

PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Effect of a financial incentive (shopping point) on increasing the number of daily walking steps among community-dwelling adults in Japan: A randomized controlled trial
AUTHORS	Tanji, Fumiya; Tomata, Yasutake; Abe, Saho; Matsuyama, Sanae; Kotaki, Yumika; Nurrika, Dieta; Matsumoto, Koichi; Liu, Yingxu; Zhang, Shu; Lu, Yukai; Sugawara, Yumi; Bando, Shino; Yamazaki, Teiichiro; Otsuka, Tatsui; Sone, Toshimasa; Tsuji, Ichiro

VERSION 1 – REVIEW

REVIEWER	Bronwyn McGill The University of Sydney
REVIEW RETURNED	11-Feb-2020

GENERAL COMMENTS	<p>Thank you for the opportunity to review this manuscript. The study is interesting and well-designed. The findings have the potential to add to the evidence for using financial incentives for increasing physical activity and have particular relevance to a Japanese setting. Parts of the manuscript need to be improved and I have made suggestions below – these provide justification for ‘no’ answers to the review checklist. While the standard of English in the manuscript is generally very good, the language and flow of the introduction needs to be improved</p> <p>Fit with the scope of the journal: The study seems to be a good fit for the journal, providing the results of a small study in an area of research which has received increasing attention in recent years. It is important that such research is published to advance the evidence for using (or not using) financial incentives in the promotion of physical activity.</p> <p>Title The title correctly reflects the study, providing readers with a clear signpost of what to expect.</p> <p>Abstract The abstract clearly summarises the content of the manuscript. Page 3, Line 2. I have concerns about the statement that ‘only two RCTs have examined the effects of financial incentives on the mean number of daily walking steps among community-dwelling adults’ (please see comment for Introduction for further explanation). Page 4, Lines 8-9. The results of this study are relevant to mid-older adults and the authors should consider including this in the conclusion of the abstract (please also see comment for discussion for further explanation).</p>
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	<p>Introduction While the introduction provides interesting background information for the study, the links between concepts could be improved:</p> <ol style="list-style-type: none"> 1. Page 6, Line 5 states that “Therefore, PA imposes a substantial burden on health care costs” – while this is true, the sentence does not clearly flow on from the previous idea about not meeting PA recommendations. I suggest re-arranging the paragraph and putting this sentence after the information about annual health care costs associated with physical inactivity. 2. Page 7, Line 3 – the authors start the sentence about the aim of the study with “therefore”, but the aim of the study is not clearly related to the previous sentence which outlines the possible reasons for the inconsistency of previous results. I suggest providing information on the context of physical activity in the Japanese setting which may lead to a clearer justification for this study. <p>The statement that there are only two RCTs examining financial incentives and mean daily walking needs to be clarified. As it is currently stated, it does not acknowledge the literature (Page 6, Lines 14-16). There are a number of RCTs that have investigated the effect of financial incentives on physical activity (and in particular the number of steps walked per day). For example, a systematic review and meta-analysis published in the British Journal of Sports Medicine (Mitchell et al., 2019) provides examples (which include community-dwelling adults and have daily walking steps as an outcome measure). The studies included in the systematic review also include the two RCTs provided in this manuscript. The authors need to acknowledge other studies OR if I have mis-interpreted their reasons for only mentioning the Harkins et al., and Patel et al., RCTs, then they need to provide a clearer justification.</p> <p>Methods The methods are mostly clearly outlined. Page 9, Line 10. Power and sample size was based on a study which was aimed at participants 65 years and older. Would you expect to see a similar effect size had you achieved a younger-aged study sample? Page 12, Lines 9 and 10. Incident falls and incident pain are described in the protocol paper, however it would improve the understanding for readers if a brief description were included for each of these outcome measures.</p> <p>Results Page 15 and 16. The results are well presented and described but there seems to be a disproportionately detailed description of Table 3 results which is not necessary. The authors might consider reducing this description.</p> <p>Page 28, Table 2 Title. This table is for the intervention period which is clear in the table but not clear in the title.</p> <p>Page 29, Table 3 Title. As above, not clear from the title that the increase in number of steps is during the intervention period.</p> <p>Discussion Page 17, Lines 11-12. The authors mention the generalisability of the results to community-dwelling adults in Japan. As the age of</p>
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	<p>participants is on average over 60 years, it would be good to discuss that in the context of the implications of the results – either here or in the limitations, and in the abstract conclusion.</p> <p>Page 18, Line 14. The authors refer to a ‘noncash’ financial incentive. To improve the meaning of this to the reader, the authors might consider adding this terminology to Line 6 – could say ‘we chose to use shopping points (i.e. a non-cash incentive) ...’.</p> <p>General comment for discussion: Follow up results are reported in the Results (not significant) and the authors very briefly mention maintenance of walking steps in the Limitations. It would be good to include more discussion of the maintenance of physical activity improvements, and also of the short intervention and follow up periods. This information would allow the reader a better appreciation of the implications of the findings of this research.</p> <p>Conclusions The short intervention period needs to be acknowledged in the conclusion.</p>
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REVIEWER	<p>Nancy Haff Center for Healthcare Delivery Sciences Division of Pharmacoepidemiology Brigham and Women's Hospital Boston, MA USA</p>
REVIEW RETURNED	06-Apr-2020

GENERAL COMMENTS	<p>Remarks to the Author: Thank you for the opportunity to discuss this paper. The paper is well-written and clear, and the study design is straightforward. The study population was appropriately selected for the question at hand. In my opinion, the most interesting part of the study is the fact that local stores wanted to continue the financial incentives after the completion of the study, which suggests an aspect of potential sustainability that is not usually present in studies of financial incentives. I remain skeptical overall of the ability of financial incentives to sustain behavior over time, but this study does not answer that question and appropriately does not claim to do so. Overall the paper is clear, and I have listed below some additional recommendations for further clarification and discussion.</p> <p>Small point for clarity - throughout the paper the authors refer to timeframes as 1-3 weeks, 4-6 weeks, 7-9 weeks, etc. To me it is clearer to label as week 1, week 3, weeks 4-6, etc to emphasize that these refer to time frames not duration. (abstract, figure 1, methods sections, etc)</p> <p>Specific comments by section are as follows: Abstract: -Overall clear, concise, contains important information. For completeness of result reporting, I would recommend that the authors add to the results and conclusions sections that the difference between the groups was not significant in follow-up after incentives were removed.</p> <p>Introduction: -There are several additional studies on financial incentives for physical activity other than the two cited here. The authors may</p>
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want to incorporate some of these additional references into the introduction. Some suggested references are below.

