports medicine/
39. athletic performance/
40. exp athletes/
41. athletic training/
42. energy expenditure/
43. (physical adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
44. (aerobic adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
45. (strength$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
46. (flexib$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
47. (balanc$ adj5 (exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
48. (exercise$ adj5 (train$ or activit$ or fit$ or endur$)).ti,ab.
49. ((occupation$ or work$ or recreation$2 or leisure or play or household or home or domestic or commut$3 or transport$) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
50. ((walk$3 or hike or hiking or climbing or run$3 or jog$3 or swim$1 or swimming or bicycl$3 or cycl$3 or bike$1 or biking or gym$ or rowing or canoe$ or kayak$ or sailing or windsurf$3 or surf$3 or diving or sport$3 or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or (jump$3 adj rope$1) or (lift$3 adj weight$1) or circuit or resistance or resilience or dance or swimming or fishing or hunting or shooting) adj5 (energ$ or exercis$ or train$ or activit$ or fit$ or endur$)).ti,ab.
51. (led walk$ or health walk$).ti,ab.
52. ((leisure or fitness) adj5 (centre$ or center$ or facilit$)).ti,ab.
53. (fitness adj class$).ti,ab.
54. (fitness adj (regime$ or program$)).ti,ab.
55. cardiorespiratory fitness.ti,ab.
56. aerobic capacity.ti,ab.
57. (intensity adj2 (rest or quiet or light or moderate or vigorous)).ti,ab.
58. ((car or cars or bus or transport$ or train or train$ or transport$) and (energ$ or activit$ or exercis$)).ti,ab.
59. (active adj (travel$4 or transport$ or commut$)).tw.
60. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 gym$).ti,ab.
61. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 physical activit$).ti,ab.
62. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (circuit$ or aqua$)).ti,ab.
63. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or sustain$ or maintain$) adj5 (exercis$ or exertion or keep fit or fitness class or yoga or aerobic$)).ti,ab.
64. ((decreas$ or reduc$ or discourag$) adj5 (sedentary or deskbound or inactiv$)).ti,ab.
65. (exercis$ adj aerobic$).tw.
66. (physical$ adj5 (fit$ or train$ or activ$ or endur$)).tw.
67. (exercis$ adj5 (train$ or physical$ or activ$)).tw.
68. ((lifestyle or life-style) adj5 physical$).tw.
69. ((lifestyle or life-style) adj5 activ$).tw.
70. or/22-69
71. 21 or 70
72. (risk$ adj4 (non-communicable or non communicable or chronic)).ti,ab.
73. exp blood pressure/
74. exp hypertension/
75. blood sugar/
76. hyperglycemia/
77. cholesterol/
78. exp overweight/
79. weight gain/
80. weight loss/
81. "obesity (attitudes toward)"
82. weight control/
83. body fat/
84. body mass index/
85. lipid metabolism/
86. harm reduction/
87. (overweight or over weight).ti,ab.
88. adpos$.ti,ab.
89. (overeat or over eat).ti,ab.
90. weight cycling.ti,ab.
91. weight reduc$.ti,ab.
92. weight losing.ti,ab.
93. weight maint$.ti,ab.
94. weight decreas$.ti,ab.
95. weight watch$.ti,ab.
96. weight control$.ti,ab.
97. weight gain.ti,ab.
98. weight loss.ti,ab.
99. weight chang$.ti,ab.
100. (bmi or obes$ or overweight or (blood adj pressure) or hypertensi$ or (blood adj glucose) or hyperglyc?mi$ or cholesterol$ or hypercholester$ or hyperlipid?emia$).ti,ab.
101. or/72-100
102. (economic$ or financ$ or cost or costs or costing or pric$ or monetis$ or income$ or wage$ or salar$ or (expenditure$ not energy) or time$).ti,ab.
103. (tax$ or subsid$ or credit$ or (((cash or income) adj2 transfer) or payment) or (welfare adj benefit$) or incentiv$ or disincentiv$ or remunerat$ or retail$ or sale$ or promo$ or consumer$ or consumption$ or purchase$ or shop$ or buy$.ti,ab.
104. ((product or good or service or market) adj (innovat$ or develop$ or efficien$ or quality)).ti,ab.
105. or/102-104
106. 71 and 105
107. 101 and 105
EconLit (EBSCO). 1886 to July 2011. 21/07/2011: 152,188 Records

