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Effect of a financial incentive (shopping point) on increasing the number of daily walking steps among community-dwelling adults in Japan: a randomised controlled trial

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ABSTRACT

Objective The aim of this study was to investigate the effect of a financial incentive on the number of daily walking steps among community-dwelling adults in Japan.
Study design Two-arm, parallel-group randomised controlled trial.
Setting/participants We recruited physically inactive community-dwelling adults from Sendai city, Japan. Eligible participants were randomly allocated to an intervention or a wait list control group. Pedometers were used to assess the mean number of daily steps in three periods: baseline (weeks 1–3), intervention (weeks 4–6) and follow-up (weeks 7–9).
Intervention The intervention group was offered a financial incentive (shopping points) to meet the target number of increased daily steps in the intervention period.
Main outcome measures The primary outcome was an increase in the mean number of daily steps in the intervention and follow-up periods compared with baseline.
Results Seventy-two participants (69.4% women; mean age, 61.2±16.2 years; mean number of daily steps at baseline, 6364±2804) were randomised to the intervention (n=36) and control groups (n=36). During the intervention period, the increase in mean daily steps was significantly higher in the intervention group (1650, 95% CI=1182 to 2119) than in the control group (514, 95% CI=136 to 891; p<0.001). However, the difference between groups was not significant at follow-up after the incentives were removed (p=0.311). In addition, compared with controls, a significantly higher proportion of participants in the intervention group showed an increase in mean daily steps of ≥1000 (69.4% vs 30.6%, respectively; OR=5.17, 95% CI=1.89 to 14.08). There were no adverse effects from the intervention.
Conclusions The present results suggest that financial incentives are effective in promoting short-term increases in physical activity.
Trial registration number UMIN000033276.

Strengths and limitations of this study

- This study is unique in offering financial incentives in the form of local shopping points.
- The financial incentive was a fairly small amount.
- The intervention involved only one type of financial incentive.
- Only the effect of a short-term intervention (over 3 weeks) was evaluated.

INTRODUCTION

Physical inactivity is a serious problem all around the world. According to the Global Action Plan on Physical Activity 2018–2030,[1] one in four adults (1.4 billion people worldwide) do not meet the WHO recommendations for physical activity levels. According to reports from the USA,[2 3] a failure to meet the recommended physical activity levels is associated with approximately US$117 billion in annual healthcare costs and 10% of all premature deaths. Therefore, physical inactivity imposes a substantial burden on healthcare 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] 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, respectively, and 7000 and 6000 steps in men and women aged ≥65 years, respectively.[7]

A systematic review (meta-analysis) has suggested that financial incentives are effective in promoting health behaviours such as smoking cessation, vaccinations and participation in cancer screening.[8] Mitchell *et al*[9] conducted a systematic review of randomised 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 (eg, cash, charity, lottery or team incentives) and target populations (eg, overweight and obese adults). Only one study from Asia (Singapore) was included in this meta-analysis.

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 (aged ≥20 years) has been decreasing, from 7655 in 2000 to 6322 in 2017.[10] Considering the rapid ageing of the population and escalating healthcare costs, more effective measures aimed at promoting walking at the population level need to be established. Therefore, the aim of this study was to examine the effects of a financial incentive on the number of daily walking steps among community-dwelling adults in Japan.

METHODS

Study design

The protocol of this study has been reported in detail elsewhere.[11] Briefly, this was a single-centre, single-blind, parallel-group RCT in which participants were randomly assigned to an intervention or a control group.

Written informed consent was obtained from all participants. This study was also registered in the University Hospital Medical Information Network.

Participants

In August 2018, leaflets were distributed to each house in the Nakayama area of Aoba-ku in Sendai city, Japan. Applicants who met the inclusion criteria could apply through an online application, fax, or telephone.