Bachireddy, Chethan, Andrew Joung, Leslie K. John, Francesca Gino, Bradford Tuckfield, Luca Foschini, and Katherine L. Milkman. "Effect of Different Financial Incentive Structures on Promoting Physical Activity Among Adults: A Randomized Clinical Trial." *JAMA Network Open* 2, no. 8 (August 2, 2019): e199863–e199863. <https://doi.org/10.1001/jamanetworkopen.2019.9863>.

Chokshi, Neel P., Srinath Adusumalli, Dylan S. Small, Alexander Morris, Jordyn Feingold, Yoonhee P. Ha, Marta D. Lynch, Charles A. L. Rareshide, Victoria Hilbert, and Mitesh S. Patel. "Loss-Framed Financial Incentives and Personalized Goal-Setting to Increase Physical Activity Among Ischemic Heart Disease Patients Using Wearable Devices: The ACTIVE REWARD Randomized Trial." *Journal of the American Heart Association* 7, no. 12 (13 2018). <https://doi.org/10.1161/JAHA.118.009173>.

Kullgren, Jeffrey T., Kristin A. Harkins, Scarlett L. Bellamy, Amy Gonzales, Yuanyuan Tao, Jingsan Zhu, Kevin G. Volpp, David A. Asch, Michele Heisler, and Jason Karlawish. "A Mixed Methods Randomized Controlled Trial of Financial Incentives and Peer Networks to Promote Walking among Older Adults." *Health Education & Behavior: The Official Publication of the Society for Public Health Education* 41, no. 10 (October 2014): 43S-50S. <https://doi.org/10.1177/1090198114540464>.

Patel, Mitesh S., Kevin G. Volpp, Roy Rosin, Scarlett L. Bellamy, Dylan S. Small, Michele A. Fletcher, Rosemary Osman-Koss, et al. "A Randomized Trial of Social Comparison Feedback and Financial Incentives to Increase Physical Activity." *American Journal of Health Promotion: AJHP* 30, no. 6 (2016): 416–24. <https://doi.org/10.1177/0890117116658195>.

Patel, Mitesh S., Kevin G. Volpp, Roy Rosin, Scarlett L. Bellamy, Dylan S. Small, Jack Heuer, Susan Sproat, et al. "A Randomized, Controlled Trial of Lottery-Based Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults." *American Journal of Health Promotion: AJHP* 32, no. 7 (2018): 1568–75. <https://doi.org/10.1177/0890117118758932>.

Methods:

-I am not familiar with a community development integrated circuit (IC) card and was not immediately able to find an answer by googling, so it may help to explain to readers who are not from the area what that entails so we can fully understand the study population.

-Some additional explanation of how the incentives were awarded would be helpful here. Were shopping points awarded in one disbursement immediately after the 3-week intervention period? Also, how were these awarded to participants (eg gift card) and how could they be redeemed?

-I note that 18 USD for three weeks of walking is a fairly low incentive dollar amount compared to other financial incentive studies for physical activity. It may be worthwhile putting the award amount in context, both compared to prior studies of financial incentives for walking, and in terms of the economic status of the population in the study (most participants in the study self-identified

	<p>as affluent per table 1, but there are numbers to put that in context).</p> <p>-For measurement of transportation when going out, there is only one category in table 1. Is the alternative walking, public transit, bike, other physical way of getting around, etc? May be helpful to explain in the methods section.</p> <p>Results:</p> <p>-The text explaining table 3 is somewhat redundant, and could be pared down, as these are subgroup analyses with small n, and are clearly displayed in the table. For example, could highlighting that subgroup analyses showed significant increase in step counts among participants with lower baseline step counts, lower physical activity level, lower BMI, greater time affluence, etc.</p> <p>Discussion:</p> <p>-Though baseline step counts are one part of assessing generalizability to other populations, the authors could comment on other characteristics that might mean more or less generalizability of the results (socioeconomic status, walkability of the area, local store participation)</p> <p>-The comment on reduction of disparities is possible, however to truly reduce disparities the intervention should have a greater effect on participants of lower socioeconomic status. Based on the subgroup analyses it looks like the effects were similar in each group, so the intervention would not be expected to worsen disparities, but may or may not help close the gap.</p> <p>-The fact that local stores wanted to continue the financial incentive program after the RCT was completed is, I think, the most interesting part of this study, because it makes the source of the financial incentives possibly sustainable over time. Though it was not within scope of this present study, I am curious what the results would be of a longer-term period of financial incentives to earn points, and if this could be a sustainable community offering over time. I would love to hear more about what was continued by the local stores and for how long.</p> <p>Conclusion:</p> <p>-Would again here clarify the statement to include information about step counts not being different between groups in the follow-up period (similar to recommendation for abstract).</p>
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REVIEWER	Catherine Cornu Hospices Civils de Lyon France
REVIEW RETURNED	15-Jun-2020

GENERAL COMMENTS	<p>bmjopen-2020-037303 Effect of a financial incentive on increasing the number of daily walking steps among community-dwelling adults in Japan: A randomized controlled trial. General comment: my major concern is whether the tested intervention has any impact on health. The authors should address this issue, to indicate whether this study demonstrates a benefit of financial incentive on health, as well as the cost benefit ratio of the intervention. Review In the rationale, the authors should the question of whether daily steps is an adequate measure of physical activity and which could be the benefit for health outcomes of a “sufficient” (to</p>
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	<p>be defined) number of daily steps. The included population could be healthy or not, overweight or not, this brought heterogeneity in the population, which could be excessive for the small sample size. The difference of 1302 steps was used for sample size calculation. The clinical relevance of this value should be discussed.</p> <p>The achievement of a physical activity which is likely to have an impact on health outcomes would be more appropriate. The value in dollars of shopping points could be given for each cited value. The authors should describe the precision of the podometers to demonstrate that their performance was sufficient to ensure that a number of steps actually corresponds to physical activity. It is not totally clear whether the assignment was really concealed, and that a selection bias can be excluded. The authors specify that the wait-list control group could also gain the financial incentive: was it just a reward for their participation in the study or were they also asked to increase their daily steps ? The content of each visit until 12 weeks should be presented in the methods section. Page 1" line 2: the authors should specify the type of feedback that was given to the participants, if any. The sentence "feedback was collected" is ambiguous. Page 14, primary outcome: The authors should specify what difference was considered: the mean increase in the number of daily steps during the intervention period or during follow-up period ? Compared with that at baseline. In the published protocol, it is stated that "4–6 weeks and 7–9 weeks" would be the primary outcome, and the calculation is made with the expected difference between baseline and 4-6 weeks. This needs to be specified. P18: the words "affluence" and "affluent" could be replaced by more specific term? Compliance? Please clarify. Table " should be better presented as forest plots (optional). The statistical test should be an interaction test rather than a simple t test. Flow diagram : the number of patients screened and excluded should be presented.</p>
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VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name: Bronwyn McGill