(TI ( (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*) ) or AB ( (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*) ) or TI ( ((drink* or beverage*) not alcohol*) ) or AB ( ((drink* or beverage*) not alcohol*) ) or TI ( (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or swimming or running or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or AB ( (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or swimming or running or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or TI ( (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertens* or "blood glucose" or hyperglyc?mi* or cholesterol* or hypercholester* or hyperlipid?emia*) ) or AB ( (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertens* or "blood glucose" or hyperglyc?mi* or cholesterol* or hypercholester* or hyperlipid?emia*) )
AND (TI ( (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentiv* or disincentiv* or remunerat* or retail* or sale* or promo* or consumer* or consumption* or purchas* or shop* or buy* or product* or good* or service* or market*) ) or AB ( (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentiv* or disincentiv* or remunerat* or retail* or sale* or promo* or consumer* or consumption* or purchas* or shop* or buy* or product* or good* or service* or market*) ))


(TI ( (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*) ) or AB ( (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*) ) or TI ( ((drink* or beverage*) not alcohol*) ) or AB ( ((drink* or beverage*) not alcohol*) ) or TI ( (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or swimming or running or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or AB ( (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or swimming or running or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or TI ( (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertens* or "blood glucose" or hyperglyc?mi* or cholesterol* or hypercholester* or hyperlipid?emia*) ) or AB ( (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertens* or "blood glucose" or hyperglyc?mi* or cholesterol* or hypercholester* or hyperlipid?emia*) )
AND (TI ( (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentiv* or disincentiv* or remunerat* or retail* or sale* or promo* or consumer* or consumption* or purchas* or shop* or buy* or product* or good* or service* or market*) ) or AB ( (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentiv* or disincentiv* or remunerat* or retail* or sale* or promo* or consumer* or consumption* or purchas* or shop* or buy* or product* or good* or service* or market*) ))
activ* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayaking* or sailing or windsurfing or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or AB ((exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayaking* or sailing or windsurfing or surf* or diving or sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting or cardiorespiratory or sedentary or deskbound or inactiv*) ) or TI ((non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or obese* or "blood pressure" or hypertensi* or "blood glucose" or hyperglycemi* or cholest* or hypercholest* or hyperlipidemia*) ) or AB ( (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or obese* or "blood pressure" or hypertensi* or "blood glucose" or hyperglycemi* or cholest* or hypercholest* or hyperlipidemia*) )) AND (TI ((econom* or finance* or cost or costs or pricing or pric* or monet* or income* or wage* or salary* or expenditure* or time* or tax* or subsidy* or credit* or cash or transfer or payment or welfare or benefit* or incentive* or disincentive* or remunerate* or retail* or sale* or promotion* or consumer* or consumption* or purchase* or shop* or buy* or product* or good* or service* or market*) ) or AB ((econom* or finance* or cost or costs or pricing or pric* or monet* or income* or wage* or salary* or expenditure* or time* or tax* or subsidy* or credit* or cash or transfer or payment or welfare or benefit* or incentive* or disincentive* or remunerate* or retail* or sale* or promotion* or consumer* or consumption* or purchase* or shop* or buy* or product* or good* or service* or market*) ))