Inclusion and exclusion criteria

Individuals could apply for participation in this study if they met all of the following inclusion criteria: (1) adult (aged ≥20 years) living in the Nakayama area, (2) possession of a community development integrated circuit (IC) card in the Nakayama area (*Nakayama Machi-dukuri IC Card*) and (3) ability to walk unaided without using a cane, walker or wheelchair.

Individuals who met any of the following exclusion criteria could not participate in the study: (1) physical activity restricted by a physician, (2) history of heart attack or stroke within the last 6 months, (3) blood pressure exceeding 180 mm Hg systolic or 110 mm Hg diastolic or (4) already habitually exercising (task of ≥4 metabolic equivalents) more than twice per week.

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. For example, customers can get 1 point when they purchase goods worth 200 JPY (≈US$2). IC cards are also intended to enhance social interaction among locals.

Power and sample size

Based on a previous study carried out in 2013,[12] we assumed that an average difference of 1302 steps would be achieved in the intervention period (weeks 4–6) by offering a financial incentive of 2000 JPY (≈US$18 at the time of the study in 2018) and setting the SD at 1711. In addition, our previous study reported that an increase of 1000 steps was associated with a reduced medical costs of 1300 JPY (≈US$12) per month,[13] 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 non-communicable diseases, dementia, joint-musculoskeletal impairment and mortality.[4] When an α error of 0.05 and a statistical power of 0.90 were applied, the minimum sample size was 74 persons (37 persons per group). When an α error of 0.05 and a statistical power of 0.80 were applied with this sample size, a mean difference of ≥1130 steps was considered statistically significant.

Study procedure

The flow of the study procedure is shown in figure 1. In a briefing session held in September 2018, the researchers rechecked the inclusion and exclusion criteria for each applicant. All the selected participants provided informed consent to participate in the study. At the briefing session, each participant was provided with a pedometer (FS-800; Estera, Saitama, Japan) containing a three-axis acceleration sensor. 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, when placed in a handbag, or when set in any other position that results in irregular movements. The number of daily walking steps at baseline was measured in the first 3 weeks of the study period (weeks 1–3) for all the participants.

Randomisation

After completing the 3-week baseline period, participants were randomised to one of the two groups (1:1 allocation) based on the permuted block method by computer-generated randomisation. The allocation sequence was managed by two experienced random assignment researchers.

Blinding

The assignment data could only be accessed by random assignment researchers; all other staff were blinded to random assignments. The assignment information was kept in a password-protected storage device. The

