



SYSTEMATIC REVIEW

REVISED **Design of financial incentive interventions to improve lifestyle behaviors and health outcomes: A systematic review****[version 2; peer review: 2 approved]**J. Jaime Miranda ^{1,2}, M. Amalia Pesantes ¹, María Lazo-Porras ^{1,3}, Jill Portocarrero ¹, Francisco Diez-Canseco ¹, Rodrigo M. Carrillo-Larco ^{1,4}, Antonio Bernabe-Ortiz ¹, Antonio J. Trujillo⁵, Robert W. Aldridge ⁶¹CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, 15074, Peru²Department of Medicine, School of Medicine, Universidad Peruana Cayetano Heredia, Lima, 15102, Peru³Division of Tropical and Humanitarian Medicine, Geneva University Hospitals & University of Geneva, Geneva, 1205, Switzerland⁴Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, W2 1UA, UK⁵Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD 21205, USA⁶Centre for Public Health Data Science, Institute of Health Informatics, University College London, London, NW1 2DA, UK**v2** First published: 25 Jun 2021, 6:163
<https://doi.org/10.12688/wellcomeopenres.16947.1>Latest published: 02 Sep 2021, 6:163
<https://doi.org/10.12688/wellcomeopenres.16947.2>**Abstract****Background:** Financial incentives may improve the initiation and engagement of behaviour change that reduce the negative outcomes associated with non-communicable diseases. There is still a paucity in guidelines or recommendations that help define key aspects of incentive-oriented interventions, including the type of incentive (e.g. cash rewards, vouchers), the frequency and magnitude of the incentive, and its mode of delivery. We aimed to systematically review the literature on financial incentives that promote healthy lifestyle behaviours or improve health profiles, and focused on the methodological approach to define the incentive intervention and its delivery. The protocol was registered at PROSPERO on 26 July 2018 ([CRD42018102556](https://doi.org/10.1136/2018022556)).**Methods:** We sought studies in which a financial incentive was delivered to improve a health-related lifestyle behaviour (e.g., physical activity) or a health profile (e.g., HbA1c in people with diabetes). The search (which took place on March 3rd 2018) was conducted using OVID (MEDLINE and Embase), CINAHL and Scopus.**Results:** The search yielded 7,575 results and 37 were included for synthesis. Of the total, 83.8% (31/37) of the studies were conducted in the US, and 40.5% (15/37) were randomised controlled trials. Only one study reported the background and rationale followed to develop the incentive and conducted a focus group to understand what sort of incentives would be acceptable for their study population. There was a degree of consistency across the studies in terms of the direction,**Open Peer Review****Reviewer Status**

	Invited Reviewers	
	1	2
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Any reports and responses or comments on the article can be found at the end of the article.

form, certainty, and recipient of the financial incentives used, but the magnitude and immediacy of the incentives were heterogeneous.

Conclusions: The available literature on financial incentives to improve health-related lifestyles rarely reports on the rationale or background that defines the incentive approach, the magnitude of the incentive and other relevant details of the intervention, and the reporting of this information is essential to foster its use as potential effective interventions.

Keywords

behavioral economics, evidence synthesis, incentives, interventions, non-communicable diseases, quality, systematic review, trials

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REVISED Amendments from Version 1

Expansion in the introduction to convey key concepts and references from the field of behavioural economics.
 Clarification on the limitations that the search strategy did not include economic and development databases and the search was conducted up to 2018.
 Full citation of the studies included in the review are now available in Table 1.

Any further responses from the reviewers can be found at the end of the article

Introduction

Many non-communicable diseases require effective engagement with lifestyle behaviours such as diet, physical activity and compliance with pharmacological medication, but this is difficult to achieve¹. There are major benefits to be achieved by preventive care, including both primary and secondary prevention, for example in the case of diabetes management²⁻⁵, yet adherence to healthy behaviors and pharmacological treatment remains a challenge⁶⁻⁹. Financial incentives may improve the initiation and engagement of behaviour change to reduce the negative outcomes associated with non-communicable diseases¹⁰. The field of behavioural economics has provided critical insights to influence public policy¹¹, and incentives are one of many tools available. Concepts such as present bias, loss aversion, choice overload, and reference points, among others, have now spread to the field of public health and healthcare delivery¹²⁻¹⁵.

