Financial Incentives for Exercise Adherence in Adults

Systematic Review and Meta-Analysis

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Context: Less than 5% of U.S. adults accumulate the required dose of exercise to maintain health. Behavioral economics has stimulated renewed interest in economic-based, population-level health interventions to address this issue. Despite widespread implementation of financial incentive-based public health and workplace wellness policies, the effects of financial incentives on exercise initiation and maintenance in adults remain unclear.

Evidence acquisition: A systematic search of 15 electronic databases for RCTs reporting the impact of financial incentives on exercise-related behaviors and outcomes was conducted in June 2012. A meta-analysis of exercise session attendance among included studies was conducted in April 2013. A qualitative analysis was conducted in February 2013 and structured along eight features of financial incentive design.

Evidence synthesis: Eleven studies were included (N=1453; ages 18–85 years and 50% female). Pooled results favored the incentive condition (z=3.81, $p<0.0001$). Incentives also exhibited significant, positive effects on exercise in eight of the 11 included studies. One study determined that incentives can sustain exercise for longer periods (>1 year), and two studies found exercise adherence persisted after the incentive was withdrawn. Promising incentive design feature attributes were noted. Assured, or "sure thing," incentives and objective behavioral assessment in particular appear to moderate incentive effectiveness. Previously sedentary adults responded favorably to incentives 100% of the time (n=4).

Conclusions: The effect estimate from the meta-analysis suggests that financial incentives increase exercise session attendance for interventions up to 6 months in duration. Similarly, a simple count of positive (n=8) and null (n=3) effect studies suggests that financial incentives can increase exercise adherence in adults in the short term (<6 months).
(Am J Prev Med 2013;45(5):658–667)

Introduction

According to the WHO, behavioral risk factors including tobacco use, poor diet, and physical inactivity account for an estimated 80% of chronic diseases.[1] Regular exercise in particular protects against debilitating and costly chronic conditions.[1] Most adults are not sufficiently active, however, with less than 5% of U.S. adults accumulating the required dose of exercise to maintain health.[2] For many adults, the "costs" of exercise (e.g., time, uncomfortable feelings) loom so large that they never start.[3,4] For those who do manage to start exercising, most drop out within 6 months.[4] Low exercise adherence, therefore, is operationally defined as a problem of both initiation *and* maintenance. Recognizing that exercise is a complex behavior influenced by multiple factors, a broad social–ecologic approach requiring action across multiple domains is likely needed to address these issues. The economic domain has become an increasingly popular target for intervention.[5]

Behavioral economics, a branch of economics complemented by insights from psychology, has motivated renewed interest in economic-based, population-level

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0749-3797/$36.00
http://dx.doi.org/10.1016/j.amepre.2013.06.017

health interventions.[5] Germany, the U.K. and U.S., South Africa and Canada, as well as several large corporations in the U.S., have adopted financial incentive–based public health and workplace wellness policies in recent years.[6–8] By acknowledging psychological tendencies that underlie decision making, behavioral economics offers a descriptively accurate portrait of human behavior and is thus a strong theoretic foundation from which to generate practical techniques for promoting behavior change. Behavioral economics acknowledges that human judgments are biased in systematic ways and that these biases can make it difficult for people to make self-beneficial choices.[9]

For example "present bias" refers to the tendency to act in favor of one's immediate self-interest at the expense of one's long-term well-being; in other words, immediate costs and benefits exert disproportionate influence on people's choices relative to those that will be experienced some time in the future.[9] In the case of exercise, the "costs" are experienced in the present; whereas the benefits (e.g., health, more attractive appearance) are delayed, resulting in notorious resolutions to "exercise more tomorrow." According to behavioral economics, increasing the immediately rewarding aspects of exercise (e.g., by offering financial incentives such as cash or vouchers) may increase people's propensity to exercise.