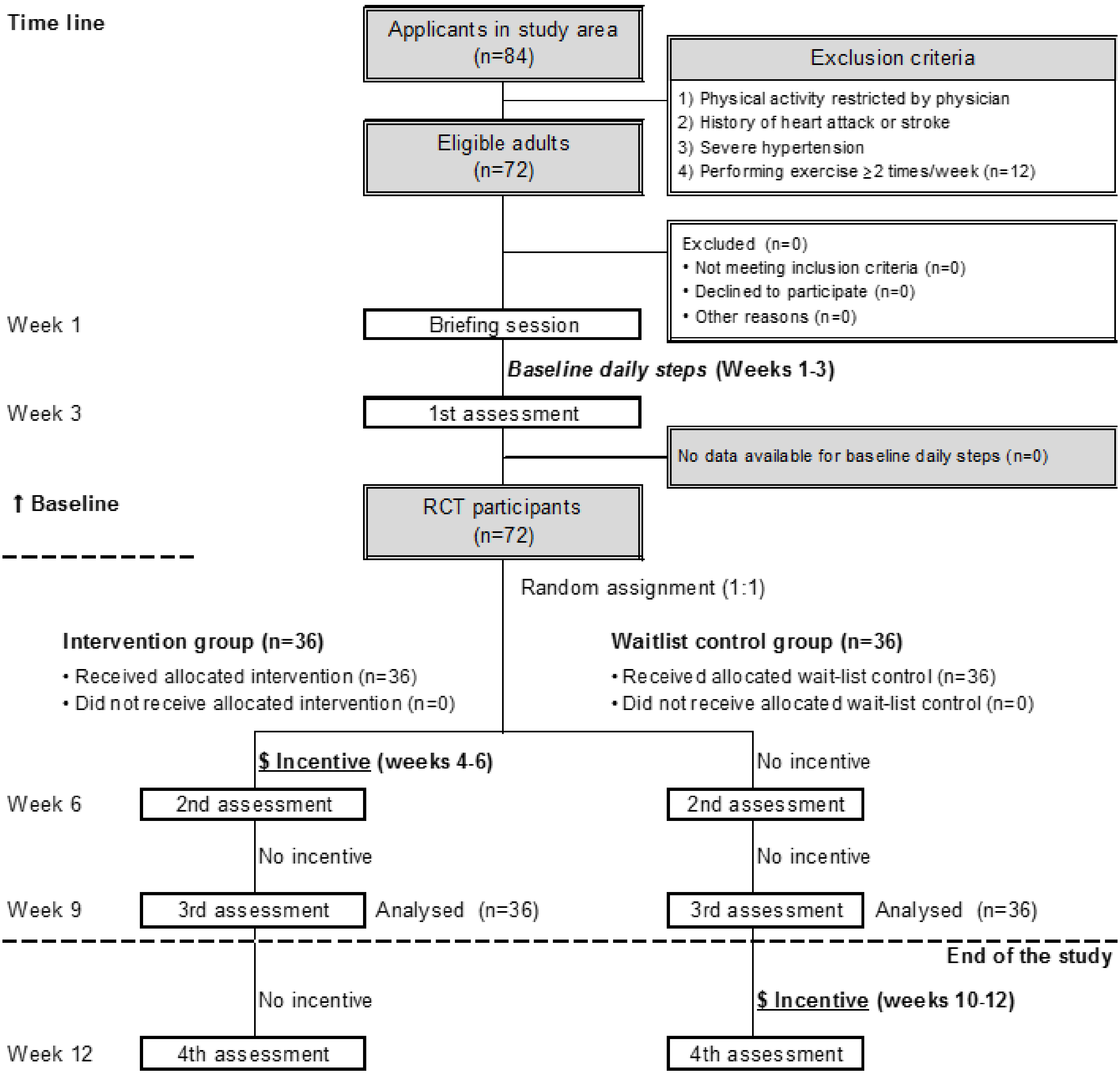

Figure 1 Consort flowchart of the study procedure. RCT, randomised controlled trial.

researchers involved exclusively in the random assignment notified the participants about their own assignment in a closed room separated from other examination locations. During the notification process, these random assignment researchers warned the participants not to talk about their assignment with anyone else. In addition, the data analyst was blinded to the assignments. The random assignment researchers were not involved in statistical analyses.

Intervention

The intervention was a financial incentive in the form of shopping points that could be redeemed at 14 stores in the study area. The following two kinds of financial incentives were offered:

1. If the mean number of daily walking steps in the intervention period was ≥6000, shopping points worth 1000 JPY were awarded.
2. If the mean number of daily walking steps during the intervention period increased by ≥1000 from baseline, shopping points worth 1000 JPY were awarded.

Based on the exchange rate on 31 August 2018, 2000 JPY was equivalent to US$18. 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 JPY or 2000 JPY on their

IC card at that time (after the end of the trial, that is, week 12). And then, their incentive was removed for the follow-up period (weeks 7–9). 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 (eg, cigarettes).

Wait list control group

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. All conditions except timing were the same as those for the intervention group.

Measurements

The participants' baseline characteristics were assessed at the date of the briefing session. Interviews with trained interviewers were conducted to obtain information regarding medical history, frailty (the Kihon Checklist),[14–18] physical activity level,[19 20] transportation when going out, education level,[21] work, subjective economic status, time affluence (having spare time),[22] body height, weight, pain and falling. Blood pressure was also measured using an automated sphygmomanometer (HEM-1040; Omron, Kyoto, Japan).