Institution and Country: The University of Sydney

Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below

Thank you for the opportunity to review this manuscript. The study is interesting and well-designed. The findings have the potential to add to the evidence for using financial incentives for increasing physical activity and have particular relevance to a Japanese setting. Parts of the manuscript need to be improved and I have made suggestions below – these provide justification for 'no' answers to the review checklist. While the standard of English in the manuscript is generally very good, the language and flow of the introduction needs to be improved

Fit with the scope of the journal: The study seems to be a good fit for the journal, providing the results of a small study in an area of research which has received increasing attention in recent years. It is important that such research is published to advance the evidence for using (or not using) financial incentives in the promotion of physical activity.

Abstract

The abstract clearly summarises the content of the manuscript.

Page 3, Line 2. I have concerns about the statement that 'only two RCTs have examined the effects of financial incentives on the mean number of daily walking steps among community-dwelling adults' (please see comment for Introduction for further explanation).

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have deleted the relevant sentence in the Abstract and revised the relevant sentences in the Introduction section.

[Revised version pages 6-7]

A systematic review (meta-analysis) has suggested that financial incentives are effective for promoting health behaviors such as smoking cessation, vaccinations, and participation in cancer screening.⁸ Mitchell et al.⁹ conducted a systematic review of randomized controlled trials (RCTs) on the effects of financial incentives on physical activity and reported the results of a meta-analysis of studies promoting changes in daily walking steps. The findings of that study indicated that financial incentives were effective for increasing the number of daily walking steps during the intervention and post-intervention periods. However, these studies did have methodological differences in terms of incentives (e.g., cash, charity, lottery, team incentives) and target populations (e.g., overweight and obese adults). Most RCTs have been conducted in the USA, whereas only one has been conducted in Asia (Singapore).

9. Mitchell MS, Orstad SL, Biswas A, et al. Financial incentives for physical activity in adults: systematic review and meta-analysis. *Br J Sports Med* 2019;bjsports-2019-100633. doi: 10.1136/bjsports-2019-100633. Online ahead of print.

Page 4, Lines 8-9. The results of this study are relevant to mid-older adults and the authors should consider including this in the conclusion of the abstract (please also see comment for discussion for further explanation).

[Authors' reply]

The participants in this study were not limited to mid-older adults. Although the mean age of the participants was 61.2 years, 34 (47.2%) of the 72 participants were < 65 years of age (Table 3), and five were in their 20s. As shown in Table 3, a significant effect was consistently observed for both age groups (≥ 65 and < 65 years).

Introduction

While the introduction provides interesting background information for the study, the links between concepts could be improved:

1. Page 6, Line 5 states that "Therefore, PA imposes a substantial burden on health care costs" – while this is true, the sentence does not clearly flow on from the previous idea about not meeting PA recommendations. I suggest re-arranging the paragraph and putting this sentence after the information about annual health care costs associated with physical inactivity.

[Authors' reply]

Your comment definitely improved that clarity and strength of our manuscript. Thank you very much.

[Revised version page 6, lines 2-11]

Physical inactivity is a serious problem all around the world. According to the Global Action Plan on

Physical Activity 2018–2030¹, one in four adults (1.4 billion people worldwide) do not meet the World Health Organization (WHO) recommendations for physical activity levels. According to reports from the USA,^{2,3} a failure to meet recommended physical activity levels is associated with approximately 117 billion USD in annual health care costs and 10% of all premature deaths. Therefore, physical inactivity imposes a substantial burden on health care costs and longevity. To help solve these problems, the WHO and national governments have developed various policies to promote higher levels of physical activity.¹⁻⁵

2. Page 7, Line 3 – the authors start the sentence about the aim of the study with “therefore”, but the aim of the study is not clearly related to the previous sentence which outlines the possible reasons for the inconsistency of previous results. I suggest providing information on the context of physical activity in the Japanese setting which may lead to a clearer justification for this study.

[Authors’ reply]

Your valuable suggestion is sincerely appreciated.

We added the following sentences just before the one starting with “Therefore, the aim of the present study...”.

[Revised version page 7, lines 9-14]

Although walking is a major source of physical activity in daily life for Japanese people, the national average number of daily walking steps for Japanese adults (age ≥ 20 years) has been decreasing, from 7655 in 2000 to 6322 in 2017.¹⁰ Considering the rapid aging of the population and escalating health care costs, more effective measures aimed at promoting walking at the population level need to be established.

The statement that there are only two RCTs examining financial incentives and mean daily walking needs to be clarified. As it is currently stated, it does not acknowledge the literature (Page 6, Lines 14-16). There are a number of RCTs that have investigated the effect of financial incentives on physical activity (and in particular the number of steps walked per day). For example, a systematic review and meta-analysis published in the British Journal of Sports Medicine (Mitchell et al., 2019) provides examples (which include community-dwelling adults and have daily walking steps as an outcome measure). The studies included in the systematic review also include the two RCTs provided in this manuscript. The authors need to acknowledge other studies OR if I have mis-interpreted their reasons for only mentioning the Harkins et al., and Patel et al., RCTs, then they need to provide a clearer justification.

[Authors’ reply]

Thank you for your suggestion. In accordance with your comment, we have revised the relevant sentences in the Introduction section.

[Revised version pages 6-7]

A systematic review (meta-analysis) has suggested that financial incentives are effective for promoting health behaviors such as smoking cessation, vaccinations, and participation in cancer screening.⁸ Mitchell et al.⁹ conducted a systematic review of randomized controlled trials (RCTs) on the effects of financial incentives on physical activity and reported the results of a meta-analysis of studies promoting changes in daily walking steps. The findings of that study indicated that financial incentives were effective for increasing the number of daily walking steps during the intervention and post-intervention periods. However, these studies did have methodological differences in terms of incentives (e.g., cash, charity, lottery, team incentives) and target populations (e.g., overweight and obese adults). Most RCTs have been conducted in the USA, whereas only one has been conducted in Asia (Singapore).

9. Mitchell MS, Orstad SL, Biswas A, et al. Financial incentives for physical activity in adults: systematic review and meta-analysis. *Br J Sports Med* 2019;bjsports-2019-100633. doi:

Methods

The methods are mostly clearly outlined.

