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The Impact of Incentives on Exercise Behavior: A Systematic Review of Randomized Controlled Trials

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Abstract

Background—The effectiveness of reinforcing exercise behavior with material incentives is unclear.

Purpose—Conduct a systematic review of existing research on material incentives for exercise, organized by incentive strategy.

Methods—Ten studies conducted between January 1965 and June 2013 assessed the impact of incentivizing exercise compared to a non-incentivized control.

Results—There was significant heterogeneity between studies regarding reinforcement procedures and outcomes. Incentives tended to improve behavior during the intervention while findings were mixed regarding sustained behavior after incentives were removed.

Conclusions—The most effective incentive procedure is unclear given the limitations of existing research. The effectiveness of various incentive procedures in promoting initial behavior change and habit formation, as well as the use of sustainable incentive procedures should be explored in future research.

Keywords

Reinforcement; Incentive; Operant Conditioning Theory; Physical Activity

INTRODUCTION

A substantial body of literature indicates that physical inactivity is common and widespread (1–3), contributes to a variety of disease states, such as cardiovascular disease and type 2 diabetes (4, 5), and places undue economic burden on healthcare systems (6, 7). Therefore,

Conflicts of Interest Statement

The authors have no conflict of interest to disclose.

research focused on how best to improve and maintain adequate levels of physical activity is a high priority.

One avenue of exploration is the use of incentives based on operant conditioning and behavioral economics principles. In operant conditioning theory, an incentive is a stimulus that is presented contingent on performance of a specified behavior for the purposes of increasing the frequency of the behavior (8). Reinforcements can be positive (i.e., presentation of a stimulus in response to behavior) or negative (i.e., removing a stimulus in response to behavior) (8). Additionally, reinforcement schedules are determined by timing of behavioral consequences (8). Ratio schedules provide reinforcement after the behavior has been performed a predetermined number of times. Interval schedules provide reinforcement following a predetermined period of time since the previous reinforcement, if the behavior is performed during that period of time. Reinforcement schedules can also be fixed or variable.

Principles of behavioral economics, such as present-bias, anticipated regret, and loss aversion have been used in conjunction with operant conditioning theory as a way to “nudge” people into adopting behaviors that they normally want to achieve, but cannot because of human tendency for departure from fully “rational” behavior (9, 10). For example, according to the principle of present bias, financial incentives may provide motivation for exercise by providing an immediate payoff in contrast to delayed health-related benefits of exercise (11–14). Likewise, anticipation of regret for missing out on a potentially large financial payoff may lead people to participate in lottery systems in which lottery chances are obtained by performing the target health behavior (15, 16). Finally, according to the principle of loss aversion, people will work harder to avoid losing a small financial deposit (i.e., negative reinforcement) than they will to win an equal financial reward (17).

Based on these operant conditioning and behavioral economics principles, incentive-based interventions have been used to promote behavior change in other areas such as diet and weight loss (18, 19), tobacco cessation (20–23) and patient medical compliance (24, 25). In this review, we discuss the outcomes of randomized controlled trials testing the effects of material incentives to promote exercise behavior across multiple age groups. Consistent with Burns and colleagues (2012) recent review of incentivized programs for weight loss (19), we categorize studies based on use of different reinforcement procedures.

METHODS

We conducted a systematic review of published literature of randomized controlled trials that utilized various incentive procedures to promote exercise behavior.

Search Strategy

Four databases (PubMed, PsycInfo, Business Sources Premier and EconLit) were searched for relevant articles published between 1965 and June 2013 using the search terms “incent,” “incentivize,” “incentive,” “financial incentive,” “cash,” “money,” “vouchers,” “lotteries,” “prize,” “gift card,” “conditional economic incentive,” “conditional cash transfer,”

“contingency management,” and “reinforcement” in combination with “exercise,” “physical activity,” “step counts,” “health promotion,” “health behavior,” “patient compliance,” “preventive health services,” “preventive medicine,” and “primary prevention” in titles and/or abstracts. The combination of each exercise-related term with each incentive-related term led to 52 individual searches across the four databases. Additionally, reference lists from articles identified through the database searches were examined to maximize coverage of the literature.

Inclusion/Exclusion Criteria

The inclusion criteria for the literature review were as follows: published in English, randomized controlled trial (RCT) with at least one experimental condition offering an incentive contingent upon an indicator of exercise behavior and at least one otherwise equivalent comparison condition in which the incentive was absent. The first author conducted the full literature search and initial screening of candidate studies. All authors assessed the papers deemed suitable to be read in full and agreed upon the final selection of papers to be included in this review.