A growing body of evidence broadly supports this line of reasoning. For example, systematic reviews suggest that financial incentives generally improve "lifestyle" health behaviors, including dietary behaviors, smoking cessation, and weight loss, in the short term (e.g., less than 6 months) and while the incentives are still in place.[10–13] These favorable effects have been largely short-lived, however, with individuals usually reverting to baseline behaviors soon after the incentive is removed.[10–13] Unfortunately, there has been less study of the impact of financial incentives on exercise specifically—arguably the behavior most closely associated with health and longevity.[14,15] Separating the effect of incentives on exercise from their effect on weight loss is important because incentive effectiveness is believed to be moderated by the behavior/outcome targeted.[16–18] According to Jeffery et al.,[17,19] Wing et al.,[18] and Charness and Gneezy,[16] for instance, incentives contingent on an immediate, directly observable behavior (e.g., exercise) may produce different effects than rewards contingent on distal consequences of behavior (e.g., weight loss).[16–19] Similarly, in their review of incentives for weight loss, Paul-Ebhohimhen and Avenell[12] observed "a very weak trend...in favor of reward for behavior change than reward for weight."[12] Learning more about the effects of incentives on weight-related behaviors, such as exercise, and not just outcomes, may optimize incentive interventions in the future.

The primary objective, then, was to conduct a systematic review to determine if financial incentives increase exercise adherence in adults in the short term (as has been observed previously with non-exercise lifestyle health behaviors), and importantly, whether this increase can be sustained over the long term ($\geq$6 months is typically considered "maintenance" within the transtheoretical model of behavior change)[20] *and* after the financial incentive is removed. A secondary objective was to explore financial incentive design features that may moderate effectiveness.

Evidence Acquisition

Electronic Search

A sensitive systematic search strategy was developed for Medline (Appendix A, available online at www.ajpmonline.org) and modified for 14 other databases (Appendix B, available online at www.ajpmonline.org). Databases were searched in June 2012 for English-language RCTs published in peer-reviewed journals from inception to June 2012. The Cochrane Database of Systematic Reviews was also searched. Eight international experts with a recent and relevant publication history were contacted to review the list of included studies for missing papers (Appendix C, available online at www.ajpmonline.org). In addition, the highest-yielding database (i.e., Medline) was searched a second time in January 2013. Reference lists of all included studies were hand-searched as were relevant financial incentive–related reviews and articles.

Eligibility Criteria

Studies of RCTs reporting the impact of financial incentives on exercise in adults (aged $\geq$18 years) where incentives were contingent on a pre-specified exercise behavior or outcome were included (e.g., exercise session attendance, aerobic fitness). Non-randomized studies where it was not possible to isolate the effects of incentives from other intervention components were excluded. Financial incentives were defined as any cash or noncash reward with a monetary value (not items with negligible monetary value, e.g., ribbons) provided directly to individuals. Where monetary value of financial incentives is not explicit, general statements (e.g., "day off work") were extracted. Studies evaluating the impact of subsidies (e.g., tax credits) and disincentives (e.g., fiscal penalties) were excluded. In studies examining multiple treatments, groups differing only in the provision of financial incentives were compared. Studies providing financial incentives for multiple behavior changes, for instance improved diet, smoking cessation, and increased exercise, were included if exercise adherence was tracked throughout the intervention, or if aerobic fitness was measured at baseline and follow-up.

Study Selection

Article records were independently screened by two reviewers using a pilot-tested a priori screening form (Appendix D, available online at www.ajpmonline.org). Where there was uncertainty, a third reviewer was consulted and made the final decision regarding inclusion. Full texts of articles deemed potentially eligible were retrieved. One reviewer screened the full-text articles for eligibility and another reviewer was consulted when it was unclear if a study should be included. Final decisions were made by consensus. The paper by Charness and Gneezy[16] reports the results of two separate studies, both of which were included in the analysis.[16] In addition, two observations (i.e., Treatment Groups 1 and 2) were extracted from Epstein et al.[21] Reasons for study exclusion are presented in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines flowchart (Figure 1).[22]

Quality of Evidence

The Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (QATool) was applied to the included studies.[23] All studies meeting the inclusion criteria were included in the analysis, regardless of their quality rating.