Page 9, Line 10. Power and sample size was based on a study which was aimed at participants 65 years and older. Would you expect to see a similar effect size had you achieved a younger-aged study sample?

[Authors' reply]

The paper by Harkins et al. (Ref. #12 in our manuscript) was the basis for us to assume the effect size and calculate the sample size when we designed this trial. At that time, we had no idea whether a similar effect size would be expected for younger study sample. The results of the present trial indicated that the effect size was not different between those aged ≥ 65 and < 65 years.

Page 12, Lines 9 and 10. Incident falls and incident pain are described in the protocol paper, however it would improve the understanding for readers if a brief description were included for each of these outcome measures.

[Authors' reply]

We appreciate your suggestion. Accordingly, we added a brief description about the methods we used to measure incident falls and pain.

[Revised version page 14, lines 3-7]

Incident falls were assessed based on the question "Have you fallen in the past 3 weeks?" The participants were asked to answer either "yes" or "no". Incident pain was assessed based on the question "How much pain have you experienced during the past 3 weeks?", with the participants asked to choose one of the following six answers: "none", "very mild", "mild", "moderate", "severe", or "very severe".

Results

Page 15 and 16. The results are well presented and described but there seems to be a disproportionately detailed description of Table 3 results which is not necessary. The authors might consider reducing this description.

[Authors' reply]

We revised the explanation of Table 3 for conciseness. Thank you very much!

[Revised version pages 17-18]

Table 3 shows the results of the analyses stratified by baseline characteristics. The subgroup analyses showed a significant increase in the number of daily steps among participants with a lower (< 6000) compared with those with a higher (≥ 6000) baseline step count (p -interaction = 0.012). Although no significant interaction was found, significant differences were observed for those with a low but not those with a high physical activity level, those with a BMI < 25 but not those with a BMI ≥ 25 , and those with time affluence; only a marginally nonsignificant difference was observed for the non-affluent group. Otherwise, significant increases in the number of daily steps were observed for both strata of sex, age group, frailty, education level, employment status, and economic affluence.

Page 28, Table 2 Title. This table is for the intervention period which is clear in the table but not clear in the title.

[Authors' reply]

Thank you for your comment. In accordance with your comment, we revised the title for Table 2.

[Revised version]

Table 2. Comparison of the proportions of participants with an increase in the number of daily steps of

1000 or more from baseline to the intervention period (weeks 4–6) (n = 72).

Page 29, Table 3 Title. As above, not clear from the title that the increase in number of steps is during the intervention period.

[Authors' reply]

Thank you for your comment. In accordance with your comment, we revised the title for Table 3.

[Revised version]

Table 3. Subgroup analysis: Comparison of increases in the number of steps from baseline to the intervention period (weeks 4–6) (n = 72).

Discussion

Page 17, Lines 11-12. The authors mention the generalisability of the results to community-dwelling adults in Japan. As the age of participants is on average over 60 years, it would be good to discuss that in the context of the implications of the results – either here or in the limitations, and in the abstract conclusion.

[Authors' reply]

Although the mean age of the participants was 61.2 years, 34 (47.2%) of the 72 participants were < 65 years of age (Table 3), and five were in their 20s. As shown in Table 3, a significant effect was consistently observed for both age groups (≥ 65 and < 65 years). Therefore, from the perspective of age, we believe our findings are generalizable to the community-dwelling adult population in Japan.

Page 18, Line 14. The authors refer to a 'noncash' financial incentive. To improve the meaning of this to the reader, the authors might consider adding this terminology to Line 6 – could say 'we chose to use shopping points (i.e. a non-cash incentive) ...'.

[Authors' reply]

Thank you for your valuable comment.

[Revised version page 20, lines 9-10]

In this study, we chose to use shopping points (a noncash incentive) that could only be redeemed at stores in the study area.

General comment for discussion: Follow up results are reported in the Results (not significant) and the authors very briefly mention maintenance of walking steps in the Limitations. It would be good to include more discussion of the maintenance of physical activity improvements, and also of the short intervention and follow up periods. This information would allow the reader a better appreciation of the implications of the findings of this research.

[Authors' reply]

We agree with you. We made major revisions in the first paragraph of the Discussion section.

[Revised version page 19, lines 2-11]

The present RCT examined the effects of a financial incentive (shopping points) on the number of daily walking steps among community-dwelling Japanese adults. The increase in the number of daily steps was significantly larger in the intervention than in the control group, with a particularly substantial increase in those with low physical activity levels at baseline. However, caution is required when interpreting the present findings because the intervention period was as short as 3 weeks and the increased number of daily steps was not maintained after receiving the incentive. Whether the incentive needs to be continued so that the participants maintain their increased number of daily steps remains unclear.

Conclusions

The short intervention period needs to be acknowledged in the conclusion.

[Authors' reply]

Thank you for your comment. We added this point to the Conclusion section.

[Revised version page 22, lines 1-5]

The results of the present study indicated that offering a financial incentive was effective for increasing the number of daily walking steps among Japanese community-dwelling adults, even though the intervention period was as short as 3 weeks.

Reviewer: 2

Reviewer Name: Nancy Haff

Institution and Country:

Center for Healthcare Delivery Sciences

Division of Pharmacoepidemiology

Brigham and Women's Hospital

Boston, MA USA

Please state any competing interests or state 'None declared': None

Please leave your comments for the authors below

Remarks to the Author:

Thank you for the opportunity to discuss this paper. The paper is well-written and clear, and the study design is straightforward. The study population was appropriately selected for the question at hand. In my opinion, the most interesting part of the study is the fact that local stores wanted to continue the financial incentives after the completion of the study, which suggests an aspect of potential sustainability that is not usually present in studies of financial incentives. I remain skeptical overall of the ability of financial incentives to sustain behavior over time, but this study does not answer that question and appropriately does not claim to do so. Overall the paper is clear, and I have listed below some additional recommendations for further clarification and discussion.

Small point for clarity - throughout the paper the authors refer to timeframes as 1-3 weeks, 4-6 weeks, 7-9 weeks, etc. To me it is clearer to label as week 1, week 3, weeks 4-6, etc to emphasize that these refer to time frames not duration. (abstract, figure 1, methods sections, etc)

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we revised the description of the time frames (e.g., 4–6 weeks to weeks 4–6) in the text, tables, and figure.

Specific comments by section are as follows:

Abstract:

-Overall clear, concise, contains important information. For completeness of result reporting, I would recommend that the authors add to the results and conclusions sections that the difference between the groups was not significant in follow-up after incentives were removed.