Analysis

Of the 1873 published reports found through the literature search, 387 were excluded as duplicates and 1467 were excluded based on preliminary screening of titles and abstracts. The remaining publications were screened for related references and one study was published during our initial analysis, leading to a total of 27 publications reviewed in full. Ultimately, 18 were excluded due to use of (a) interventions that combined incentives and non-incentive-based treatment, such that the isolated effect of incentives could not be determined (26–28); (b) incentives that were not contingent on individual exercise behavior (29–31); (c) a non-RCT design (32–41) and (d) lack of formal peer review. For the final analysis, 10 studies in 9 papers met all inclusion criteria (See Figure 1). The studies’ diversity in sample, design, data analysis, variables and follow-up assessment precluded meta-analysis.

RESULTS

Characteristics of each study are highlighted in Table 1, including descriptions of sample, intervention, incentive type and maximum cost of incentive per participant (if known) with adjustments for inflation (42). Maintenance of exercise behavior after removal of incentives is reported only when relevant data are available.

Positive Reinforcement / Fixed-Ratio Schedule

Four studies used positive reinforcement with fixed ratio scheduling. One study, conducted among previously sedentary obese adults, rewarded attendance at supervised walking sessions with modest cash incentives (43). The cash incentive was administered on an increasing scale based on cumulative attendance (\$1 per walk for first 25 walks, \$1.50 per walk for next 50 walks, \$2 per walk for next 50 walks, and \$3 per walk for any remaining walks). This incentive schedule is considered fixed despite the changes in the incentive amount, because incentives were consistently contingent on a single walking episode. The

addition of a cash incentive essentially doubled the number of attended walks relative to a no-incentive condition; however, overall rates of attendance in the incentive condition declined throughout the treatment period, averaging 30% of possible sessions. In a third experimental condition in which the cash incentive was paired with a personal trainer, attendance was triple that of the non-incentive control group but still declined over time with an overall attendance of 46.5%.

Two additional studies (44, 45) used a TV allowance unit to budget screen time among 8–12 year old children so that 60 minutes of television time was allotted for every 400 physical activity counts recorded via accelerometry (approximately equivalent to walking 5kph for one hour of TV). In both studies, greater increases in total physical activity counts and minutes spent in moderate-to-vigorous physical activity were observed within the incentivized condition compared to controls.

The fourth study assessed a school-based physical activity intervention and found that rewarding children with small prizes (balls, Frisbees, etc.) each day a pedometer step goal was met significantly increased mean daily step count compared to children exposed to the intervention alone.

Of the four studies using positive reinforcement with fixed ratio scheduling, two included assessments after the incentive schedule was removed. Incentivized behavior returned to baseline levels within 14 weeks (46) or 1 year (44) post-intervention.

Positive Reinforcement / Variable Ratio Schedule

Lottery systems (that do not require an initial fee) are considered positive variable ratio reinforcement schedules, because the amount of exercise necessary to obtain the incentive (if obtained) is variable. Two studies used a procedure in which lotteries were held for smaller prizes during the treatment period and additional lotteries were held for larger prizes either at the end of treatment (47) or at both the midpoint and end of treatment (48). Entries into lotteries were proportional to exercise session attendance during a specified period of time. In one of these studies, conducted within the context of behavioral weight loss treatment among obese women (47), the number of sessions attended and the proportion of participants with “good adherence” (attending >50% of sessions) was numerically greater (71% versus 56%) with the lottery component, but did not reach statistical significance. In the other study, the use of lotteries for college students had no effect on jogging class attendance at the end of the three-month treatment or at three-month follow-up (48).

Positive Reinforcement / Fixed Interval Schedule

Three studies used fixed interval schedules to distribute cash after a predetermined (and fixed) amount of time if participants attended fitness centers a predetermined number of times during the specified time period. In one study (49), college students were paid \$100 to attend the university fitness center eight times during a month. Attendance during the one-month intervention period was not reported; however, relative to non-incentivized controls, participants in the incentive condition increased their average attendance during the following (non-incentivized) seven weeks (1.24 visits per week) compared to average attendance during the eight weeks prior to the study (0.60 visits per week). Post-intervention

attendance was not significantly affected by paying participants \$25 to attend once within a one-week period or providing no incentives at all. In a second study by the same authors (49), students were randomized into the same three conditions (control, one gym visit, eight gym visits), but the control condition was paid the same amount of money available to the incentive conditions (\$175) non-contingent on fitness center attendance. Findings were similar to those from the first study. Average number of gym visits during a 13-week, non-incentivized follow-up period was significantly greater for the group previously paid \$100 for eight visits during a one-month period (1.46 visits per week post-intervention representing a 181% increase from pre-intervention) compared to the group previously paid \$25 for one visit during a one-week period (0.87 visits per week post-intervention representing a 40% increase from pre-intervention) or no visits (1.10 visits per week post-intervention representing a 36% increase from pre-intervention).