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? The participants were asked to choose one of the following eight responses: 'walking', 'bicycle', 'motorbike', 'car', 'train', 'bus', 'taxi' and 'other'.

Economic affluence was assessed by asking the question 'How do you feel about your current household situation?' The participants were asked to choose one of the following five answers: 'most affluent', 'more affluent', 'neither more nor less', 'less affluent' and 'non-affluent'. We classified the first three answers as 'affluent' and the last two as 'non-affluent'.

Time affluence (having spare time) was assessed by asking the question 'Do you have enough time available to take rest or enjoy leisure in daily life?' The participants were asked to choose one of the following four answers: 'more affluent', 'little affluent', 'less affluent' and 'non-affluent'. We classified the first two answers as 'affluent' and the last two as 'non-affluent'.

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?' The participants were asked to choose one of the following six answers: 'none', 'very mild', 'mild', 'moderate', 'severe' and 'very severe'.

Outcome measurements

The participants were asked to visit the study centre 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.

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.

The secondary outcomes were (1) an increase in the number of daily steps by ≥1000 at weeks 4–6 or weeks 7–9 from baseline, (2) incident falls at weeks 4–6 or weeks 7–9 and (3) incident pain at weeks 4–6 or weeks 7–9.

Statistical analyses

Regarding the primary outcome, the t-test was applied to examine whether the mean increases and rate of change in the number of daily steps at weeks 4–6 and weeks 7–9 from baseline differed significantly between the intervention and control groups.

Regarding the secondary outcomes, logistic regression models were applied to examine whether the proportions of participants with an increase of ≥1000 steps were significantly different and to assess the probabilities of incident falls and incident pain. ORs and 95% CIs were also estimated.

In addition, stratified analyses were conducted to check for any differences in the number of daily steps in terms of sex, age, frailty, physical activity level, transportation when going out, education level, work, subjective economic status, time affluence and obesity.

All analyses were performed using IBM SPSS Statistics V.25 (IBM SPSS).

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our trial.

RESULTS

The mean age (SD) of the participants (69.4% women) was 61.2 (16.2) years, and 30.6% had an undergraduate or graduate degree.

At baseline, the mean numbers of daily steps (SD) in the intervention and control groups were 6859 (3223) and 5869 (2249), respectively; this difference was not significant (p=0.135) (table 1). Participants in the intervention group were significantly more likely to have pain than those in the control group (p=0.011). No significant differences in age, sex, blood pressure, history of disease, frailty, physical activity level, transportation, educational level, employment, subjective household economic status, subjective time affluence or body mass index were found between the two groups.

All 72 participants completed the intervention (weeks 4–6) and follow-up periods (weeks 7–9). Comparisons of steps between the baseline and intervention or follow-up periods in the intervention and control groups are shown

Table 1 Baseline characteristics of the study participants (n=72)

Characteristics	Intervention (n=36)	Control (n=36)	P value
Female, %	69.4	69.4	1.000
Age, years (mean±SD)	62.0±16.5	60.4±16.1	0.671
Blood pressure, mm Hg (mean±SD)			
Systolic blood pressure	130.7±20.7	125.5±18.5	0.264
Diastolic blood pressure	79.0±11.4	76.7±10.8	0.378
History of disease, %			
Stroke	2.8	0.0	0.314
Hypertension	25.0	30.6	0.599
Myocardial infarction	0.0	5.6	0.151
Diabetes	8.3	8.3	1.000
Arthritis	2.8	5.6	0.555
Osteoporosis	5.6	0.0	0.151
Cancer	16.7	8.3	0.285
Frailty, %	5.6	19.4	0.075
Physical activity, MET (mean±SD)	35.8±8.5	36.1±5.3	0.822
Transportation, %			
Motorbike or car	61.1	80.6	0.070
Educational attainment, %			
High school or less	52.8	47.2	0.820
College/university	16.7	22.2	
Undergraduate or graduate degree	30.6	30.6	
Employment, %			
≥4 days/week	27.8	36.1	0.546
<4 days/week	19.4	11.1	
Not working	52.8	52.8	
Subjective household economic status			
Affluent	80.6	86.1	0.527
Non-affluent	19.4	13.9	
Subjective time affluence			
Affluent	72.2	77.8	0.586
Non-affluent	27.8	22.2	
Pain			
Absent	22.2	44.4	0.011
Present	5.6	2.8	
Body mass index, kg/m^2 (mean±SD)	22.1±3.0	23.2±4.6	0.250
Baseline number of steps/day (mean±SD)	6859±3223	5869±2249	0.135

