Evaluation of the effectiveness of behavioural economic incentive programmes for the promotion of a healthy diet and physical activity: a protocol for a systematic review and network meta-analysis

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INTRODUCTION
Obesity and being overweight are major risk factors for metabolic syndrome and non-communicable diseases. Despite the recommendation that a healthy diet and physical activity can reduce the severity of these diseases, many fail to adhere to these measures. From a behavioural economic perspective, adherence to such measures can be encouraged through financial incentives. However, additional related behavioural economic approaches may improve the effectiveness of an incentive programme. As such, we have developed a protocol for a systematic review and network meta-analysis to summarise the current evidence from financial incentive programmes with and without behavioural economic insights for promoting healthy diet and physical activity.

Methods and analysis
Previous systematic reviews, meta-analyses and individual studies were identified from Medline and Scopus in June 2020 and will be updated until December 2020. Individual studies will be selected and data extracted by two reviewers. Disagreement will be resolved by consensus or adjudicated by a third reviewer. A descriptive analysis will summarise the effectiveness of behavioural economic incentive programmes for promoting healthy diet and physical activity. Moreover, individual studies will be pooled using network meta-analyses where possible. i2 statistics and Cochran’s Q test will be used to assess heterogeneity. Risk of bias and publication bias, if appropriate, will be evaluated, as well as the overall strength of the evidence.

Ethics and dissemination
Ethics approval for a systematic review and meta-analysis is not required. The findings will be published in a peer-reviewed journal.

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Strength and limitations of this study
- To our knowledge, this is the first systematic review and meta-analysis that has evaluated the effectiveness of behavioural economic incentive programmes related to standard financial/price incentive for the promotion of a healthy diet and physical activity.
- Behavioural economic incentive programmes in this study consists of deposit contracts, lottery-based incentives, regret lotteries and group-based payments.
- We will assess the effect of behavioural economic incentives on surrogate outcomes, but might not be able to assess the clinical disease outcomes due to insufficient data.
- We have considered financial incentive programmes, which focused only on healthy diet and physical activity.
- There may be studies available published in other languages, which we could not translate.

INTRODUCTION
Obesity and being overweight have become a global epidemic and significant public health concern. Increasing obesity prevalence worldwide has more than tripled in men and more than doubled in women from 1975 to 2014,1 with associated health concerns particularly in many developing countries, and especially in urban areas.2 Obesity and overweight are substantially burden causing metabolic syndrome3,4 and non-communicable diseases such as diabetes, hypertension and cardiovascular diseases.2,5

Nevertheless, obesity and being overweight are preventable through appropriate interventions and WHO provides recommendations for both individual and societal approaches.2 At an individual level, WHO recommends reduced fat and sugar consumption, increased fruit and vegetable intake as well as whole grains, nuts and legumes,
addition to regular physical activity, which is 60 min per
day for children and 150 min per week for adults.2

Despite these recommendations, unhealthy dietary behaviours6 and insufficient physical activity are increas-
ingly common.7 Interventions to promote healthier diet
and regular physical activity at both individual and popu-
lation levels have mostly focused on legislation (such as
banning partially hydrogenated oils and advertisement
of alcohol, etc.), taxes (such as sugar and alcohol tax) and
subsidies (on low-fat products, fruit and vegetables) as
well as knowledge and information provision.8–11 Never-
theless, only a small number of countries have had some
success in the recommended interventions to control
obesity since 1980.12 As such, there is opportunity to
improve interventions to promote improved diet and
physical activity outcomes, particularly through the use
of behavioural economics.13,14

Behavioural economics is a field that integrates
insights and methods from psychology and economics
to understand human decision making.15–17 It has gained
increased attention in promoting healthy behaviours,
such as healthy food choice,18–20 physical activity,20–21
smoking cessation20 22 23 and reduced alcohol consump-
tion.20 24 While conventional economics assumes rational
informed decision making, yet in reality, irrational
health behaviours including overeating and sedentary
lifestyle are common.16 25 26 In contrast, behavioural
economic accounts for irrational behaviours or bias in
explaining and predicting behaviour,16 26 including deci-
sion making, which contradicts recommended healthy
behaviours.16 25 27 28 The rationale for such decisions
commonly results from the time lapse between the cost
and benefits of an action, especially if the benefit and the
costs are significantly separated in time, a phenomenon
known as ‘present bias’.27

