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RESEARCH ARTICLE

A Cluster-Randomized Trial on Small Incentives to Promote Physical Activity

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Introduction: There has been limited research investigating whether small financial incentives can promote participation, behavior change, and engagement in physical activity promotion programs. This study evaluates the effects of two types of small financial incentives within a physical activity promotion program of a Swiss health insurance company.

Study design: Three-arm cluster-randomized trial comparing small personal financial incentives and charity financial incentives (10 Swiss Francs, equal to US$10.40) for each month with an average step count of >10,000 steps per day to control. Insureds' federal state of residence was the unit of randomization. Data were collected in 2015 and analyses were completed in 2018.

Setting/participants: German-speaking insureds of a large health insurer in Switzerland were invited. Invited insureds were aged ≥18 years, enrolled in complementary insurance plans and registered on the insurer's online platform.

Main outcome measures: Primary outcome was the participation rate. Secondary outcomes were steps per day, the proportion of participant days in which >10,000 steps were achieved and non-usage attrition over the first 3 months of the program.

Results: Participation rate was 5.94% in the personal financial incentive group (OR=1.96, 95% CI=1.55, 2.49) and 4.98% in the charity financial incentive group (OR=1.59, 95% CI=1.25, 2.01) compared with 3.23% in the control group. At the start of the program, the charity financial group had a 12% higher chance of walking 10,000 steps per day than the control group (OR=1.68, 95% CI=1.23, 2.30), but this effect dissipated after 3 months. Steps per day and non-usage attrition did not differ significantly between the groups.

Conclusions: Small personal and charity financial incentives can increase participation in physical activity promotion programs. Incentives may need to be modified in order to prevent attrition and promote behavior change over a longer period of time.

Trial registration: This study is registered at www.isrctn.com ISRCTN24436134.

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INTRODUCTION

Strong empirical evidence indicates that physical inactivity increases the risk of mortality[1] as well as of noncommunicable diseases, such as coronary heart disease, diabetes, or cancer.[2,3] More than 20% of the world's population is inactive (i.e., accumulating less than 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity

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per week),[4] illustrating the need for effective promotion of physical activity at a large scale. Technology may provide a viable means to address this problem: Driven by the promise and increasing popularity of wearable devices,[5] many key stakeholders in health care, including employers and health insurers, have designed large-scale physical activity promotion programs that utilize commercial-grade activity trackers.[6] For example, participants of the U.S. health insurer Humana's Go365 program can earn points for every 1,000 steps they log using a smartphone or activity tracker.[7]

To provide an effective solution to the high prevalence of physical inactivity, those programs have to attract the individuals in need, effectively change behavior, and engage participants in the long term. Therefore, health insurers and employers often promote their physical activity programs using financial incentives like cash, bonus points, or vouchers.[6,8] This strategy is supported by empirical evidence: Previous research demonstrated that financial incentives can increase participation in health promotion programs[9,10] and change physical activity−related behaviors, such as exercise session attendance,[11−13] exercise behavior,[12] and objectively measured physical activity.[13] However, these studies mostly use large incentive amounts. A review of RCTs, for example, calculated a mean maximum incentive value of $20.75 per week.[11] Because changes in physical activity are typically not sustained after incentives are withdrawn,[14−18] larger incentives are unsuitable for application in large-scale physical activity programs.

A potential solution is the use of financial incentives that are small enough to be sustained indefinitely, but little is known about whether small incentives can produce the desired effects. In previous studies, small incentives have primarily been shown to change simple behaviors, such as completing child vaccinations,[19] attending preventive health examinations,[20] or completing tuberculosis skin test readings[21] primarily in deprived populations. In studies investigating the effect of incentives on physical activity, the incentive value seems to correlate with the effect size,[12] but very few studies have specifically investigated the effect of small financial incentives. Thus, it is unclear whether small financial incentives can promote physical activity and how they affect behavioral change.