MET, metabolic equivalent.

in figure 2. The mean increases in the numbers of daily steps from baseline to the intervention period in the intervention and control groups were 1650 (95% CI=1182 to 2119) and 514 (95% CI=136 to 891), respectively, indicating a significant difference between groups (p<0.001). The mean increase rate in the number of daily steps from baseline to the intervention period was significantly higher in the intervention group than in the control group (31.0% vs 9.1%, respectively; p<0.001) (online supplemental table 1). The mean increase in the number of daily steps from baseline to the follow-up period was larger in the intervention group (933, 95% CI=312 to 1555) than in the control group (556, 95% CI=136 to 976) (figure 2); however, no significant difference was observed between groups (p=0.311). Regarding the mean increase rate in the number of daily steps from baseline to the follow-up period, no significant difference was found between groups (p=0.270) (online supplemental table 2).

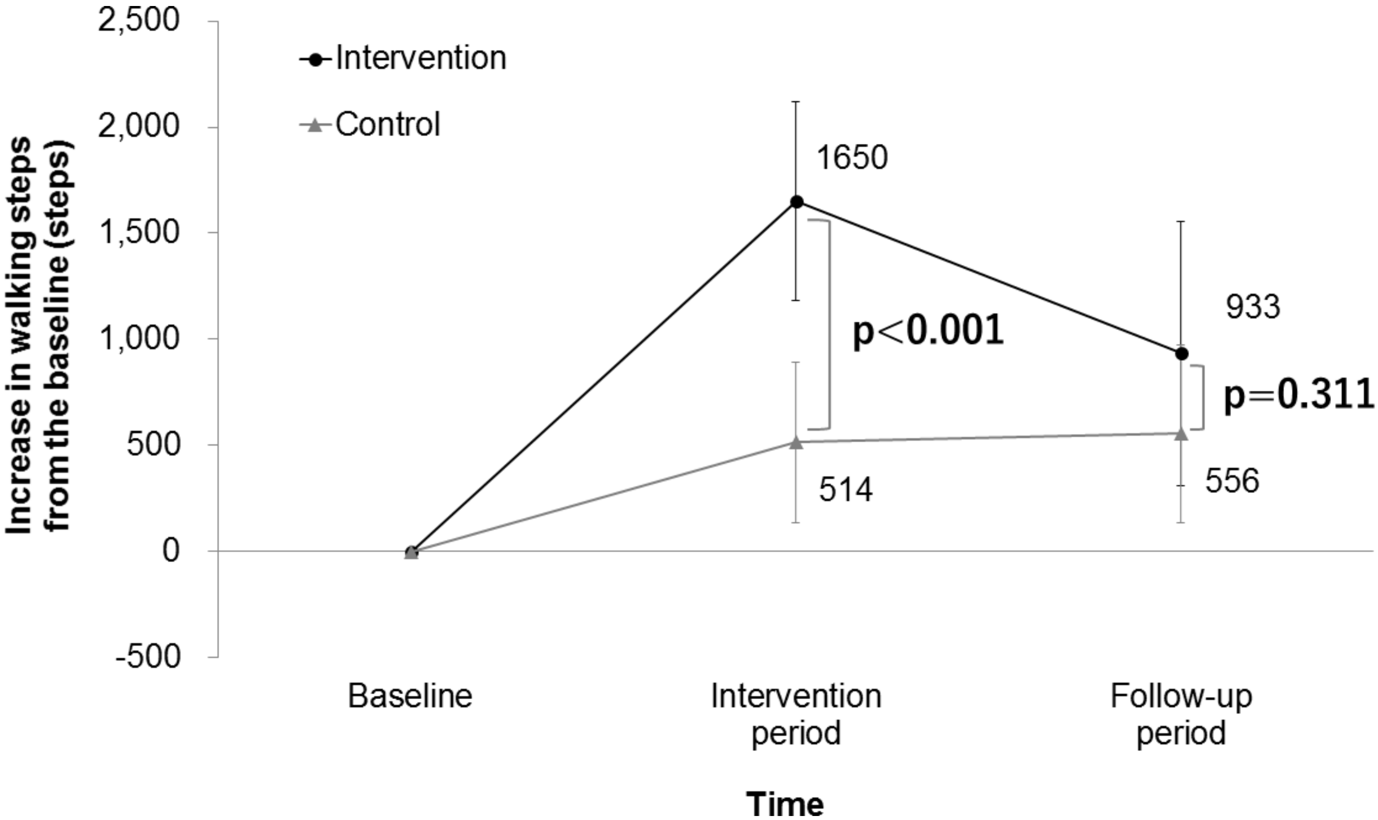

Figure 2 Changes in the number of daily walking steps during the intervention and follow-up periods (means and 95% CIs).

A comparison of the proportion of participants who increased the mean number of daily steps by ≥1000 from baseline to the intervention period is shown in table 2. The proportion in the intervention group was 69.4% (n=25) and that in the control group was 30.6% (n=11). The proportion was significantly higher in the intervention group than in the control group (OR=5.17; 95% CI=1.89 to 14.08).

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) than those with a higher (≥6000) baseline step count (p interaction=0.012).

Incident falls were reported in two participants (5.7%) in the intervention group and in one participant (2.9%) in the control group, and the incident rate was not significantly different (p=0.555). Incident pain was reported in four participants (14.3%) in the intervention group and in one participant (4.2%) in the control group, and the incident rate was not significantly different (p=0.217).

Table 2 Comparison of the proportions of participants with an increase in the number of daily steps of ≥1000 from baseline to the intervention period (weeks 4–6) (n=72)

		Intervention period (weeks 4–6)		
	n	**Proportion***	**OR†**	**95% CI**
Intervention	36	69.4	5.17	1.89 to 14.08
Control	36	30.6	1.00	Reference

*Proportions of participants who increased the number of daily steps by ≥1000 from baseline.
†Logistic regression analysis.

DISCUSSION

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 group 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.

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 generalisable 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]