The provision of financial incentives is an effective
tool to encourage healthy behaviours given the current
nature of the incentive in relation to the distant health
benefit. Financial incentives of monetary value are
rewards for achieving the prespecified health goal; alter-
natively, incentivisation of healthy choices such as price
discounts, coupons for healthy food or choices and access
to sports facilities before any health goal is met can also
be used.29–31 Incentivisation of healthy behaviours offers
experience of healthy choices, while price discounts or
free distribution/access to healthy choices help reduce
barriers to behavioural change associated with switching
costs.32 Several studies have demonstrated the effective-
ness of financial incentive programmes in the promotion
of healthy diet and physical activity behaviours.8 33 34 In
addition, the effectiveness of these incentive programmes
should be able to improve by behavioural economics.

Financial incentive interventions incorporated other
behavioural insights beyond present bias8 33 35 36 include:

► Deposit contracts are voluntary options for indi-
viduals to deposit their own money which will be
refunded if they achieve the prespecified health
goal, for example, steps per day, weight loss.37 Some
incentive programmes also match rewards when the
goal is met.35 Due to loss aversion38 programme
participants will be more determined to hold to their
commitments.

► Lottery-based incentives are rewarded to individ-
uals who achieved the specific goal.39 Due to over-
weighting of a small probability of receiving rewards,
persons tend to be more motivated by an uncertain
larger reward than a certain smaller reward because
they believe that they will get a larger reward.40 41

► Regret lotteries pay only individuals who achieved
the goal at the time they win the lottery. However, and
importantly, everyone in the programme has a chance
to be drawn to get the incentive and is informed when
winning the lottery regardless of their goal
achievement. This design should induce the regret
aversion,42 43 that is, people do not want to feel regret
when they are informed of being drawn for the incentive
but are not eligible to get it because they failed to
achieve the goal.44 45

► Group-based payments pay the whole group—all
group members—when the group goal is achieved
instead of incentivising on individual level.46 Evidence
from a large body of literature on social preferences
shows that people do not care only about their own
payoffs but also others’ payoffs when making deci-
sions.47 48

Recent narrative reviews evaluated financial incentive
programmes that incorporated behavioural economic
insights into the study design for the promotion of healthy
diet and physical activity.5 56 In addition, a meta-analysis
by Haff et al compared the effectiveness of standard finan-
cial and behavioural economic incentive programmes on
change in health behaviours (weight loss, smoking cessa-
tion and medication adherence). However, this meta-
analysis was limited to seven studies which considered
standard financial incentives, deposit contracts and regret
lotteries.35 Additional financial incentive programmes
that were not considered within the meta-analysis include
price incentives, lottery-based incentives and group-based
payments.

This systematic review and network meta-analysis protocol
will address the following aims. First, comparisons of effec-
tiveness between standard financial, price and behavioural
economic incentive programmes using pooled mean differ-
ences (MD) of weight change and/or steps per day, relative
risks (eg, OR and risk ratios (RR)) of goal achievement,
non-communicable diseases and disease complications, should
sufficient data be amenable to pooling. Second, evaluations
of associations between the effectiveness of financial incen-
tive design features based on a framework by Adams et al
that considers direction (rewards/penalties), form (cash/
non-cash), magnitude (level), target (on effort/outcome),
length (for how long) as well as frequency (how often) of
incentives,49 type of other components (eg, text reminder,
feedback, education classes, etc) and participant character-
istics (eg, female proportion, health condition, etc) using
meta-regression analyses.
METHODS AND ANALYSIS

This systematic review and network meta-analysis will be conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols guidelines. The review will be conducted between June 2020 and May 2021.

Location of studies

Relevant studies published until June 2020 will be identified from Medline via PubMed and Scopus databases. In addition, reference list of identified studies will also be examined for additional relevant studies. Searches will be updated every 6 months until December 2020 to ensure the most recent studies are included in the final analysis.