Incentives in the form of donations to charity (charity financial incentives) are a promising alternative incentive design. Donating to charity activates an additional neural reward system compared with mere financial incentives[22] and has been related to happiness in observational and experimental studies.[23] This "warm glow of giving"[24] has been used in marketing strategies to motivate purchase behavior,[25] and recent[17,18] and ongoing[26] studies investigate its potential to promote physical activity. These previous studies have found mixed results: In a large RCT in Singapore, weekly personal financial incentives but not charity financial incentives ($30 for walking 70,000 steps per week) increased daily steps of full-time workers at 6 months.[18] In a smaller RCT with older adults in Philadelphia, both weekly personal financial and charity financial incentives ($20 for meeting a personalized step goal on at least 5 of 7 days) were successful in promoting step goal achievement over the 16-week study period but not during the 4-week follow period.[17]

The present study adds to this evidence base by comparing the effects of personal financial and charity financial incentives within a physical activity promotion program offered by a large Swiss health insurance company. In contrast to previous research, this study deliberately investigates small incentive values that have the potential to be sustained indefinitely. In addition to changes in physical activity, this study also analyzes effects on participation and retention, because they represent central outcomes for the success of health promotion programs.

METHODS

The design of this study is described in greater detail elsewhere.[27] Briefly, this study was conducted in cooperation with a large Swiss health insurance company that implemented a 6-month pilot initiative to promote physical activity among its insureds from July to December 2015. In June 2015, eligible insureds were randomly assigned to a type of incentive (personal financial, charity financial, or no incentive) and invited via e-mail to participate in the pilot program. Invitation e-mails contained information about the promotion program, the incentive condition of the e-mail recipient, and a link to the insurance's online platform where insureds could log in and register for the program (Appendix, available online). Additionally, the invitation e-mail informed insureds about the opportunity to buy a compatible activity tracker at a reduced price if they did not own one already. Insureds who were not interested in the program were asked to indicate the underlying reasons of their decision by completing a brief survey via a separate link at the bottom of the invitation e-mail.

On the insurance provider's online platform, insureds received detailed information about the pilot program, data protection policies, and eligibility criteria and could provide consent to participate. To provide consent, participants had to confirm that they did not have a medical condition that prohibits increased levels of physical activity by ticking a checkbox. Insureds were advised to consult a physician if they were in doubt. Insureds did not receive any information about the existence of different incentive groups. To complete registration, insureds linked their wearable manufacturer's customer account to the insurance provider's online platform so that their steps would be synchronized daily via an application programming interface. To facilitate automatic synchronization of step counts, compatible activity trackers were limited to devices developed by the major wearable manufacturers on the Swiss market Garmin, Jawbone, and Fitbit. Alternatively, insureds could use the Fitbit smartphone application to track daily steps. Once registered, participants were able to add family members who also met the eligibility criteria to the pilot program.

At the beginning of the program, participants were asked to complete a web-based survey to collect data on demographic variables and covariates of physical activity. Participants received 10 Swiss Francs (CHF) for the completion of the survey. The insurance company provided data on age, sex, nationality, and federal state (canton) of all invited insureds as well as step data of participants. The IRB of the University of St. Gallen approved the study. Analyses of primary and secondary outcomes were completed in 2018.

Study Sample

Because of legal regulations in Switzerland, the physical activity promotion program is not part of the statutory health insurance but offered to insureds with complementary insurance plans only. Note, however, that in Switzerland 75% of people are enrolled in complementary insurance plans.[28] To facilitate enrolment, only insureds who met the predefined eligibility criteria were invited to participate: insureds had to be aged >18 years, German speaking, enrolled in a complementary insurance plan, and registered on the insurer's online platform. There was no racial or gender bias in the selection of invited insureds. Naturally, invited insureds resided primarily in the German-speaking parts of Switzerland. No eligibility criteria were defined on the canton level.