Previous systematic reviews have focused on the effect of financial incentives on lifestyle behaviours¹⁶⁻²⁰, with less attention on how the financial incentives and rewards have been developed. Given the growing attention to develop incentive-oriented interventions¹⁰, there is still a paucity in guidelines or recommendations that help define key aspects of such interventions, including the type of incentive (e.g. cash rewards, vouchers), the frequency and magnitude of the incentive, and its mode of delivery. To address this gap in the evidence-base, this study aimed to systematically review the literature on financial incentives to promote healthy lifestyle behaviours (e.g., physical activity) or to improve health profiles (e.g., HbA1c levels) with a specific interest in the methodological approach used to identify how the incentive intervention was defined, as well as its mechanisms of delivery.

Methods**Study design**

A systematic review of the literature was conducted following the PRISMA guidelines²¹ (see *Reporting guidelines*²²). In addition, the protocol was registered at PROSPERO on 26 July 2018 (CRD42018102556)²³. We included studies that: i) had adults subjects (18+ years); ii) included financial incentives as a broad topic, i.e., no specific types of incentives (e.g. cash transfers or vouchers) were sought; and iii) the outcome of interest was a health-related lifestyle behaviour (e.g., physical activity) or a risk factor for a cardiovascular or metabolic disease (e.g., HbA1C in diabetes patients). To

ensure a broad range of included studies, our review focused on the methods of the included study, rather than on the effect of the financial incentive. We also did not require a specific comparator group for the interventions. Therefore, the search approach and the selection and extraction process did not focus on effects estimates, but on the methods, including for example: criteria used to define the incentive, criteria used to define the magnitude of the incentive, and criteria used to define the recipient of the incentive²⁴.

Search

The search was conducted in OVID (MEDLINE and Embase), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Scopus from inception to March 3rd 2018. No language or article type restrictions were set. The search terms used in OVID are presented in *Extended data*²².

Study selection

Search results were downloaded and saved in EndNote X7 (Clarivate, Philadelphia, PA, USA). Duplicates were eliminated from the search results using EndNote duplicate reference identification. Titles and abstracts were independently screened by two reviewers; discrepancies between them were solved by a third party independently. Titles and abstracts selected from this first stage were sought in full-text, and these were studied by two reviewers independently; as before, discrepancies were solved by a third reviewer independently. These selection processes were conducted using the Rayyan online software²⁵.

Data extraction

With the list of selected studies, information was extracted by one reviewer using a pre-specified data extraction form. Data extraction focused on items described in a framework used to document the complexity of financial incentive interventions to change health behaviours created by Adams *et al.*²⁴. In particular, the extraction form collated information about the study design, the methodological approach of the intervention, and aspects of the financial reward used, including its direction, form (e.g. cash, vouchers etc), certainty (e.g. certain if they did something, a chance of getting something), frequency, immediacy, schedule, and recipient. The details of the reviewed studies and all data extracted during the review are available at Table 1 and Table 2 (see *Underlying data*²²).

Analysis

Our review aimed to describe selected characteristics of intervention studies which used economic incentives to promote healthy lifestyle behaviours as per the framework described by Adams *et al.*²⁴. To achieve this aim we undertook a narrative synthesis of the included studies and aimed to summarise the methods followed to decide upon financial incentives, magnitude of the incentives, recipient of the incentives, among other features of the economic incentives intervention. We pre-specified that we would not undertake a comprehensive analysis of the studies' results (e.g., risk or impact estimates), including a meta-analysis, as was not the focus of our study. We also decided not to undertake a risk of bias assessment

for the same reasons that this was not considered necessary for our analytical aims.