Data Analysis

Outcomes were not comparable enough to pool data (i.e., energy expenditure, aerobic fitness, exercise session attendance, aerobic minutes). A sufficient number of studies (more than two), however, reported the same outcome (i.e., exercise session attendance) to undertake a meta-analysis of a subsample of included studies (April 2013). Means and SDs were extracted and expressed in percent sessions attended in order to control for varying attendance expectations (e.g., two per week, four per week). Percentages of sessions attended were pooled using a weighted mean difference. Heterogeneity was explored using the impact of heterogeneity statistic (I^2). Where $I^2 \leq 50\%$ and $I^2 > 50\%$, fixed-effects model and random-effects model approaches were used, respectively. Sensitivity analyses including and excluding studies with a high risk of bias (EPHPP "weak" quality rating) were conducted. Analyses were conducted in Review Manager 5.2 (The Cochrane Collaboration).

The small number of studies included in the meta-analysis ($n<10$) made it inappropriate to examine relationships between clinical characteristics (e.g., incentive design features) and the direction, size, or duration of the intervention effect using meta-regression. Too few studies reporting exercise session attendance examined incentive effectiveness for >6 months (n=1) and in the post-intervention period (n=2) to stratify studies based on these variables in subgroup analyses. For these reasons, a qualitative analysis of the data was conducted (February 2013).

The purpose of the qualitative analysis, structured along the seven published features of financial incentive design (each possessing a range of attributes; Table 3),[24] was to explore the impact of incentive design features on intervention effectiveness. Based on a review of the literature, Klein and Karlawish[24] proposed the seven features to facilitate the design of financial incentive programs for different subpopulations. These features are the first set to comprehensively list and define financial health incentive program components and are a valuable incentive design and evaluation resource. Even subtle changes to these features have rendered incentives ineffective in the past (e.g., requiring monetary deposits can limit incentive program participation),[25] highlighting the importance of considering each in this review. Minor adjustments to these features are recommended (e.g., reimbursement-type incentive was added as a distinct feature attribute). One new design feature was also added to cover an additional facet of incentive design (type of assessment; Table 3). Study characteristics, study quality appraisal, and financial incentive design features are summarized in Tables 1 and 2 and Appendix E (available online at www.ajpmonline.org).

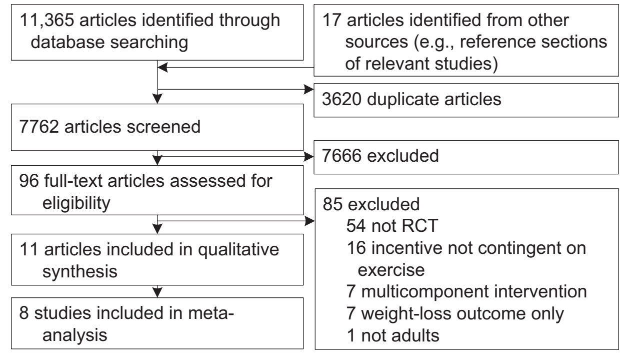

Figure 1. Flowchart of included and excluded studies examining the impact of incentives on exercise in adults

Evidence Synthesis

Study Characteristics

From an initial return of 7762 articles (after de-duplication), 96 full texts were assessed for eligibility and 11 met inclusion criteria.[16,18,19,21,26–31] Five studies were retrieved using Medline and seven from other sources (i.e., hand-searching). Characteristics of included studies are presented in Appendix E (available online at www.ajpmonline.org). Eligible studies with a cumulative sample of 1453 healthy, community-dwelling adult participants (aged 18–85 years; approximately 50% female and 40% overweight) were published between 1980 and 2010. The sample size of included studies ranged from 15 to 395. Only one study reported income level,[30] and the psychological variables that may mediate sustained behavior change, such as self-efficacy or intrinsic motivation, were not assessed in any study.