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have added a relevant sentence in the Results section of the Abstract. We did not add a similar statement in the Conclusion section because of the word limit.

[Revised version page 4, lines 1-3]

However, the difference between groups was not significant at follow-up after the incentives were removed ($p = 0.311$).

Introduction:

-There are several additional studies on financial incentives for physical activity other than the two cited here. The authors may want to incorporate some of these additional references into the introduction. Some suggested references are below.

[Authors' reply]

Thank you for your valuable suggestions. We received a similar suggestion from Reviewer 1. In accordance with your comment, in addition to those you suggested, we have added a reference to a systematic review and meta-analysis and revised the text accordingly.

[Revised version pages 6-7]

Mitchell et al.⁹ conducted a systematic review of randomized controlled trials (RCTs) on the effects of financial incentives on physical activity and reported the results of a meta-analysis of studies promoting changes in daily walking steps. The findings of that study indicated that financial incentives were effective for increasing the number of daily walking steps during the intervention and post-intervention periods. However, these studies did have methodological differences in terms of incentives (e.g., cash, charity, lottery, team incentives) and target populations (e.g., overweight and obese adults). Most RCTs have been conducted in the USA, whereas only one has been conducted in Asia (Singapore).

9. Mitchell MS, Orstad SL, Biswas A, et al. Financial incentives for physical activity in adults: systematic review and meta-analysis. *Br J Sports Med* 2019;bjsports-2019-100633. doi: 10.1136/bjsports-2019-100633. Online ahead of print.

Methods:

-I am not familiar with a community development integrated circuit (IC) card and was not immediately able to find an answer by googling, so it may help to explain to readers who are not from the area what that entails so we can fully understand the study population.

[Authors' reply]

Thank you for your suggestion. We have added an explanation of IC cards in the Methods section.

[Revised version page 9, lines 7-11]

Shopping points are added to an IC card when the customer purchases goods or participates in community activities in the Nakayama area. Customers can redeem their points during payment transactions while shopping. IC cards are also intended to enhance social interaction among locals.

-Some additional explanation of how the incentives were awarded would be helpful here. Were shopping points awarded in one disbursement immediately after the 3-week intervention period? Also, how were these awarded to participants (eg gift card) and how could they be redeemed?

[Authors' reply]

Thank you for your suggestion. We have added relevant explanations in the Methods section.

[Revised version page 12, lines 8-20]

Based on the exchange rate on August 31, 2018, 2000 JPY was equivalent to 18 USD. All participants in the intervention and control groups who achieved their daily step goals were rewarded with shopping points worth 1000 or 2000 JPY on their IC card at that time (after the end of the trial, i.e., week 12). However, we did not specify how the shopping points could be used, so it is possible that they might have used the points for unhealthy purchases (e.g., cigarettes).

Wait list control group

The wait list control group was also asked to increase their daily steps in the last 3 weeks (weeks 10–12). They could gain a financial incentive only if they achieved the goals. All conditions except for the timing were the same as those for the intervention group.

-I note that 18 USD for three weeks of walking is a fairly low incentive dollar amount compared to other financial incentive studies for physical activity. It may be worthwhile putting the award amount in context, both compared to prior studies of financial incentives for walking, and in terms of the economic status of the population in the study (most participants in the study self-identified as affluent per table 1, but there are numbers to put that in context).

[Authors' reply]

Thank you for your suggestion. We have added a relevant sentence in the Discussion section in regard to the strengths of the study.

[Revised version pages 20-21]

Third, the financial incentive offered in this study was a fairly low amount compared with other financial incentive studies involving physical activity. Although most of study participants were classified as affluent in terms of their economic status, the relatively small financial incentive was still effective for increasing the number of daily walking steps.

-For measurement of transportation when going out, there is only one category in table 1. Is the alternative walking, public transit, bike, other physical way of getting around, etc? May be helpful to explain in the methods section.

[Authors' reply]

Thank you for your suggestion. We have added a relevant sentence in the Methods section.

[Revised version page 13, lines 9-12]

Transportation when going out was assessed by asking the question "What kinds of transportation have you used more than twice per week when going out in the last month?", for which, the available responses were: "walking", "bicycle", "motorbike", "car", "train", "bus", "taxi", or "other".

Results:

-The text explaining table 3 is somewhat redundant, and could be pared down, as these are subgroup analyses with small n, and are clearly displayed in the table. For example, could highlighting that subgroup analyses showed significant increase in step counts among participants with lower baseline step counts, lower physical activity level, lower BMI, greater time affluence, etc.

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have revised the relevant text in the Results section.

[Revised version pages 17-18]

Table 3 shows the results of the analyses stratified by baseline characteristics. The subgroup analyses showed a significant increase in the number of daily steps among participants with a lower (< 6000) compared with those with a higher (\geq 6000) baseline step count (p -interaction = 0.012). Although no significant interaction was found, significant differences were observed for those with a low but not those with a high physical activity level, those with a BMI < 25 but not those with a BMI \geq 25, and those with time affluence; only a marginally nonsignificant difference was observed for the non-affluent group. Otherwise, significant increases in the number of daily steps were observed for both strata of sex, age group, frailty, education level, employment status, and economic affluence.

Discussion:

-Though baseline step counts are one part of assessing generalizability to other populations, the authors could comment on other characteristics that might mean more or less generalizability of the results (socioeconomic status, walkability of the area, local store participation)

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have revised the relevant text in the Discussion section.

[Revised version page 19, lines 12 - 19]

Although most of the study participants might be considered more health-conscious than average because they volunteered to participate in this RCT and were classified as economically affluent, the present results are considered to be generalizable to the community-dwelling adult population in Japan because the mean number of daily steps among the study participants at baseline was similar to the nationwide average (6364 vs. 6322, respectively).¹⁰ The study area was safe for walking and has sidewalks that are favorable for pedestrians, which is typical in local communities in Japan.

-The comment on reduction of disparities is possible, however to truly reduce disparities the intervention should have a greater effect on participants of lower socioeconomic status. Based on the subgroup analyses it looks like the effects were similar in each group, so the intervention would not be expected to worsen disparities, but may or may not help close the gap.

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have revised the relevant text in the Discussion section.

[Revised version page 20, lines 5-7]

This could be the reason why the financial incentive resulted in an increase in the number of daily walking steps, regardless of socioeconomic status.

-The fact that local stores wanted to continue the financial incentive program after the RCT was completed is, I think, the most interesting part of this study, because it makes the source of the financial incentives possibly sustainable over time. Though it was not within scope of this present study, I am curious what the results would be of a longer-term period of financial incentives to earn points, and if this could be a sustainable community offering over time. I would love to hear more about what was continued by the local stores and for how long.