Results

General characteristics

The search yielded 7,575 results, of which 3,656 were excluded after the initial screening. From 119 texts studied in detail, 37 were included (Figure 1 summarizes the study selection process). All but two of the retrieved studies were conducted in high-income countries, with a majority in the USA (83.8%; 31/37), and the exception were two studies from Mexico. 40.5%

(14/37) of the studies were randomized controlled trials and 26 (70.2%; 26/37) included more than 100 people.

Table 1 (see *Underlying data*²²) summarises the details for each included study. There were a wide range of study populations including employees, families with school aged children, and low-income families. Participants had a range of different health conditions or risk factors, such as diabetes and hypertension. Interventions targeting lifestyle behaviors and health outcomes were also equally diverse ranging from group meetings with rewards, information feedback

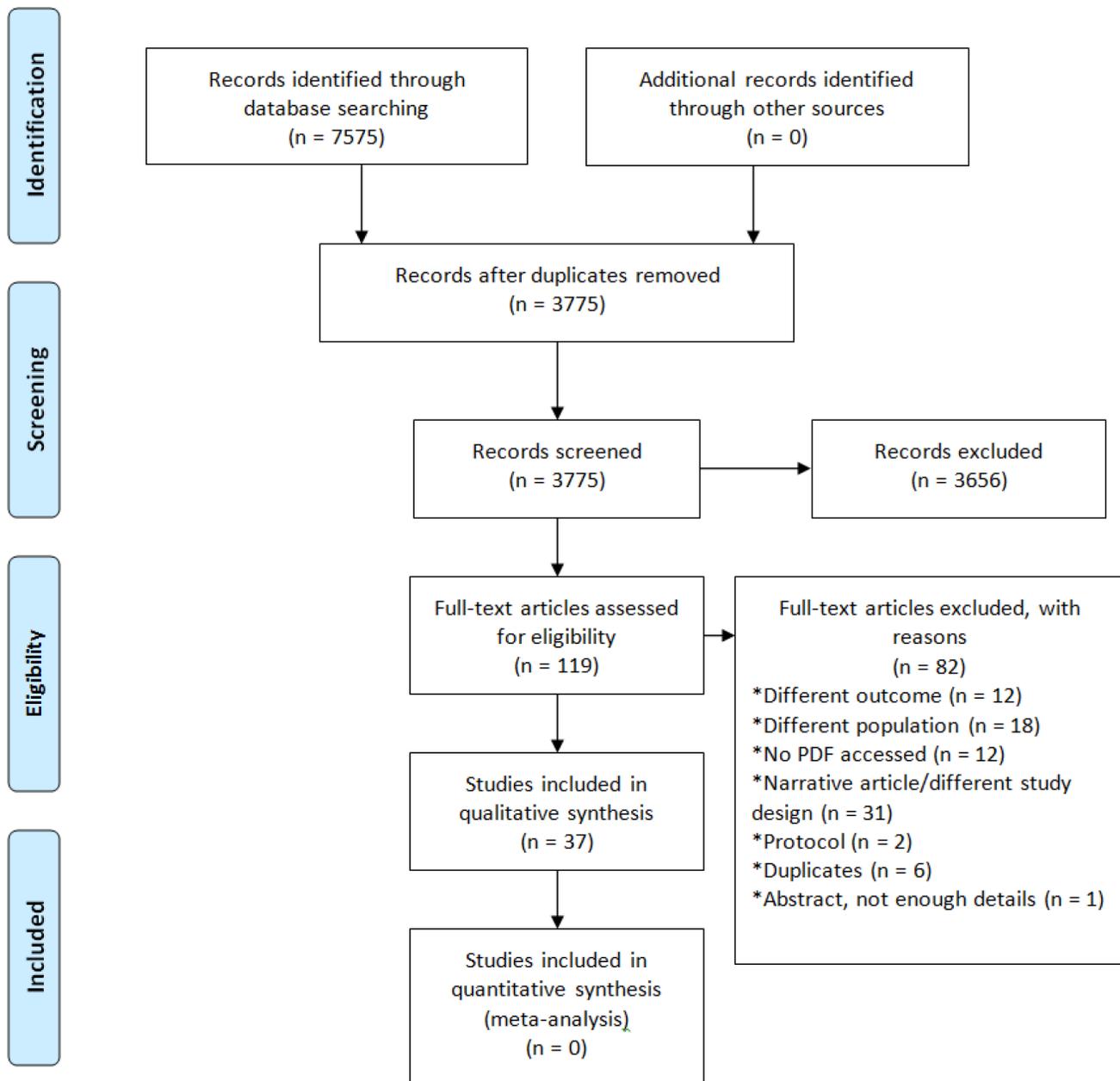


Figure 1. Flow diagram with the number of studies reviewed at each stage.

from clinicians in the form of written letters, and process and outcome-based incentives.

Defining the rationale for the financial incentive used

Only one study described a detailed rationale for the financial incentive used²⁶, and their methods involved conducting focus groups to understand what sort of incentives would be acceptable for their study population. None of the other included studies reported a detailed methodology or rationale to define the magnitude of the incentive, i.e. why they gave that amount of money or reward. In one of the retrieved studies, Kranker *et al.*²⁷ described that the magnitude of the incentive for one of the target goals was small because they considered such a goal (medication adherence) to be easy to achieve; in addition, they reported that “Incentive payments were moderately sized for two reasons. First, the research team needed to guarantee that total program costs would fall under a budget ceiling. Second, the research team was primarily interested in studying the effects of moderate financial incentives paired with aggressive behavior goals”.