Patient and public involvement

No patient involved

Search strategies

The search terms will address the following PICO criteria. See the full search strategy for Medline via PubMed and Scopus in online supplemental materials.

Patients (P)

General population (children and adults) and specific patient cohorts (eg, diabetes, obese, cardiovascular disease, etc) will be considered and therefore unrestricted.

Interventions (I) and comparator (C)

will include any type of financial incentive programmes including standard financial, price and behavioural economic incentive programmes, encompassing the following terms: “behavioural economic*”, “behavioural economic*”, nudg*, incentive*, “deposit contract*”, “monetary contingency contract*”, “commitment device*”, lotter*, “regret theory”, “group payment”, “group-based payment”, “team payment”, “team-based payment”.

Outcomes (O)

► Behavioural change:
  “health behavior change”, diet*, “physical activity”, exercis*
► Surrogate outcomes:
  “weight loss”, “weight gain”, overweight, “goal achievement”.
► Long-term clinical outcomes:

Selection of studies

There are a significant number of individual studies, systematic reviews, and meta-analyses evaluating the effectiveness of financial incentives on healthy diet and physical activity. As such, we will implement a dichotomous approach. First, relevant individual studies from the systematic reviews with or without meta-analysis (SRs/MAAs) will be selected. Then, relevant individual studies published since the previous SR/MA search date will be added.

Studies published in English and other languages amenable to Google translate will be included according to the following criteria.

Systematic reviews with or without meta-analysis

► SRs/MAAs of randomised controlled trials (RCTs) or non-RCTs undertaken in either general population or disease specific patients.
► Published financial incentive programme comparisons (eg, standard monetary (or equivalent) rewards, price incentives, or behavioural economic incentive programmes, or with no incentive) that were implemented on subject/patient levels.
► Assessed any outcome of improved healthy diet and/or physical activity.
► Studies that provided economic incentive for healthcare or intervention providers or any third party will be excluded.

Individual studies in the SRs/MAAs and studies published after the search date from published SRs/MAAs

► RCTs or non-RCTs of general population or disease specific patients.
► Published any comparisons among standard monetary (or equivalent) rewards, price incentives, deposit contract, lottery-based incentive, regret lottery, group-based payment or no incentive which were implemented on subject/patient levels.
► Assessed any outcome of improved healthy diet and/or physical activity including actual weight, weight change, steps per day, number of physical activity sessions completed, gym visits, goal achievement, non-communicable diseases, disease complications (among disease specific patients).

Studies will be excluded on the basis of the following criteria: included interventions as gifts of symbolic value as a reward, involved economic incentives for healthcare providers, intervention providers or any third party, and incomplete data for pooling after two attempts to contact the corresponding author.

Two reviewers (SB and OP) will independently select studies by screening titles and abstracts. If a decision can be not made, the full texts will be retrieved and reviewed. Any disagreement will be resolved by consensus or adjudicated by a third reviewer (AT).

Interventions

Interventions of interest include financial incentive programmes for promoting healthy diet and physical activity such as:

► Standard monetary (or equivalent) rewards of a specified amount or with a transferable monetary value to individuals when a specific health goal is achieved.
► Price incentive for healthy options, for example, discount, coupons or free distribution for healthy food and exercise facilities.
Physical activity: steps per day, number of completed sessions, frequency of gym visit.

Weight: actual weight, weight difference.

Goal achievement (success or failure).

In addition, we will consider secondary long-term clinical outcomes if data are available including diabetes mellitus, hypertension and cardiovascular diseases.

**Outcomes of interest**

The surrogate outcomes of interest are related to healthy diet and physical activity including:

- **Weight**: actual weight, weight difference.
- **Physical activity**: steps per day, number of completed sessions, frequency of gym visit.
- **Goal achievement** (success or failure).

In addition, we will consider secondary long-term clinical outcomes if data are available including diabetes mellitus, hypertension and cardiovascular diseases.