[Authors' reply]

Thank you for your thoughtful comments. Even after the official project was completed, incentives for increasing the number of daily steps continued as an independent project of the shopping district. However, since the outbreak of the COVID-19 pandemic in Japan in February 2020, incentive programs have faced a major challenge because some local stores have closed and people are instructed to refrain from going out.

Conclusion:

-Would again here clarify the statement to include information about step counts not being different between groups in the follow-up period (similar to recommendation for abstract).

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have revised the relevant text in the Conclusion section.

[Revised version page 22, lines 4-5]

The difference between the intervention and control groups was not significant at follow-up after the incentives were removed.

Reviewer: 3

Reviewer Name: Catherine Cornu

Institution and Country

Hospices Civils de Lyon

France

Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below

bmjopen-2020-037303

Effect of a financial incentive on increasing the number of daily walking steps among community-dwelling adults in Japan: A randomized controlled trial.

General comment: my major concern is whether the tested intervention has any impact on health. The authors should address this issue, to indicate whether this study demonstrates a benefit of financial incentive on health, as well as the cost benefit ratio of the intervention.

[Authors' reply]

We agree with the reviewer's comment that calculating the benefits of a financial incentive are important. Our previous study reported that an increase of 1000 steps was associated with reduced medical costs of 1300 JPY (\approx 12 USD) per month [1]. However, we did not include this in the present manuscript because it was an older study and not conducted in parallel with the present study.

1. Tsuji I, et al. Impact of walking upon medical care expenditure in Japan: the Ohsaki Cohort Study. *Int J Epidemiol.* 2003 Oct;32(5):809-14. doi: 10.1093/ije/dyg189.

Review

In the rationale, the authors should address the question of whether daily steps is an adequate measure of physical activity and which could bring some benefit for health outcomes. What would be a "sufficient" (to be defined) number of daily steps?

[Authors' reply]

We appreciate the reviewer's comments. We added relevant text as follows.

[Revised version page 6, lines 11–16]

Walking is a popular and major source of physical activity worldwide.^{1,2,6} In the Japanese National Health Promotion Movement ("Health Japan 21"), a higher number of daily walking steps is a target for physical activity as follows: 9000 and 8500 steps in men and women aged < 65 years, and 7000 and 6000 steps in men and women aged \geq 65 years, respectively.⁷

6. Althoff T, Sosič R, Hicks JL, et al. Large-scale physical activity data reveal worldwide activity inequality. *Nature* 2017;547(7663):336–339.

7. Ministry of Health, Labour and Welfare. Health Japan 21. 2012. https://www.mhlw.go.jp/bunya/kenkou/dl/kenkounippon21_01.pdf

The included population could be healthy or not, overweight or not, this brought heterogeneity in the population, which could be excessive for the small sample size.

[Authors' reply]

We appreciate the reviewer's comments. The participants in this study were basically healthy because those with severe health conditions according to the exclusion criteria were excluded. In addition, as shown in Table 1, BMI values were standard in both the intervention and control groups (BMI \geq 30: 8.3%, BMI < 18.5: 8.3%, data not shown in Table 1).

The difference of 1302 steps was used for sample size calculation. The clinical relevance of this value should be discussed. The achievement of a physical activity which is likely to have an impact on health outcomes would be more appropriate.

[Authors' reply]

We apologize for providing insufficient information on the clinical relevance of steps. We added text as follows.

[Revised version pages 9-10]

The difference of 1302 steps was the effect size reported in a previous study. Additionally, our

previous study reported that an increase of 1000 steps was associated with reduced medical costs of 1300 JPY (\approx 12 USD) per month, and another study reported that an increase of 1000 steps had some impact on health at the population level because it contributes to a 3.2% reduction in the average relative risk of noncommunicable diseases, dementia, joint-musculoskeletal impairment, and mortality.⁴

The value in dollars of shopping points could be given for each cited value.

[Authors' reply]

We agree with the reviewer's suggestion. We added the value in USD as follows.

[Revised version page 9, lines 14-17]

Based on a previous study carried out in 2013¹², we assumed that an average difference of 1302 steps would be achieved in the intervention period (4–6 weeks) by offering a financial incentive of 2000 JPY (\approx 18 USD at the time of the study in 2018) and setting the standard deviation (SD) at 1711.

The authors should describe the precision of the pedometers to demonstrate that their performance was sufficient to ensure that a number of steps actually corresponds to physical activity.

[Authors' reply]

We appreciate the reviewer's comments. We added relevant text as follows.

[Revised version page 10, lines 15-19]

To maintain the accuracy of the pedometer, all participants received an explanation that they should wear the pedometer close to their waist because steps will not be counted correctly when worn on a different location, placed in a handbag, or set in any other position results in irregular movements.

It is not totally clear whether the assignment was really concealed, and that a selection bias can be excluded.

[Authors' reply]

We appreciate your comment. As we wrote in our design paper, the assignment was blinded to everyone except for two random assignment researchers. We added this point in the Blinding section.

[Revised version page 11, lines 10-16]

The assignment information was kept in a password-protected storage device. The researchers involved exclusively in the random assignment notified the participants about their own assignment in a closed room separated from the other examination locations. During the notification process, these random assignment researchers warned the participants not to talk about their assignment with anyone else.

The authors specify that the wait-list control group could also gain the financial incentive: was it just a reward for their participation in the study or were they also asked to increase their daily steps ?

[Authors' reply]

We appreciate your comment. The wait list control group was also asked to increase their daily steps, but they could gain a financial incentive only if they achieved the goals. We made the following correction.

[Revised version page 12, lines 8-20]

Based on the exchange rate on August 31, 2018, 2000 JPY was equivalent to 18 USD. All participants in the intervention and control groups who achieved their daily step goals were rewarded with shopping points worth 1000 or 2000 JPY on their IC card at that time (after the end of the trial, i.e., week 12). However, we did not specify how the shopping points could be used, so it is possible that they might have used the points for unhealthy purchases (e.g., cigarettes).

Wait list control group

The wait list control group was also asked to increase their daily steps in the last 3 weeks (weeks 10–12). They could gain a financial incentive only if they achieved the goals. All conditions except for the timing were the same as those for the intervention group.

The content of each visit until 12 weeks should be summarised in the methods section.

[Authors' reply]

We agree with your suggestion. Therefore, we clarified the content of each visit in the Outcome assessment section.