A review of the framework used for financial incentives

Table 2 (see *Underlying data*²²) summarises the financial incentives framework used for each included study. The majority of included studies (83.8%; 31/37) used positive gains for the financial rewards, with three studies using the avoidance of a negative loss and three using a mixture of rewards. Cash or vouchers exchangeable for a range of goods or services were used as the financial incentive in 83.8% (31/37) of studies and five used specific goods or services, for example, health insurance discounts or diabetes test strips (see ‘Form of reward’, Table 2, *Underlying data*²²). The majority of included studies 81.1% (30/37) used financial incentives that participants were certain to receive if they completed the required activity, five studies used a mixed approach (e.g. some activities were certain, but others were based upon chance), and one study used chance alone (see ‘Certainty’, Table 2, *Underlying data*²²). In the majority of studies the recipient of the financial incentive was the individual study participant (83.8%; 31/37) with three studies providing a mixture of individual and group rewards, and a further three studies providing household-based incentives (see ‘Recipient’, Table 2, *Underlying data*²²).

The magnitude of the incentive varied widely from \$10 up to and including \$3000. 19/37 studies rewarded some behaviours, with the remaining 18 studies rewarding all incentivised behaviours. Just under half of the studies provided financial incentives immediately after an incentivised behaviour was undertaken (45.9%; 17/37). The remaining studies delayed incentives with a maximum lag of one year after the intervention. Just over half (51.4%; 19/37) of studies used a fixed schedule for the financial incentives and 17 studies (45.9%; 17/37) used a variable schedule, although these were not always provided incrementally.