**Data extraction**

A standardised data extraction form will be developed. Two reviewers (SB and OP) will independently extract data from published studies. Any difference of extracted results will be discussed and resolved by consensus or adjudicated by a third author (AT).

Data from all included individual studies will be extracted including authors, year of publication, study design, type of participants, country of study, characteristics of study population (eg, percentage female, mean age, etc) financial interventions (type, duration, features, etc), type of other components (eg, text reminder, feedback, education/dietary classes, etc), type of outcomes and data for pooling.

**Quality and risk of bias assessment**

The quality assessment will be performed separately by SB and OP. Any disagreement will be resolved by the third reviewer (AT).

For randomised trials, the Cochrane risk-of-bias tool for randomised trials (RoB V2) will evaluate five bias domains: bias arising from the randomisation process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. Several questions will be evaluated against each domain; overall judgement will indicate either low or high risk of bias or some concerns.

For non-randomised studies, Risk of Bias In Non-randomised Studies-of Interventions will evaluate bias that may arise due to the non-randomised trial design which may influence the intervention comparative effectiveness estimates. This approach considers seven domains of bias: bias due to confounding, selection bias, bias in classification of interventions, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, bias in selection of the reported result. Note that the last four domains of bias are identical with the domains in RoB V2. The judgement for each domain, in addition to the overall judgement, can be either low, moderate, serious or critical risk of bias or insufficient information.

**Statistical analysis**

**Direct meta-analysis**

The effectiveness of different financial incentive programmes will be compared directly and pooled for each outcome of interest, if there is a minimum of two studies for each comparison. Effect sizes such as MD, and OR or RR will be estimated for continuous outcomes (eg, weight difference, steps per day) and dichotomous outcomes (eg, goal achievement, non-communicable disease status), respectively. These will be pooled across studies using a random-effect model if heterogeneity is present, otherwise a fixed-effect model will be applied.

Heterogeneity will be assessed using Cochrane’s Q test and I^2 statistics and regarded as present if p <0.10 or I^2 ≥25%. Source of heterogeneity will be explored by fitting covariates (eg, magnitude, frequency of incentive, length of incentive programme, a reminder system (eg, text reminders or phone call about goal, feedback), supporting components (eg, education/dietary classes, counselling programmes, information booklet/brochure), female proportion, health condition of participants, etc) individually in a meta-regression model and subgroup analysis will be performed accordingly.

Publication bias will be assessed using a funnel plot and Egger test. If asymmetry is present, a contour enhanced funnel plot will be constructed to identify the cause of publication bias.

**Network meta-analysis**

Interventions will be numerically coded as 1, 2, 3, 4, 5, 6 and 7 for no financial incentive, standard financial incentive, price incentive, a deposit contract, lottery-based incentive, regret lottery, group-based payment, respectively. A network map consisting of nodes and edges will be constructed with nodes weighted by number of studies for the corresponding comparison.

To assess relative treatment effects (ie, MDs, ln(ORs) or ln(RRs)), a network meta-analysis will be applied using a two-stage meta-analysis approach separately for each outcome. First, a binary or linear regression will be applied to estimate relative treatment effects and variance-covariance using no incentive as the reference. Second, a multivariate meta-analysis with a consistency model will pool relative treatment effects across studies. Mixed relative treatment comparisons between all financial incentive programmes will be estimated.

The probability of being the best financial incentive programme will be estimated using surface under the cumulative ranking curve method with appropriate ranking of interventions. In addition, differences between
direct and indirect estimates for each comparison (inconsistency assumption) will be evaluated by a design-by-treatment interaction model. All analyses will be stratified by age, that is, child or adult status, then they will be performed using STATA software V.16.1; a p<0.05 will be considered statistically significant, except for the presence of heterogeneity where p<0.10 will be used.

ETHICS AND DISSEMINATION

Ethics approval for systematic review and meta-analysis is not required. We will disseminate our findings through peer-reviewed publication, academic conference presentations and teaching materials.

If amendments to this protocol are required following its publication, we will provide the date, description of the change(s) and rationale for the change(s) of each amendment in resulting publications from this protocol.

REFERENCES