Quality of Evidence

Three,[21,26,31] six,[16,18,19,29,30] (reference 16 contains two studies), and two studies[27,28] were assigned weak, moderate, and strong quality ratings, respectively. Among those studies rated moderate, selection bias (on the basis that participants were recruited by media advertisement/e-mail lists) lowered the quality rating on each occasion. Quality of evidence is summarized in Table 1.

Meta-Analysis of Subsample of Studies with Similar Outcomes

Seven studies (eight observations between 4 and 26 weeks; n=554) reported mean exercise session attendance and results were pooled in a meta-analysis. Because of heterogeneity between the studies (chi-square=280.55, df=7, $p<0.00001$; I^2=98%), sensitivity analyses excluded

Table 1. Study quality rating using effective public health practice project quality assessment tool for quantitative studies

Study	Overall rating	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawals and dropouts
Epstein (1980)[21]	Weak	Weak	Strong	Weak	Moderate	Strong	Strong
Noland (1989)[26]	Weak	Weak	Strong	Weak	Weak	Strong	Strong
Gomel (1993)[27]	Strong	Strong	Strong	Strong	Moderate	Strong	Strong
Wing (1996)	Moderate	Weak	Strong	Strong	Moderate	Strong	Strong
Courneya (1997)[28]	Strong	Strong	Strong	Strong	Strong	Strong	Strong
Jeffery (1998)[19]	Moderate	Weak	Strong	Strong	Strong	Strong	Moderate
Jeffery (1999)[29]	Moderate	Weak	Strong	Strong	Strong	Moderate	Moderate
Finkelstein (2008)[30]	Moderate	Weak	Strong	Strong	Strong	Strong	Moderate
Charness (2009)[16]	Moderate	Weak	Strong	Strong	Strong	Strong	Strong
Charness (2009)[16]	Moderate	Weak	Strong	Strong	Strong	Strong	Strong
Daryanto (2010)[31]	Weak	Weak	Strong	Weak	Strong	Strong	Strong

Note: The Charness 2009 paper reported on two studies, so results are given for each.

"weak" quality as well as outlying studies. Excluding the "weak" quality studies[21,31] did not reduce heterogeneity (chi-square=250.37, df=4, $p<0.00001$; I^2=98%). In a separate sensitivity analysis excluding the outlying studies,[16] heterogeneity was reduced considerably (chi-square=2.05, df=5, p=0.84; I^2=0%).

The incentives in these outlier studies were the largest among included studies (i.e., $33.54 to $46.82 per week; Table 2), possibly explaining their pronounced effect on exercise session attendance. Even after removing the outliers, pooled results for exercise session attendance over a period of 4–26 weeks favored the incentive condition; the use of financial incentives was associated with an increase in exercise session attendance of 11.55% (95% CI=5.61%, 17.50%; z=3.81, $p<0.0001$; Figure 2). The effect estimate persisted after removing studies at high risk of bias from the meta-analysis (weighted mean difference 11.75%, (95% CI=4.60%, 18.96%, z=3.22, $p<0.001$).

Qualitative Synthesis of All Included Studies Using "Vote Counting"

A simple count of positive (n=8)[16,19,21,26,28,30,31] and null effect (n=3)[18,27,29] studies suggests that financial incentives can increase exercise adherence in adults. Although it appears that incentives differentially affect classes of behavior (e.g., increase in exercise session attendance, but not overall physical activity level), a closer examination helps to explain disparate findings (e.g., poor intervention designs, inadequate outcome measures).[17,29] Among the studies demonstrating significant, positive effects, three received a weak quality rating (and thus at high risk of bias),[21,26,31] four moderate,[16,19,30] and one strong.[28] Notably, six of the eight positive studies tested financial incentive effectiveness in the short term only (≤3 months).[16,21,28,30,31] Among the three studies monitoring exercise adherence after incentives were withdrawn,[16,27] two demonstrated persisting levels of adherence, but only for the previously inactive.[16] The previously active adults (i.e., those who were exercising regularly at baseline) exhibited a drop in attendance following the intervention.[16] For the studies showing a null effect (n=609), two were rated moderate[18,29] and one was rated strong.[27]