Discussion

This work aimed to systematically review the literature on financial incentives with a specific focus on the methodological

approaches followed to define the incentive intervention, rather than on the effect of the intervention. In so doing, we build upon previous systematic reviews which have focused on the effect of financial incentives on lifestyle behaviours^{16–20}, however less attention has been placed on how the financial incentives and rewards were developed. We found that whilst being key to achieve the expected results in any given direction, little attention has been paid to a critical aspect of how to design and define the best possible incentive strategies. The average or range earned per participant was often not described and whilst targets or outcomes were described, the achievement of the tasks depends on its difficulty. If this were to be compared to a pharmacological intervention, the field of financial incentives lacks substantial attention to the design of the pharmacodynamics of the drug —minimum and maximum doses, the most effective delivery modes to guarantee higher adoption, and the frequency and spanning of the doses to be given. Different scheme designs are likely to lead to different outcomes, and hence, it is important to think about the most effective design of incentive schemes¹², as subtle design choices in how incentives are situated, framed, or deployed can have substantial effects on their success^{12,15}. Experimental data indicates that insufficient incentives may paradoxically produce less motivation to engage with a given habit than if there were no incentive at all²⁸. Despite the lack of studies reporting the methodological approaches taken to define the incentive intervention, there was still a degree of consistency across the studies in terms of the direction, form, certainty, and recipient of the financial incentives used, but the magnitude and immediacy of the incentives were more varied.

These findings are relevant to inform checklists and other recommendations to improve the reporting of interventions and other endeavours using financial incentives. Either on the main manuscript, a published protocol, or on an accompanying scientific report, future studies should report on the rationale used to derive key elements of the financial incentives. More detailed information about the interventions that utilize financial incentives, an objective that adds to the broader objectives of improving the quality of the reporting of health research, is needed to critically appraise the interventions, to inform the development and testing of new interventions, and to facilitate the implementation of these interventions at a larger scale, e.g., as a public health policy. We do not have any reasons to think that the available literature did not thoroughly consider the rationale of the intervention while planning the work, yet our findings suggest that this process needs to be better and more frequently reported. The development of standardised reporting guidelines such as those used to report complex interventions (TIDieR)²⁹ or trials (CONSORT)³⁰, observational studies (STROBE)³¹ or data linkage studies (RECORD)³² should be developed in order to support this process.

Our study followed standard systematic review methods including a comprehensive search in four international data sources, but there were limitations to our approach. First, because of the aims and scope of our work we did not extract

and report on the effect estimates of the economic incentives interventions. Second, we did not conduct a risk of bias assessment because we aimed to summarize the methodology of the financial incentives rather than to evaluate the quality of the whole literature. Third, we did not search libraries specific for economic or behavioral sciences, which could have retrieved additional studies in addition to the health sciences databases that considers the field of health economics. Finally, our search was conducted up to 2018, an inherent limitation given the considerable dynamism in the field. Yet, this does not preclude the recommendation that guidelines for the reporting of incentive-related studies are needed, in particular the need for including information on key design features of the incentive being examined.

Our study has systematically reviewed the literature on financial incentives to promote healthy lifestyle behaviours and examined the methodological approach to identify how the incentive intervention was defined and its mechanisms of delivery. We found that studies rarely report on the rationale or background to define the incentive approach, the magnitude of the incentive and other relevant details of the intervention. Future studies to guide interventions and generate evidence about the implementation of financial incentive interventions are required to fill this evidence gap.

Data availability

Underlying data

Figshare: Design of financial incentive interventions to improve lifestyle behaviors and health outcomes: A systematic review. <https://doi.org/10.6084/m9.figshare.14659176.v4²²>.

This project contains the following underlying data:

- 1 Underlying data – Table 1.docx (characteristics of studies included in the review).

- 2 Underlying data – Table 2.docx (financial incentives framework summary).

Extended data

Figshare: Design of financial incentive interventions to improve lifestyle behaviors and health outcomes: A systematic review. <https://doi.org/10.6084/m9.figshare.14659176.v4²²>.