A third study also focused on increasing use of a university fitness center among college students (50). A fixed interval schedule (weekly, escalating cash payment [minimum of \$5 to maximum of \$7.75 per visit] based on meeting a pre-determined attendance goal that also escalated from two to five visits per week) was combined with a reset contingency plan, in which failure to meet the weekly goal reduced the reward to the original (i.e., minimum) amount. Over 12 weeks, students in the incentive condition met the goal for fitness center visits 63% of the time, while students in the control condition met the goal 13% of the time. By week 12, 47% of participants in the incentive group were meeting the goals vs. only 5% of controls.

Negative Reinforcement

One study used a negative reinforcement paradigm in which a combination of fixed ratio and variable ratio scheduling of reinforcements was conducted to improve attendance in a university jogging class that required students to jog one mile per day (51). Individuals were randomly assigned into contract or lottery conditions, requiring a deposit of either \$5 (contracting) or \$3 (lottery) of their own money prior to the start of the study. If 80% of weekly sessions were attended, individuals in the contracting group earned back \$1 and individuals in the lottery group were given one entry into the final lottery in which the prize was the total amount of money deposited by the lottery group. Contract and lottery groups demonstrated equivalent attendance rates, both of which were significantly greater than that of a non-incentivized control group.

Summary of Monetary Incentives

Monetary incentives (e.g. cash, gift certificates) were used in 9 of the 10 reviewed studies. Taking inflation into account, the average lottery prize was \$809.25 (SD $\pm$ 1440.21, range: \$59 to \$2969). To compare cash incentives among studies of different durations, the maximum payment per participant (also adjusted for inflation) was divided by weeks of active treatment. Using this method, the mean maximum cash payment per participant per week was \$20.75 (SD = \$14.25, range: \$2.80 to \$38.10).

DISCUSSION

Providing incentives to promote health behavior change has been used in both research and commercial (52) settings. This practice stems from operant conditioning and behavioral economics principles, whereby applying consequences (positive or negative) can either increase or decrease a target behavior (53) and repetition can lead to “rational addiction” and habit formation (54). An important criticism of incentive-based interventions is that providing incentives may undermine the development of intrinsic motivation and remove autonomy in decision making (55–58), factors which are strongly predictive of long-term exercise adherence (59). Despite this criticism, none of the studies reviewed utilized any measures of motivation to determine if intrinsic motivation was impacted. Thus, based on the present review, it is not possible to determine whether incentives undermine intrinsic motivation. Nonetheless, providing a variety of monetary and non-monetary incentives led to improvements in exercise behavior relative to no-incentive controls during active intervention among children (44–46), young adults (49–51) and middle-age adults (43). An exception was studies that used variable ratio reinforcement schedules, which may trigger feelings of unfairness and tension (47, 48).

Only four of the reviewed studies assessed non-incentivized behavior at follow-up intervals: two showed a regression of behavior to baseline levels (44, 48) and two demonstrated that improvements over baseline persisted for a period of time without incentives (49, studies 1 & 2). The latter two studies used fixed interval reinforcement schedules. Thus, the possibility exists that rewarding participants only after a behavior is performed multiple times within a specified timeframe (e.g. eight gym visits in four weeks) may be more effective in forming a habit than rewarding each instance of the behavior (e.g. earning a specified reward per visit), in which the behavior may occur less frequently over a longer duration. While these findings are promising, the lack of long-term follow up of non-incentivized exercise behavior limits the ability to draw definite conclusions regarding exercise habit formation.

Future Directions

The use of incentive-based worksite and insurance reimbursement programs targeting preventive health behaviors is growing in popularity (60, 61). Likewise, the Patient Protection and Affordable Care Act (PPACA, effective as of January 1st, 2014) encourages the use of incentive programs to improve preventative care (62). Consistent with the PPACA, several uncontrolled studies have demonstrated favorable results for incentivized worksite physical activity programs (36, 39–41). Offering cash rebates of \$150 (40) or savings on out-of-pocket insurance expenses (up to \$2000 in some cases) (41) have yielded pre-post increases in both self-reported and objectively measured physical activity behavior, respectively. Unlike the studies reviewed herein, these programs seek to promote long-term improvements in exercise behavior through maintaining an incentive schedule indefinitely. While uncontrolled studies demonstrate initial feasibility, RCTs are needed to minimize selection bias, control for confounding factors, and decrease the likelihood of spurious findings (63). Existing reimbursement programs often do not adhere to basic principles of operant conditioning and behavioral economics. For example, one-time large rewards that

are inconspicuous (e.g., hidden in a monthly electronic paycheck) may not be as effective as smaller, periodic, and more salient incentives (64). It is also unclear whether changes to copays and insurance structures would be readily understood by the general public (64). Thus, the challenge of scaling up incentive programs while maintaining fidelity to operant conditioning and behavioral economics principles remains an important issue.