Measures

In the personal financial incentive condition, participants received CHF 10 for each month they walked >10,000 steps per day on average and CHF 5 for each month they walked <10,000 but >7,500 steps per day, which matches the approximate minimum recommendation for daily physical activity.[29] The insurance company considered a value of CHF 10 as appropriate to be sustained indefinitely. Charity financial incentives coincided with personal financial incentives, with the exception that participants could donate a chosen proportion of their earned reward to one of three charity organizations (a foundation supporting the rights and needs of Swiss children and adolescents, a foundation for health promotion of Swiss adolescents, and an organization committed to preserving the Swiss hiking track network). Participants in the control group were informed that participation can enhance health and well-being but did not receive any incentives during the first 3 months of the program. However, from the fourth month onwards until the end of the program, the control group was entitled to personal financial incentives of CHF 20 for walking 10,000 steps on average and CHF 10 for walking 7,500 steps on average per month. Thus, participants of all groups could earn or donate a maximum of CHF 60 during the 6-month pilot program. Participants could log in to their online account on the insurance company's website to view a summary of their daily step counts and the amount of their earned or donated rewards if applicable. At the beginning of each month, all participants received an e-mail containing information on whether they earned a reward in the past month as well as a tip on how to increase physical activity.

An important study design consideration was minimizing the risk of spillover effects between study groups, especially between the incentivized groups and the control group, to prevent frustration and dropout among insureds. Insureds were therefore randomized using blocked cluster-randomization based on their canton of residence (n=20) with a block size of five and an allocation ratio of 2:2:1 with fewer insureds allocated to the control condition. Each block consisted of two pairs of neighboring cantons and one single canton. An additional consideration in the study's randomization scheme was to account for differences in activity preferences between urban and rural areas in Switzerland.[30] The blocks were therefore matched for population density. Next, canton pairs within each block were randomized to the incentive conditions using the toss of a coin, and the remaining canton was allocated to the control group.

Because the incentive structure changed for the control group in the fourth month, all outcomes and analyses refer to the first 3 months of the pilot program. Primary outcome was the participation rate in the three different groups. Insureds were considered as participants if they provided consent to participate and shared their step counts at least once during the first 3 months of the study. Participants' non-usage attrition,[31] daily step counts, and the proportion of participant days with >10,000 steps during the first 3 months of the program were analyzed as secondary outcomes. A participant was coded as non-usage attrition observed, when she or he stopped synchronizing step counts with the insurance company.

Statistical Analysis

The approach by Gao and colleagues[32] for non-aggregate cluster RCTs with binary outcomes was used to determine the minimum number of insureds to invite to the pilot program. Accordingly, a sample size of N=15,822 invited insureds is necessary to detect a 5% difference in participation rates between control and incentive groups assuming an α-level of 0.05, a power of 0.80, an intra-cluster correlation of ρ=0.01[33] and a mean cluster size of 879 (SD=1,326; based on data from the health insurance company).

Linear mixed models and generalized linear mixed models[34] were fitted to the data to analyze group differences of primary and secondary outcomes. The model of participation rate included a fixed effect for incentive condition and a random intercept for canton. Models of step counts and participant days with >10,000 steps included fixed effects for time, self-reported physical activity measures at baseline, covariates of physical activity, incentive condition, the incentive condition by time interaction, and a random intercept for participants. The time variable was mean-centered before entering the model. The non-usage attrition model included fixed effects for incentive condition, age, sex, and nationality and a random intercept for canton. In addition, all models of secondary outcomes were adjusted for group differences at baseline. To be able to adjust models for covariates and group differences at baseline, only participants who completed the baseline survey were included in the analyses of secondary outcomes. Several sensitivity analyses were performed to assess the robustness of the results. Differences in participation rates between groups were further adjusted using fixed effects for age, sex, and nationality of participants and cantonal