KW=(deskbound) or KW=(inactiv*) or KW="non-communicable" or KW="non communicable" or KW=(chronic) or KW=(weight*) or KW=(overweight) or KW="over weight" or KW=(overeat) or KW="over eat" or KW=(bmi) or KW=(obes*) or KW="blood pressure" or KW=(hypertensi*) or KW="blood glucose" or KW=(hyperglyc?mi*) or KW=(cholester*) or KW=(hypercholester*) or KW=(hyperlipid?emia*) and (KW=(econom*) or KW=(finance*) or KW=(cost) or KW=(costs) or KW=(costing) or KW=(pric*) or KW=(monetis*) or KW=(income*) or KW=(wage*) or KW=(salar*) or KW=(expenditure*) or KW=(time*) or KW=(tax*) or KW=(subsid*) or KW=(credit*) or KW=(cash) or KW=(transfer) or KW=(payment) or KW=(welfare) or KW=(benefit*) or KW=(incentiv*) or KW=(disincentiv*) or KW=(remunerat*) or KW=(retail*) or KW=(sale*) or KW=(promo*) or KW=(consumer*) or KW=(consumption*) or KW=(purchase*) or KW=(shop*) or KW=(buy*) or KW=(product*) or KW=(good*) or KW=(service*) or KW=(market*)) not (KW=(animal model*) or KW=(animal*) or KW=(animal experiment*) or KW=(animal disease model*) or KW=(laboratory animal*))

**The Cochrane Library (Wiley Online Library). 03/08/2011.**

Cochrane Database of Systematic Reviews: 2,427 Records.
Health Technology Assessment Database: 139 Records.
NHS Economic Evaluations Database: 1,164 Records.

#1 MeSH descriptor Diet explode all trees
#2 MeSH descriptor Diet Therapy explode all trees
#3 MeSH descriptor Food explode all trees
#4 MeSH descriptor Beverages explode all trees
#5 MeSH descriptor Food Habits, this term only
#6 MeSH descriptor Food Preferences, this term only
#7 MeSH descriptor Fasting, this term only
#8 MeSH descriptor Adolescent Nutritional Physiological Phenomena, this term only
#9 MeSH descriptor Elder Nutritional Physiological Phenomena, this term only
#10 MeSH descriptor Food Industry explode all trees
#11 MeSH descriptor Hunger explode all trees
#12 MeSH descriptor Appetite Regulation explode all trees
#13 MeSH descriptor Appetite explode all trees
#14 MeSH descriptor Digestion explode all trees
#15 MeSH descriptor Eating explode all trees
#16 MeSH descriptor Eating Disorders explode all trees
#17 MeSH descriptor Child Nutrition Disorders explode all trees
#18 MeSH descriptor Infant Nutrition Disorders explode all trees
#19 MeSH descriptor Nutritional Requirements, this term only
#20 MeSH descriptor Nutritional Status, this term only
#21 MeSH descriptor Nutrition Assessment, this term only
#22 MeSH descriptor Nutrition Disorders, this term only
#23 MeSH descriptor Nutritive Value explode all trees
#24 (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*):ti
April 2013