This project contains the following extended data:

- 3 Extended data – Search strategy.docx (Search terms as used in OVID - MEDLINE and Embase)

Reporting guidelines

Figshare: PRISMA checklist for 'Design of financial incentive interventions to improve lifestyle behaviors and health outcomes: A systematic review'. <https://doi.org/10.6084/m9.figshare.14659176.v4²²>.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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The authors responded to my comments to version 1 of the article. I have no additional comments to version 2.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Economics, Health Economics, Health Econometrics, Economic evaluation, Impact evaluation of health policies.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 07 September 2021

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No further comments.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health program evaluation.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 16 August 2021

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Gustavo Angeles

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This is a valuable paper. The topic of the systematic review is very relevant as it identifies the magnitude of an important gap in the reporting of studies of financial incentives for modifying health behaviors. In my view, the results of this review ought to be disseminated and standards/guidelines of reporting should indicate the need for including information on key design features of the incentive being examined.

A drawback of this review is that it is not clear why papers from the economic and development literature were omitted. The rationale for that omission is not clear to me. Other than that, this is a valuable review.

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Yes

Are sufficient details of the methods and analysis provided to allow replication by others?

Yes

Is the statistical analysis and its interpretation appropriate?

Yes

Are the conclusions drawn adequately supported by the results presented in the review?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health program evaluation.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 21 Aug 2021

Jaime Miranda, Universidad Peruana Cayetano Heredia, Lima, Peru

We are grateful for the feedback provided. The comment that "the results of this review ought to be disseminated and standards/guidelines of reporting should indicate the need for including information on key design features of the incentive being examined" is precisely the key motivation for this work.

We agree with the reviewer that an important limitation of our study was that our search strategy did not include databases for the fields of economics and development. This has been highlighted as a limitation in the revised version of our work.

Thank you for your time and feedback.

Competing Interests: No competing interests were disclosed.

Reviewer Report 03 August 2021

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The article addresses a topic of great relevance for the design and implementation of financial interventions to improve the population's behaviours and lifestyles. The study contributes to understanding the key characteristics of these financial interventions and how the applied studies designed (or not) such financial incentives.

After reviewing the article, I have three main comments and one minor comment.

Major comments:

1. The authors carried out the bibliographic search in March 2018 (over three years ago). In a subject that has had a considerable dynamism, I consider three years is a long time for a systematic review. I suggest the authors update the bibliographic search. If this is not

possible because of the workload that it could imply, the authors should establish this point as a study limitation.

2. The authors searched for published articles only in biomedical repositories (such as MEDLINE). From my point of view, this represents the most important limitation of the study, given the economic nature of the subject and considering that in later years the economic literature (in fields such as Behavioral Economics and Economic Development) has produced several applied studies in the topic. Although the authors mention this as a study limitation, I assume they relativize it, suggesting that economics journals do not focus on this type of applied studies. I consider that this is not correct, and the authors should revalue the relevance of this limitation.
3. The review focus on the empirical aspects of the design of financial incentives, but I consider the authors could enhance the article if they present or reference (in the introduction and/or discussion section) a conceptual framework from Behavioral Economics on individual behaviours in the face of financial incentives. Concepts such as loss aversion, overweighting of small probabilities, hyperbolic discounting, increasing payoffs and reference points have ceased to be characteristic of economics, spreading to the field of public health. Some studies considering this are:

Vlaev, Ivo, *et al.* "Changing health behaviours using financial incentives: a review from behavioural economics." *BMC public health* 19.1 (2019): 1-9¹.

Mitchell, Marc S., *et al.* "Financial incentives for physical activity in adults: systematic review and meta-analysis." *British Journal of Sports Medicine* 54.21 (2020): 1259-1268².

Minor comment:

1. The citations/references of the 37 studies included in the qualitative synthesis are not available either in the manuscript or in the tables. The authors should resolve this.

References

1. Vlaev I, King D, Darzi A, Dolan P: Changing health behaviors using financial incentives: a review from behavioral economics. *BMC Public Health*. 2019; **19** (1): 1059 [PubMed Abstract](#) | [Publisher Full Text](#)
2. Mitchell MS, Orstad SL, Biswas A, Oh PI, et al.: Financial incentives for physical activity in adults: systematic review and meta-analysis. *Br J Sports Med*. 2020; **54** (21): 1259-1268 [PubMed Abstract](#) | [Publisher Full Text](#)

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Yes

Are sufficient details of the methods and analysis provided to allow replication by others?