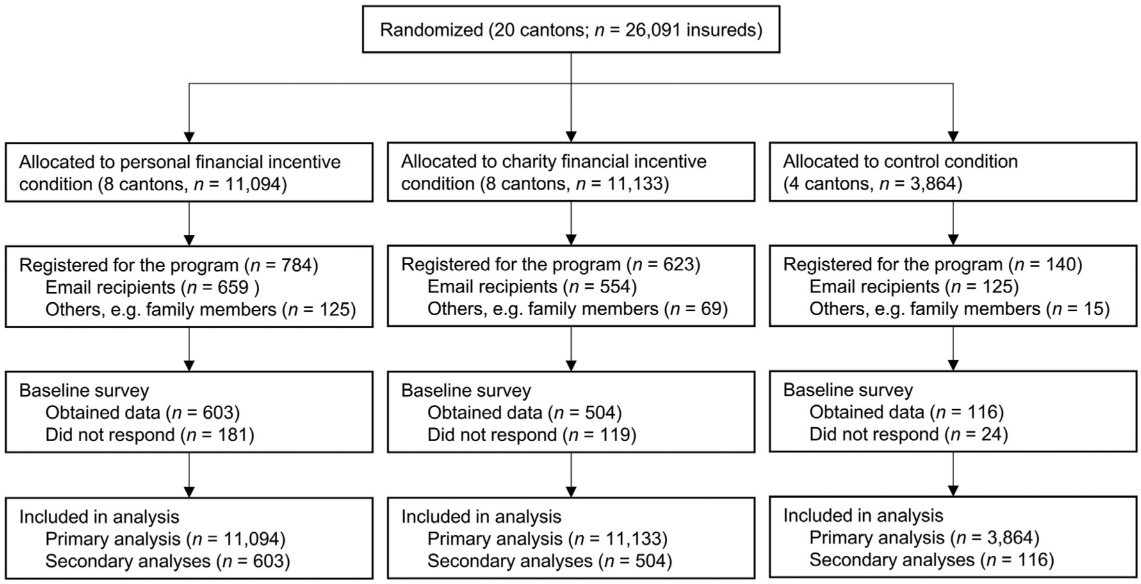

Figure 1. Flow diagram.

population density. For the secondary outcomes of steps and participant days with >10,000 steps, a nested random effect for canton was added to the model to account for potential clustering on the canton level. Additionally, sensitivity analyses with regard to missing data were performed for all outcomes (Appendix Tables 1–4, available online).

The reported results are pooled over separate analyses of 20 imputed data sets created using 50 imputation iterations for each data set. Data were imputed in wide format using all variables in the statistical models plus additional auxiliary variables to set up the imputation models (Appendix Table 6, available online). Subsequently, convergence of the imputation algorithm was examined by visual inspection of plots of mean and SD of imputations across all iterations. Based on data from a Swiss representative sample,[35] daily step counts >25,000 or <1,000 steps were set to missing before starting the imputation. Data were analyzed in R, version 3.4.2, using the lme4 package[36] for fitting (generalized) linear mixed models and the mice package[37] for multiple imputation.

Because of an error in the randomization process, six of all 26 Swiss cantons were non-randomly allocated to the three study groups. These cantons contained 831 (3.09%) of invited insureds and were excluded from all analyses. The study protocol further specified self-reported health status assessed after 3 months for the control group and after 6 months for both incentive groups as a further secondary outcome. This comparison is not reported because the time difference in measurements does not allow valid group comparisons. Lastly, participant's service billings with the insurance company could not be included in the analyses, because these data were not available at the time of writing.

RESULTS

In total, N=26,091 insureds (mean age 45.48 years, SD=14.97, 38.52% female) met the predefined eligibility criteria and were randomized. Of those, 1,338 (5.13%) participated in the pilot program. Additionally, 209 family members of invited insureds participated, bringing the total number of participants to *n*=1,547 (Figure 1). The proportion of women was higher among participants than among all invited insureds (47.83% vs 38.52%), indicating that women were more likely to participate. Participants were on average aged 42.65 (SD=13.03) years and mostly Swiss (90.20%). Based on baseline survey data (*n*=1,223), 43.58% had a university degree and only 3.84% reported poor or fair health conditions. There were statistically significant and meaningful group differences with regard to participants' residential environment, self-reported health status, and sitting minutes per week (Table 1). In the charity financial incentive condition, the mean proportion of donated rewards was 20.29% (SD=26.81%). However, 310 of 623 participants (49.76%) chose not to donate any proportion of their reward to charity.