#25 (nutri* or calori* or diet* or food* or eat* or meal* or snack* or cook* or restaurant* or supermarket* or cafe*):ab
#26 ((drink* or beverage*) not alcohol*):ti
#27 ((drink* or beverage*) not alcohol*):ab
#28 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27)
#29 MeSH descriptor Physical Exertion, this term only
#30 MeSH descriptor Human Activities explode all trees
#31 MeSH descriptor Leisure Activities explode all trees
#32 MeSH descriptor Locomotion explode all trees
#33 MeSH descriptor Physical Education and Training explode all trees
#34 MeSH descriptor Life Style, this term only
#35 MeSH descriptor Sedentary Lifestyle, this term only
#36 MeSH descriptor Yoga, this term only
#37 MeSH descriptor Fitness Centers, this term only
#38 MeSH descriptor Motor Activity, this term only
#39 (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving):ti
#40 (exercise* or train* or activit* or fit* or endur* or exertion or aerobic or strength* or flexib* or balance* or recreation* or leisure or play or energ* or walk* or hike or hiking or climbing or run* or jog* or swim* or aqua* or bicycl* or cycl* or bike* or biking or gym* or rowing or canoe* or kayak* or sailing or windsurf* or surf* or diving):ab
#41 (sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or gym* or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting or cardiorespiratory or sedentary or deskbound or inactiv*):ti
#42 (sport* or rollerblading or rollerskating or skating or skiing or yoga or pilates or calisthenics or jump* or lift* or gym* or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting or cardiorespiratory or sedentary or deskbound or inactiv*):ab
#43 (#29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42)
#44 MeSH descriptor Blood Pressure, this term only
#45 MeSH descriptor Hypertension, this term only
#46 MeSH descriptor Blood Glucose, this term only
#47 MeSH descriptor Hyperglycemia, this term only
#48 MeSH descriptor Cholesterol, this term only
#49 MeSH descriptor Cholesterol, Dietary, this term only
#50 MeSH descriptor Cholesterol, HDL, this term only
#51 MeSH descriptor Cholesterol, LDL, this term only
#52 MeSH descriptor Cholesterol, VLDL, this term only
#53 MeSH descriptor Cholesterol Esters, this term only
#54 MeSH descriptor Hypercholesterolemia, this term only
#55 MeSH descriptor Hyperlipidemias explode all trees
#56 MeSH descriptor Body Weight Changes explode all trees
#57 MeSH descriptor Harm Reduction, this term only
April 2013

#58 MeSH descriptor Overnutrition explode all trees
#59 MeSH descriptor Overweight explode all trees
#60 MeSH descriptor Obesity explode all trees
#61 (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertensi* or "blood glucose" or hyperglycemi* or cholesterol* or hypercholester* or hyperlipidemia*):ti
#62 (non-communicable or "non communicable" or chronic or weight* or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or hypertensi* or "blood glucose" or hyperglycemi* or cholesterol* or hypercholester* or hyperlipidemia*):ab
#63 (#44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62)
#64 (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentivi* or disincentivi* or remunerati* or retail* or sale* or promo* or consumer* or consumption* or purchasi* or shop* or buy* or product* or good* or service* or market*):ti
#65 (econom* or finance* or cost or costs or costing or pric* or monetis* or income* or wage* or salar* or expenditure* or time* or tax* or subsid* or credit* or cash or transfer or payment or welfare or benefit* or incentivi* or disincentivi* or remunerati* or retail* or sale* or promo* or consumer* or consumption* or purchasi* or shop* or buy* or product* or good* or service* or market*):ab
#66 (#64 OR #65)
#67 (#28 AND #66)
#68 (#43 AND #66)
#69 (#63 AND #66)
#70 (#67 OR #68 OR #69)


"nutri*" or "calori*" or "diet*" or "food*" or "eat*" or "meal*" or "snack*" or "cook*" or "restaurant*" or "supermarket*" or "cafe*" or "drink*" or "beverage*" or "exercise*" or "train*" or "activiti*" or "fit*" or "endur*" or exertion or aerobic or "strength*" or "flexib*" or "balance*" or "recreation*" or "leisure" or "play" or "energi*" or "walk*" or hike or hiking or climbing or "run*" or "jog*" or "swim*" or "aqua*" or "bicycli*" or "cycl*" or "bike*" or biking or "gym*" or rowing or "canoe*" or "kayak*" or sailing or "windsurf*" or "surf*" or diving or "sport*" or "roller*" or skating or skiing or yoga or pilates or calisthenics or "jump*" or "lift*" or circuit or resistance or resilience or dance or dancing or fishing or hunting or shooting or cardiorespiratory or sedentary or deskbound or "inactiv*" or "non communicable" or "non-communicable" or chronic or "weight*" or overweight or "over weight" or overeat or "over eat" or bmi or obes* or "blood pressure" or "hypertens*" or "blood glucose" or "hyperglycemi*" or "cholester*" or "hypercholester*" or "hyperlipidemia*" or (Focus of the report: cardiovascular or diabetes or healthy eating or leisure or obesity or physical activity)