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

Subgroup		n	Intervention period (weeks 4–6) Mean	95% CI	P value*	P interaction*
Sex						
Male	Intervention	11	2199	783 to 3615	0.021	0.140
	Control	11	401	–331 to 1134		
Female	Intervention	25	1409	1054 to 1765	0.005	
	Control	25	563	91 to 1036		
Age (years)						
<65	Intervention	17	1650	780 to 2519	0.006	0.245
	Control	17	148	–475 to 771		
≥65	Intervention	19	1651	1127 to 2175	0.019	
	Control	19	841	390 to 1292		
Baseline number of steps						
<6000	Intervention	16	2193	1331 to 3056	<0.001	0.012
	Control	18	264	–183 to 712		
≥6000	Intervention	20	1216	745 to 1687	0.229	
	Control	18	763	130 to 1397		
Physical activity						
Low	Intervention	19	1796	1060 to 2531	0.001	0.116
	Control	17	181	–286 to 648		
High	Intervention	17	1488	856 to 2121	0.107	
	Control	19	812	223 to 1400		
Body mass index (kg/m^2)						
≥25	Intervention	4	1433	–1262 to 4127	0.333	0.701
	Control	8	577	–435 to 1590		
<25	Intervention	32	1678	1184 to 2172	0.001	
	Control	28	496	65 to 926		
Time affluence						
Non-affluent	Intervention	10	998	338 to 1658	0.054	0.926
	Control	8	–236	–1550 to 1077		
Affluent	Intervention	26	1901	1311 to 2492	0.001	
	Control	28	728	390 to 1066		
Frailty						
Yes	Intervention	2	1692	–10 558 to13 941	0.043	0.166
	Control	7	–599	–1637 to 438		
No	Intervention	34	1648	1158 to 2138	0.007	
	Control	29	783	421 to 1144		
Educational level						
High	Intervention	17	1697	869 to 2525	0.022	0.964
	Control	19	569	–5 to 1142		
Low	Intervention	19	1609	1035 to 2182	0.004	
	Control	17	453	–92 to 997		
Employment status						

Continued

Table 3 Continued

Subgroup		n	Intervention period (weeks 4–6) Mean	95% CI	P value*	P interaction*
Working	Intervention	17	1286	770 to 1802	0.015	0.661
	Control	17	285	–363 to 932		
Not working	Intervention	19	1977	1201 to 2752	0.006	
	Control	19	719	257 to 1180		
Economic affluence						
Affluent	Intervention	29	1670	1112 to 2228	0.002	0.698
	Control	31	572	156 to 988		
Non-affluent	Intervention	7	1569	591 to 2547	0.043	
	Control	5	154	–1118 to 1425		

*t-Test

The study area was safe for walking and has sidewalks that are favourable for pedestrians, which is typical in local communities in Japan.

Previous studies have reported that socioeconomic status, which includes occupation and education and income levels, is associated with health inequality.[23 24] However, the results of this study demonstrated that offering a financial incentive to increase the number of daily walking steps was not affected by economic affluence or education level. Walking has considerable health benefits[25] and does not require any special training or substantial additional costs. This could be the reason why the financial incentive resulted in an increase in the number of daily walking steps, regardless of the socioeconomic status.

Previous studies aiming to increase physical activity levels have used cash as a financial incentive.[12 26–28] In this study, we chose to use shopping points (a non-cash incentive) that could only be redeemed at stores in the study area because we believed that it would cause the participants to patronise local stores in the community more frequently. Therefore, a unique aspect of this study is that it aimed to promote both health and economic activities in the local community. In fact, local stores in the study area chose to resume the financial incentive programme after this RCT was completed.

This study had several notable strengths. First, all of the participants completed each programme during the trial period. Second, to our knowledge, this study is unique in offering financial incentives in the form of local shopping points. 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. Fourth, the present results are considered to be generalisable to the community-dwelling adult population in Japan because the mean number of daily walking steps among the study participants at baseline was similar to the nationwide average.[10]

Limitations

This study also had several limitations. First, the intervention involved only one type of financial incentive; therefore, the effects of changes in the corresponding financial incentive or its application (eg, donations) are unclear. Second, only the effect of a short-term intervention (over 3 weeks) was evaluated; whether an intervention involving a financial incentive would be effective for maintaining an increase in the number of daily walking steps over the long term is unclear. Third, the study participants were all Japanese adults; therefore, the present results may not generalisable to non-Japanese populations. Fourth, the possibility of overestimation due to the small sample size cannot be ruled out. However, the sample size set at the start of the study was almost achieved.

CONCLUSIONS

The results of this 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. The difference between the intervention and control groups was not significant at follow-up after the incentives were removed. Future research should explore whether the continuation of financial incentives can maintain an increased number of daily steps over the long term.

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Competing interests None declared.

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