Among invited insureds, 5.94% participated in the personal financial incentive group and 4.98% in the charity financial incentive group compared with 3.23% in the control group. Differences between incentive groups and control group were statistically significant (personal financial incentives: OR=1.96, 95% CI=1.55, 2.49, $p<0.001$; charity financial incentives: OR=1.59, 95% CI=1.25, 2.01, $p<0.001$). Contrast analysis revealed that participation rates also differed significantly between insureds in the personal financial incentive and the charity financial incentive group (OR=1.24, 95% CI=1.06, 1.44, $p=0.006$).

Table 1. Baseline Characteristics of Invited Insurees and Participants

Characteristics	PFI	CFI	CG	*p*-value[a]	SMD[b]		
					PFI versus CG	CFI versus CG	PFI versus CFI
Invited insurees (N=26,091), *n*	11,094	11,133	3,864				
Canton level							
Number of cantons	8	8	4				
Cluster size	1,353.38 (2,080.96)	1,362.75 (1,439.82)	934.00 (1,263.82)	0.907	0.25	0.32	0.01
Population density (residents/km^2)[c]	619.32 (244.93)	505.92 (1,721.03)	270.15 (826.41)	0.732	0.65	0.19	0.11
Individual level							
Age, years	44.81 (14.73)	45.87 (15.12)	46.30 (15.15)	**<0.001**	0.10	0.03	0.07
Female	4,441 (40.03)	4,261 (38.27)	1,348 (34.89)	**<0.001**	0.11	0.07	0.04
Nationality				**<0.001**	0.16	0.07	0.13
Swiss	9,491 (85.55)	9,973 (89.58)	3,486 (90.22)				
German	582 (5.25)	384 (3.45)	111 (2.87)				
Other	654 (5.90)	476 (4.28)	191 (4.94)				
NA	367 (3.31)	300 (2.69)	76 (1.97)				
Participants (N=1,547),[d] *n*	784	623	140				
Age, years	42.71 (12.99)	42.14 (12.95)	44.63 (12.53)	0.126	0.15	0.18	0.04
Female	382 (48.72)	299 (47.99)	59 (42.14)	0.424	0.13	0.12	0.01
Educational attainment				0.473	0.25	0.19	0.09
Secondary school	12 (1.99)	8 (1.59)	2 (1.72)				
Vocational school	181 (30.02)	163 (32.34)	35 (30.17)				
High school	92 (15.26)	85 (16.87)	27 (23.28)				
University	278 (46.10)	213 (42.26)	42 (36.21)				
NA	40 (6.63)	35 (6.94)	10 (8.62)				
Residential environment				**<0.001**	0.29	0.15	0.32
Town	85 (14.10)	42 (8.33)	11 (9.48)				
Outskirts of town	173 (28.69)	102 (20.24)	24 (20.69)				
Village	253 (41.96)	260 (51.59)	64 (55.17)				
Countryside	73 (12.11)	88 (17.46)	14 (12.07)				
NA	19 (3.15)	12 (2.38)	3 (2.59)				
Monthly net income				0.343	0.26	0.24	0.17
≤CHF 2,500	27 (4.48)	30 (5.95)	3 (2.59)				
CHF 2,501–5,000	83 (13.76)	80 (15.87)	18 (15.52)				
CHF 5,001–7,500	190 (31.51)	147 (29.17)	33 (28.45)				
CHF 7,501–10,000	101 (16.75)	78 (15.48)	26 (22.41)				
>CHF 10,000	73 (12.11)	46 (9.13)	8 (6.90)				
No answer	110 (18.24)	111 (22.02)	25 (21.55)				
NA	19 (3.15)	12 (2.38)	3 (2.59)				
Health status				**0.032**	0.23	0.21	0.18
Poor	2 (0.33)	1 (0.20)	0 (0.00)				
Fair	15 (2.49)	20 (3.97)	9 (7.76)				
Good	230 (38.14)	225 (44.64)	43 (37.07)				
Very good	266 (44.11)	203 (40.28)	48 (41.38)				
Excellent	68 (11.28)	40 (7.94)	12 (10.34)				
NA	22 (3.65)	15 (2.98)	4 (3.45)				
Activity tracker brand				0.520	0.13	0.17	0.04
Fitbit	511 (84.74)	432 (85.71)	94 (81.03)				
Garmin	67 (11.11)	55 (10.91)	14 (12.07)				
Jawbone	25 (4.15)	17 (3.37)	8 (6.90)				