[Revised version page 14, lines 10-15]

The participants were asked to visit the study center every 3 weeks, and evaluations of individual daily steps were carried out during each visit. For each visit, we transferred data on the number of daily steps to a computer and asked the participants whether they had experienced any pain or falls in the 3-week period. All participants were instructed to wear the pedometer while awake every day during the study period (weeks 9).

Page 13 line 2: the authors should specify the type of feedback that was given to the participants, if any. The sentence “feedback was collected” is ambiguous.

[Authors' reply]

We apologize for the ambiguous sentence. We revised this with the content of each visit as summarized above.

[Revised version page 14, lines 10-15]

The participants were asked to visit the study center every 3 weeks, and evaluations of individual daily steps were carried out during each visit. For each visit, we transferred data on the number of daily steps to a computer and asked the participants whether they had experienced any pain or falls in the 3-week period. All participants were instructed to wear the pedometer while awake every day during the study period (weeks 9).

Page 14, primary outcome: The authors should specify what difference was considered: the mean increase in the number of daily steps during the intervention period or during follow-up period? Compared with that at baseline. In the published protocol, it is stated that “4–6 weeks and 7–9 weeks” would be the primary outcome, and the calculation is made with the expected difference between baseline and 4-6 weeks. This needs to be clarified.

[Authors' reply]

Thank you very much for your excellent comment. We apologize for the mistake made regarding the study protocol when defining the primary outcome in Table 2. This should have been “4–6 weeks” instead of “4–6 weeks and 7–9 weeks”. We will contact BMJ Open to correct this as soon as possible. We clarified the primary outcome as follows.

[Revised version page 14, lines 16-18]

The primary outcome was the mean increase in the number of daily steps during the intervention period (weeks 4–6) compared with that at baseline.

P18: the words “affluence” and “affluent” could be replaced by more specific term? Compliance? Please clarify.

[Authors' reply]

Your suggestion is appreciated, but we would like to keep these phrases because “affluence/affluent” here means that having enough time or money.

Table 3 should be better presented as forest plots (optional). The statistical test should be an interaction test rather than a simple t test.

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we performed an interaction test, as shown in Table 3. However, we also want to present details in Table 3 and pare down the relevant sentences in the Results section based on comments from Reviewers 1 and 2.

Flow diagram : the number of patients screened and excluded should be presented.

[Authors' reply]

Thank you for your suggestion. In accordance with your comment, we have added the relevant number in Fig. 1.

VERSION 2 – REVIEW

REVIEWER	Bronwyn McGill The University of Sydney Australia
REVIEW RETURNED	15-Jul-2020

GENERAL COMMENTS	Thank you for addressing all comments. Your responses and amendments to the manuscript have helped to improve the readability and flow of the paper.
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REVIEWER	Nancy Haff Brigham and Women's Hospital, USA
REVIEW RETURNED	30-Jul-2020

GENERAL COMMENTS	<p>Thank you for the opportunity to review this revised manuscript. Most of the suggestions have been addressed, and the clarity of the paper has improved. However, I would recommend some additional changes to further help with clarity.</p> <p>Small points: -In title should read "(shopping points)" plural -page 9 line 16 (or 11/71 line 46): please change "4-6 weeks" to "weeks 4-6"</p> <p>Introduction: -The discussion of the Mitchell paper in the second paragraph of the introduction could be condensed to decrease length and improve clarity.</p> <p>Methods: -Even more information on the IC cards would be helpful for me to fully understand the magnitude and generalizability of the intervention. One quick sentence with the approximate percentage of the population that uses IC cards in the region and how do the number of points awarded as part of the study compare to the number of points people would earn from everyday shopping would be helpful. -The power and sample size paragraph should be revised for clarity. Specifically, the second sentence is duplicative of the first. Is the reduced medical cost statistic from the same study? Would recommend citing that or reworking the first three sentences of the paragraph so that is more clear. For the statistic about the 3.2%</p>
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	<p>reduction in relative risk of noncommunicable diseases, etc, would recommend citing the original paper that this comes from as it was not clear to me from the reference cited.</p> <p>-In the blinding section, please clarify the sentence “In addition, all statistical analyses were blinded to the assignments.” Knowledge of group assignment is needed to perform the outcome analyses, so I’m not sure what is meant here.</p> <p>-The different parts of the study are well outlined in Figure 1, but on reading the text I became confused. A few points to help with clarity of timeline:</p> <p>-First line of the randomization paragraph: I recommend saying “After completing the three-week baseline period, participants were randomized. . .” rather than after confirming eligibility, because by figure 1 they were randomized between weeks 3 and 4, not after eligibility screening.</p> <p>-The sentence “All participants in the intervention and control groups who achieved their daily step goals were rewarded with shopping points . . .” is confusing because there is no reference to time frame here, so it sounds like there was no difference between intervention and control. Instead, I would recommend focusing this section just on the intervention group. Eg: “Participant in the intervention group who achieved their daily step goals during the intervention period (weeks 4-6) were rewarded with shopping points. . .”. Please also state that the incentives were then removed for the follow-up period (weeks 7-9).</p> <p>-Then in the section about the wait list group, please make it clear that that group had no incentives all the way through the end of the follow-up period, and it was only after the study was complete that they were offered the same incentives as the intervention group during weeks 10-12.</p> <p>Results:</p> <p>-The paragraph explaining table 3 may need revising for clarity. The authors state “Although no significant interaction was found, significant differences were observed for . . .” Is this sentence referring to the interaction term being non-significant but the p value for intervention compared to baseline is significant for one of the two subgroups but not the other? If so this should be clarified and rephrased. Perhaps consider only discussing baseline number of steps in the text as it is the only one with a positive p value for interaction, and allow the reader to interpret other trends based on the table alone? As one of the reviewers mentioned, a forest plot might also be helpful here instead of table format, but optional.</p> <p>Discussion:</p> <p>-The word order in this sentence is confusing to me: “Second, to our knowledge, this study offered ‘shopping points’ as an unique financial incentive.” Consider: To our knowledge, this study is unique in offering financial incentives in the form of local shopping points.</p>
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REVIEWER	Catherine Cornu Hospices Civils de Lyon
REVIEW RETURNED	20-Jul-2020

GENERAL COMMENTS	The comments have been adequately addressed. This version is acceptable for
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VERSION 2 – AUTHOR RESPONSE

Reviewer: 2

Thank you for the opportunity to review this revised manuscript. Most of the suggestions have been addressed, and the clarity of the paper has improved. However, I would recommend some additional changes to further help with clarity.