Additionally, providing relatively large monetary rewards to each individual meeting an exercise program goal, while potentially viable in large companies, may not be feasible for local fitness centers or small businesses. Several options for less costly sustainable incentive programs warrant further study. One option is the use of substantially smaller monetary incentives to influence exercise behavior. For example, in an uncontrolled intervention study, Schummacher and colleagues (36) demonstrated that relatively minimal incentives (\$0.20 per day maximum) boosted employee stair utilization within a larger employee-based health rewards program. A second option is implementing a negative reinforcement “buy-in” system, in which participants pay a fee to enroll that provides an opportunity to earn money back for meeting exercise goals. Improvements in behavior have been observed using similar designs in research settings, including an above-reviewed RCT (39, 51). A third option for implementing a sustainable incentive program is reinforcing exercise behavior with charitable donations (65). Currently, a variety of “fitness-based fundraising” devices are available for commercial use, including smart phone apps, free websites and specially designed pedometers (66). “Anti-charity” programs have emerged (e.g. www.stickk.com) that utilize commitment contracts, such that failing to meet personal goals leads to a donation to a charity or entity considered to be unfavorable to the individual. The recent appearance of such programs suggests that within the general population there is interest in using charitable donations as a motivational tool for exercise; however, such programs have not yet been evaluated in controlled research studies. Implementation of a donation-based exercise promotion program may be particularly attractive for privately owned fitness centers as it could benefit both the participant (e.g. promoting feelings of altruism in addition to improving exercise level) and the organization (e.g. possibility for tax deductions or generating positive publicity). Each approach to a fiscally-sustainable program presents opportunities for future research.

Conclusions

This systematic review identified 10 randomized controlled trials that tested the impact of providing incentives on increasing exercise behavior. Findings from these studies suggest that monetary incentive programs can be successful, at least in the short term, for increasing participation in exercise programs. However, research in this area is minimal and heterogeneous in terms of target population, magnitude of incentive, incentive type, study duration and follow-up assessment. Thus, it is not possible to draw definite conclusions regarding best practices for using incentives to promote increases in exercise behavior. Additionally, because the removal of the incentives typically leads to regression of the targeted behavior, it is important to explore both the implementation of short-term incentive schedules that promote habit formation and implementation of incentive schedules that can be sustainable long-term. Further, it is likely that the response to a particular incentive-based program varies between individuals or populations; so additional research is necessary to

determine which approaches—incentives alone or in combination with other techniques (e.g. motivational interviewing or cognitive behavioral therapy)—are most appropriate for maximizing behavioral outcomes.

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Figure 1. PRISMA flowchart for the selection of studies to include in the review

Representation of a systematic literature search and subsequent process for determining eligible studies for review.

Table 1

Sample and intervention characteristics of identified studies

Descriptive information for 10 randomized controlled trials, including sample population size and demographics, intervention design, and maximum incentive cost per participant.

Author Group and Year of Publication (citation)	Sample Description	Intervention Duration (follow-up duration)	Study Setting	Incentivized Behavior	Incentive Type	Incentive Cost (2013 cost adjusted for inflation)
Epstein 1980 (51)	20 female college students	5 weeks	University	Attendance at exercise sessions	Cash	Contracting condition = \$5 (\$14) Lottery Condition = \$21 (\$59)
Martin 1984 (48)	34 adults, age 20–57y (82% female)	3 months (6 months)	University	Attendance at exercise sessions	Lotteries for prizes and gift certificates	Gift certificate = \$60 (\$135)
Wing 1996 (47)	37 obese women, mean age 44.5 y	6 months	Community	Attendance at exercise sessions	Lotteries for gift certificates	Gift certificates = \$50 (\$74) Travel certificate = \$2000 (\$2969)
Jeffery 1998 (43)	193 obese adults, age 25–55y (85% female)	18 months	Community	Attendance at exercise sessions	Cash	\$491 (\$702)
Goldfield 2006 (45)	30 overweight or obese, sedentary children age 8–12 y (57% female)	2 months	Home	Physical activity counts	TV viewing	N/A
Chmessa 2009 (49) Study 1	120 college students	5 weeks (7 weeks)	University	Attendance at fitness center	Cash	\$125 (\$136)
Chmessa 2009 (49) Study 2	168 college students	5 weeks (13 weeks)	University	Attendance at fitness center	Cash	\$175 (\$190.50)
Hardman 2011 (46)	386 children, age 7–11 y (54% female)	21 weeks	School	Steps per day	Inexpensive prizes (balls, Frisbees, erasers, etc.)	N/A
Roemmich 2012 (44)	61 nonoverweight, sedentary children age 8–12 y (49% female)	4 months (1 year)	Home	Physical activity counts	TV viewing	N/A
Pope, 2013 (50)	117 first year college students, age 18–19y (63% female)	3 months	University	Meeting weekly gym visit goal	Cash	\$310.50 (\$310.50)