(*continued on next page*)

Table 1. Baseline Characteristics of Invited Insurees and Participants (*continued*)

Characteristics	PFI	CFI	CG	*p*-value[a]	SMD[b]		
					PFI versus CG	CFI versus CG	PFI versus CFI
Bought an activity tracker to participate	320 (53.07)	303 (60.12)	62 (53.45)	**0.048**	0.01	0.15	0.14
Sitting (minutes/week)[e]	2,435.80 (1,378.83)	2,263.40 (1,303.22)	2,165.52 (1,247.31)	**0.039**	0.21	0.08	0.13
Moderate activities and walking (MET-minutes/ week), median (IQR)[e]	2,628.00 (3,306)	2,745.75 (3,327)	2,079.00 (3,720)	0.243	0.09	0.04	0.05

Note: Boldface indicates statistical significance ($p<0.05$). Table displays M (SD) for continuous and *n* (percentage) for categorical variables unless stated otherwise.
[a]Based on one-way ANOVA for normal, Kruskal-Wallis test for non-normal, and χ^2 test of independence for categorical variables.
[b]Values greater 0.20 defined as small effect size.[38] Non-normal variables were log-transformed before calculating SMD.
[c]Reported values are weighted by cluster size.
[d]Data on age and sex of participants were provided by the insurance company (*n*=1,547), data on other variables are based on baseline survey data (*n*=1,223).
[e]Assessed using the International Physical Activity Questionnaire.[39]
CFI, charity financial incentives; CHF, Swiss Francs; CG, control group; IQR, interquartile range; NA, not available; PFI, personal financial incentives; SMD, absolute standardized difference.

On average, participants walked 10,709 (SD=4,555) steps per day and reached the 10,000 steps goal on 54.24% of all days during the first 3 months of the pilot program. To investigate group differences, Table 2 and Figure 2 compare steps per day and the probability of walking >10,000 steps per day between the groups at the beginning, in the middle, and at the end of the first 3 months of the pilot program. Although participants in the charity financial incentive group consistently accumulated a higher number of steps than participants in the personal financial incentive and in the control group, these step count differences were not statistically significant at any time point. The difference between the incentive groups and the control group diminished over time (Figure 2), but this trend was also not statistically significant (change of the charity financial incentive effect over time: −3 steps/day, 95% CI= −6, 1, p=0.16; change of the personal financial incentive effect over time: −3 steps/day, 95% CI= −6, 1, p=0.15).

At the beginning of the program, participants receiving charity financial incentives had a 12% higher chance (OR=1.68, 95% CI=1.23, 2.30, p=0.004) of walking >10,000 steps per day compared with the control group. This difference diminished significantly over time (change of the charity financial incentive effect over time: −0.003, 95% CI= −0.01, −0.001, p=0.003) and was no longer significant 3 months after the start of the program. After adjusting p-values for multiple comparisons across time, the probability of walking >10,000 steps per day did not differ