Small points:

1. -In title should read "(shopping points)" plural
-page 9 line 16 (or 11/71 line 46): please change "4-6 weeks" to "weeks 4-6"

[Authors' reply]

Thank you for your comment. We revised the relevant words.

[Revised version page 9, lines 16]

weeks 4-6

Introduction:

2. -The discussion of the Mitchell paper in the second paragraph of the introduction could be condensed to decrease length and improve clarity.

[Authors' reply]

Thank you for your suggestion. We have decreased length in the relevant paragraph of the Introduction section.

[Revised version page 6, line 19 – page 7, line 5]

Mitchell et al.⁹ conducted a systematic review of randomized controlled trials (RCTs) on the effects of financial incentives on physical activity and reported the results of a meta-analysis of studies promoting changes in daily walking steps. However, these studies did have methodological differences in terms of incentives (e.g., cash, charity, lottery, or team incentives) and target populations (e.g., overweight and obese adults) And only one study from Asia (Singapore) was included in this meta-analysis.

Methods:

3. -Even more information on the IC cards would be helpful for me to fully understand the magnitude and generalizability of the intervention. One quick sentence with the approximate percentage of the population that uses IC cards in the region and how do the number of points awarded as part of the study compare to the number of points people would earn from everyday shopping would be helpful.

[Authors' reply]

Thank you for your comment. In accordance with your comment, we have added the number of points people would earn from everyday shopping. However, we could not include the percentage of the population that used IC cards in the study area because the IC card was just introduced there at that time.

[Revised version page 9, lines 10-11]

For example, customers can get 1 point when they purchase goods worth 200JPY (≈2 USD).

4. -The power and sample size paragraph should be revised for clarity. Specifically, the second sentence is duplicative of the first. Is the reduced medical cost statistic from the same study? Would recommend citing that or reworking the first three sentences of the paragraph so that is more clear. For the statistic about the 3.2% reduction in relative risk of noncommunicable diseases, etc, would recommend citing the original paper that this comes from as it was not clear to me from the reference cited.

[Authors' reply]

Thank you for your comment. We're sorry apologize for not having cited the relevant reference. We have added the relevant reference.

[Revised version page 9, line 20]

Additionally, our previous study reported that an increase of 1000 steps was associated with reduced medical costs of 1300 JPY (\approx 12 USD) per month¹³, and another study reported that an increase of 1000 steps had some impact on health at the population level because it contributes to a 3.2% reduction in the average relative risk of noncommunicable diseases, dementia, joint-musculoskeletal impairment, and mortality.⁴

13. Tsuji I, Takahashi K, Nishino Y, et al. Impact of walking upon medical care expenditure in Japan: the Ohsaki Cohort Study. *Int J Epidemiol* 2003;32 (5):809-14.

5. -In the blinding section, please clarify the sentence "In addition, all statistical analyses were blinded to the assignments." Knowledge of group assignment is needed to perform the outcome analyses, so I'm not sure what is meant here.

[Authors' reply]

Thank you for your comment. In accordance with your comment, we have revised the relevant sentence.

[Revised version page 11, lines 16-17]

In addition, data analyst was blinded to the assignments.

6. -The different parts of the study are well outlined in Figure 1, but on reading the text I became confused. A few points to help with clarity of timeline:

6-1. -First line of the randomization paragraph: I recommend saying "After completing the three-week baseline period, participants were randomized. . ." rather than after confirming eligibility, because by figure 1 they were randomized between weeks 3 and 4, not after eligibility screening.

[Authors' reply]

Thank you for your suggestion. In accordance with your suggestion, we have revised the relevant sentence.

[Revised version page 11, lines 3-5]

After completing the 3 weeks baseline period, participants were randomized to one of the two groups (1:1 allocation) based on the permuted block method by computer-generated randomization.

6-2. -The sentence "All participants in the intervention and control groups who achieved their daily step goals were rewarded with shopping points . . ." is confusing because there is no reference to time frame here, so it sounds like there was no difference between intervention and control. Instead, I would recommend focusing this section just on the intervention group. Eg: "Participant in the intervention group who achieved their daily step goals during the intervention period (weeks 4-6) were rewarded with shopping points. . .". Please also state that the incentives were then removed for the follow-up period (weeks 7-9).

[Authors' reply]

Thank you for your suggestion. In accordance with your suggestion, we have revised the relevant sentence.

[Revised version page 12, lines 9-13]

Participants in the intervention group who achieved their daily step goals during the intervention period (weeks 4-6) were rewarded with shopping points worth 1000 or 2000 JPY on their IC card at that time (after the end of the trial, i.e., week 12). And then, their incentive removed for the follow-up period (weeks 7-9).

6-3. -Then in the section about the wait list group, please make it clear that that group had no incentives all the way through the end of the follow-up period, and it was only after the study was complete that they were offered the same incentives as the intervention group during weeks 10-12.

[Authors' reply]

Thank you for your suggestion. In accordance with your suggestion, we have revised the relevant sentence.

[Revised version page 12, lines 18-20]

The wait list control group had no incentives all the way through the end of the follow-up period. It was only after the study was complete that they were offered the same incentives as the intervention group during weeks 10-12.

Results:

7. -The paragraph explaining table 3 may need revising for clarity. The authors state "Although no significant interaction was found, significant differences were observed for . . ." Is this sentence referring to the interaction term being non-significant but the p value for intervention compared to baseline is significant for one of the two subgroups but not the other? If so this should be clarified and rephrased. Perhaps consider only discussing baseline number of steps in the text as it is the only one with a positive p value for interaction, and allow the reader to interpret other trends based on the table alone? As one of the reviewers mentioned, a forest plot might also be helpful here instead of table format, but optional.

[Authors' reply]

Thank you for your suggestion. In accordance with your suggestion, we have deleted the confusing sentences, and then referred to only the interaction term.

Discussion:

8. -The word order in this sentence is confusing to me: "Second, to our knowledge, this study offered 'shopping points' as an unique financial incentive." Consider: To our knowledge, this study is unique in offering financial incentives in the form of local shopping points.

[Authors' reply]

Thank you for your useful suggestion. In accordance with your suggestion, we have revised the relevant sentence.

[Revised version page 21, lines 18-20]

Second, to our knowledge, this study is unique in offering financial incentives in the form of local shopping points.

VERSION 3 – REVIEW

REVIEWER	Nancy Haff Brigham and Women's Hospital, USA
REVIEW RETURNED	06-Oct-2020
GENERAL COMMENTS	Thank you for thoroughly addressing the comments. Your revisions have helped improve the clarity and readability of the paper.