Yes

Is the statistical analysis and its interpretation appropriate?

Yes

Are the conclusions drawn adequately supported by the results presented in the review?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Economics, Health Economics, Health Econometrics, Economic evaluation, Impact evaluation of health policies.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 21 Aug 2021

Jaime Miranda, Universidad Peruana Cayetano Heredia, Lima, Peru

We are grateful for the constructive comments provided by the reviewer. We appreciate that our work was deemed “a topic of great relevance for the design and implementation of financial interventions to improve the population’s behaviours and lifestyles.” Here we proceed to respond to his comments.

Comment #1: The authors carried out the bibliographic search in March 2018 (over three years ago). In a subject that has had a considerable dynamism, I consider three years is a long time for a systematic review. I suggest the authors update the bibliographic search. If this is not possible because of the workload that it could imply, the authors should establish this point as a study limitation.

Response #1: Yes, this is a limitation and we have added it in our revised version. The new text reads:

“Finally, our search was conducted up to 2018, an inherent limitation given the considerable dynamism in the field. Yet, this does not preclude the recommendation that guidelines for the reporting of incentive-related studies are needed, in particular the need for including information on key design features of the incentive being examined.”

Comment #2: The authors searched for published articles only in biomedical repositories (such as MEDLINE). From my point of view, this represents the most important limitation of the study, given the economic nature of the subject and considering that in later years the economic literature (in fields such as Behavioral Economics and Economic Development) has produced several applied studies in the topic. Although the authors mention this as a study limitation, I assume they relativize it, suggesting that economics journals do not focus on this type of applied studies. I consider that this is not correct, and the authors should revalue the relevance of this limitation.

Response #2: Point taken. We feel partly reassured that the databases used for our review are key ones for the field of health economics, as per

<https://guides.himmelfarb.gwu.edu/HealthEconomics/bibliographic-databases>. Another reassurance is that there will be some degree of overlap between economic and health databases as exemplified by this publication that appears on IDEAS database (<https://ideas.repec.org/a/eee/ehbiol/v41y2021ics1570677x2100006x.html>) and PubMed/MEDLINE (<https://pubmed.ncbi.nlm.nih.gov/33611235/>). Yet, we concur that not

exploring economics and development literature remains a limitation, and we have reworded that limitation in light of the feedback provided.

Comment #3: The review focus on the empirical aspects of the design of financial incentives, but I consider the authors could enhance the article if they present or reference (in the introduction and/or discussion section) a conceptual framework from Behavioral Economics on individual behaviours in the face of financial incentives. Concepts such as loss aversion, overweighting of small probabilities, hyperbolic discounting, increasing payoffs and reference points have ceased to be characteristic of economics, spreading to the field of public health. Some studies considering this are:

Response #3: Thank you, this is very useful and we have added the two suggested references as well as others. As suggested, we have expanded about this in the introduction and the discussion. The new text reads:

"The field of behavioural economics has provided critical insights to influence public policy [REF], and incentives are one of many tools available. Concepts such as present bias, loss aversion, choice overload, and reference points, among others, have now spread to the field of public health and healthcare delivery [REF]."

"Different scheme designs are likely to lead to different outcomes, and hence, it is important to think about the most effective design of incentive schemes [REF], as subtle design choices in how incentives are situated, framed, or deployed can have substantial effects on their success [REF]."

Comment #4 (minor): The citations/references of the 37 studies included in the qualitative synthesis are not available either in the manuscript or in the tables. The authors should resolve this.

Response #4: The tables (Underlying data, available at <http://www.doi.org/10.6084/m9.figshare.14659176.v3>) provide the first author and the year of publication, together with additional details of the study. We have added the full citation to Table 1 (underlying data).

Competing Interests: None