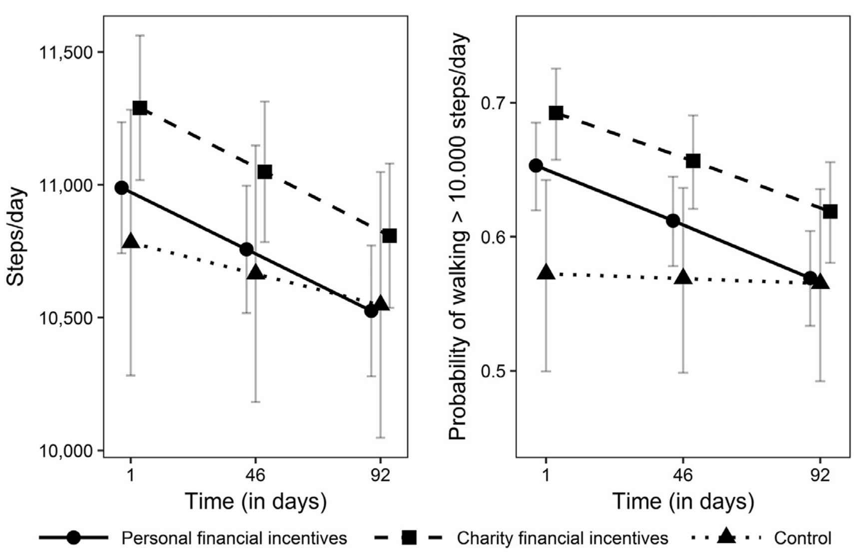

Figure 2. Steps per day and probability of walking more than 10,000 daily steps over time by incentive condition.

Table 2. Group Comparisons Regarding Steps per Day and Probability of Walking More Than 10,000 Steps

Outcome	Day 1	*p*-value[a]	Day 46	*p*-value[a]	Day 92	*p*-value[a]
Difference in steps (95% CI)						
PFI versus CG	206.49 (−322.13, 735.12)	1.00	91.99 (−415.57, 599.55)	1.00	−22.51 (−557.45, 512.43)	0.934
CFI versus CG	507.24 (−29.48, 1043.96)	0.192	383.81 (−128.35, 895.98)	0.284	260.39 (−280.95, 801.72)	0.346
PFI versus CFI	−300.75 (−620.39, 18.90)	0.130	−291.82 (−597.34, 13.70)	0.184	−282.90 (−603.73, 37.94)	0.084
Walking >10,000 steps per day, OR (95% CI)						
PFI versus CG	1.41 (1.03, 1.92)	0.093	1.20 (0.89, 1.61)	0.477	1.02 (0.74, 1.39)	0.919
CFI versus CG	**1.68 (1.23, 2.30)**	**0.004**	**1.45 (1.07, 1.96)**	**0.031**	1.25 (0.91, 1.71)	0.168
PFI versus CFI	0.84 (0.69, 1.01)	0.063	0.83 (0.69, 0.99)	0.069	0.81 (0.68, 0.98)	0.092

Note: Boldface indicates statistical significance (*$p<0.05$).
[a]*p*-values are adjusted for multiple testing across time points using the Holm-Bonferroni method. 95% CIs are not adjusted, because Holm-Bonferroni-adjusted CIs are non-informative.[40]
CFI, charity financial incentives; CG, control group; PFI, personal financial incentives.

significantly between the personal financial incentive group and the control group at any time point. Likewise, the probability of walking >10,000 steps per day did not differ significantly between the personal and the charity financial incentive group.

Lastly, non-usage attrition during the first 3 months was highest in the charity financial incentive group (10.91%), followed by the personal financial incentive group (9.62%) and the control group (9.48%). In the adjusted model, differences between the incentive groups and the control group were not statistically significant (OR=1.05, 95% CI=0.41, 2.69, p=0.92, for the personal financial incentive group; OR=1.21, 95% CI=0.48, 3.08, p=0.69, for the charity financial incentive group).

DISCUSSION

This three-arm cluster RCT investigated whether small personal and charity financial incentives can promote participation in a physical activity promotion program utilizing activity trackers. Secondary analyses examined group differences with regard to physical activity and attrition of participants. This study is among the first to investigate the potential of small personal financial and charity financial incentives for the promotion of physical activity. A strength of this study is that its pragmatic setting makes it possible to demonstrate real-world effectiveness and to inform the design of large-scale physical activity promotion programs.

Small monthly personal financial and charity financial incentives significantly increased participation, with personal financial incentives being more effective than charity financial incentives. However, the effects of these incentives on behavior may be limited. The data of this study suggest that charity financial incentives increase the likelihood of walking 10,000 steps per day only in the short term, with effects dissipating after 3 months. Personal financial incentives did not lead to significant changes in physical activity. In addition, there was no evidence that personal financial and charity financial incentives prevent attrition of participants. Consequently, this study supports utilizing small personal financial or charity financial incentives to promote participation but not behavior change in large-scale physical activity promotion programs. These findings add to the understanding of the effects of financial and charity incentives for the promotion of physical activity.

Regarding physical activity, these results deviate from previous studies that typically find a stable effect of incentives as long as they are in place.[17,18] This may indicate that an incentive value of CHF 10 per month could have been too low to sustain motivation after an initial phase of excitement at the beginning of the program had passed. To the best of the authors' knowledge, the lowest incentive value that has demonstrated effects on physical activity in randomized trials is around $1 per day,[15,40,41] which is three times the incentive value of the present study. In addition, previous studies often used daily[15,41] or weekly[17,18] incentive schedules instead of the monthly incentives in the present study. Research in the field of behavioral economics reveals that people tend to place more weight on immediate and discount future rewards,[42] a phenomenon known as present bias. The monthly reward schedule in the present study may have caused participants to further attenuate the subjective value of the already small incentives. Both factors, the small incentive value and the monthly incentive schedule, may explain the study's limited results on the ability of incentives to change behavior. Future research could investigate whether small incentives with immediate or dynamic incentive schedules lead to sustained behavior changes or what minimum incentive amount is necessary to produce sustained effects.

Designing physical activity promotion programs that rely on activity trackers may entail the risk of a favorable selection effect because individuals who already own a tracker face less barriers for participation and may be more likely to meet the recommended activity levels. Indeed, in the present study, the requirement to purchase an activity tracker was named the main barrier for participation (selected by 41.05 % of insureds who gave reasons for refusing to participate; Appendix Table 7, available online) and 44% of participants already owned an activity tracker before being invited to the program. However, although owners of activity trackers were significantly younger, better educated, and reported better health than non-owners (Appendix Table 6, available online), they accumulated on average 1,004 fewer steps (95% CI=708, 1,301) than those who purchased an activity tracker for participation (Appendix Figure 1, available online). Thus, although the investment in an activity tracker might have increased commitment to the program, it remains a big barrier to participation. Relying on smartphones for tracking physical activity or further reimbursing the financial investment (e.g., conditional on meeting activity goals after 1 year) could reduce this barrier and help to better reach people in need of the program.

Limitations

The present study has a few limitations to consider. First, because data were collected from a single insurer, results may not generalize to other programs with other insurers or populations. Second, results regarding secondary outcomes have to be interpreted with caution because voluntary registration of participants may have resulted in selection bias. Indeed, program participants were better educated and earned higher wages compared with the general Swiss population.[43,44] Incentive effects may differ in populations with lower education or income.[45] Further, nonsignificant results may not be taken as evidence for the absence of meaningful effects because the study was not powered for secondary outcomes. In addition, because participants could respond to the baseline survey after the program had started, it is possible that some self-reported baseline information was affected by the incentive strategies. This could potentially lead to overly conservative estimates of group differences in adjusted models. Third, participants in the charity incentive group had the opportunity to select the proportion of their reward that they wish to donate to charity. Thus, results of this study are not directly comparable to those of previous studies, which did not offer this option. Lastly, reported absolute step counts and proportions of days with more than 10,000 steps are likely to be conservative because consumer-grade activity trackers tend to underestimate true step counts.[46]

CONCLUSIONS

In this large cluster-RCT from Switzerland, small monthly personal financial and charity financial incentives increased participation in a physical activity promotion program utilizing activity trackers. Organizations offering such programs can thus encourage participation even when using relatively small incentives. However, the short-term effects of these incentives on physical activity and attrition limits their utility in the context of health promotion programs. Incentives may need to be modified in order to prevent attrition and promote behavior change over a longer period of time.

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Tobias Kowatsch and Elgar Fleisch developed the conception and design of the study. Jan-Niklas Kramer developed the methodology, performed the data analyses, and wrote the manuscript. Peter Tinschert, Tobias Kowatsch, and Urte Scholz

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2018.09.018.

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