Design Feature Attributes of Studies Demonstrating Positive and Null Effects

Design feature attributes for included studies are summarized in Table 2. Although financial incentive designs varied considerably between studies, several attributes

Table 2. Incentive design feature attributes of included studies

Study, country	Type	Quantity[a]	Probability	Timing	Participant investment	Information disclosure	Dispensing type	Type of assessment
Epstein (1980),[21] U.S.	Incentive 1: Cash, Incentive 2: Cash	Incentive 1: Indexed, $11.70 Incentive 2: Indexed, $2.79	Incentive 1: Chance Incentive 2: Assured	Incentive 1: Assessed weekly; incentive delayed 5 weeks Incentive 2: Assessed weekly; incentive at 1 week	Incentive 1: Escrow, $3 deposit Incentive 2: Escrow, $5 deposit	Factual	Incentive 1: Aggregative Incentive 2: Reset	Objective, direct, behavioral assessment
Noland (1989),[26] U.S.	Noncash	Uniform, ~$0 to $92.58	Assured	Assessed at set intervals/ program completion; incentive within 1 week of assessment	Opportunity cost	Factual	Aggregative	Self-reported behaviors/ aerobic fitness outcome
Gomel (1993),[27] U.S.	Noncash	(a) Indexed, $12.71 (b) Uniform, $5.29 (c) Uniform, $2.78	(a) Chance (b) Assured (c) Chance	Assessed weekly/3, 6 months; incentive delayed >1 week after assessment	Opportunity cost	Factual/ counterfactual	(a) Aggregative (b) Reset (c) Aggregative	Self-reported behaviors/ aerobic fitness outcome
Wing (1996),[18] U.S.	Noncash	(a) Indexed, $73.17 (b) Indexed, $121.94	(a) Chance (b) Chance	Assessed weekly; weekly and delayed incentives	Opportunity cost	Factual/ counterfactual	(a) Aggregative (b) Aggregative	Objective, direct, behavioral assessment
Courneya (1997),[28] Canada	Reimb.	Uniform, $17.76	Assured	Immediate assessment; incentive at end of month	Opportunity cost	Factual	Aggregative	Objective, indirect, behavioral assessment
Jeffery (1998),[19] U.S.	Cash	Indexed, escalating, $9.61	Assured	Immediate assessment; incentive at 1-month intervals	Opportunity cost	Factual	Aggregative	Objective, direct, behavioral assessment
Jeffery (1999),[29] U.S.	Cash	Indexed, $34.45	Chance	Assessment upon receiving postcard in mail; incentive within week	Opportunity cost	Factual	Aggregative	Self-reported behaviors
Finkelstein (2008),[30] U.S.	Cash	Escalating, $39.99– includes one-time payment of $53.48 for initial study enrollment	Assured	Daily/weekly assessment; incentive at study end (1 month)	Opportunity cost	Factual	Reset	Self-reported behaviors/ Objective indirect, behavioral assessment
Charness (2009),[16] U.S.	Cash	Incentive 1: Uniform, $26.75 Incentive 2: Uniform, $33.54	Incentive 1: Assured Incentive 2: Assured	Immediate assessment; incentive at intervention end	Opportunity cost	Factual	Incentive 1: Aggregative Incentive 2: Aggregative	Objective, indirect, behavioral assessment
Charness (2009),[16] U.S.	Cash	Incentive 1: Uniform, $46.82 Incentive 2: Uniform, $46.82	Incentive 1: Assured Incentive 2: Assured	Immediate assessment; incentive at intervention end	Opportunity cost	Factual	Incentive 1: Aggregative Incentive 2: Aggregative	Objective, indirect behavioral assessment
Daryanto (2010a),[31] U.K.	Reimb.	Uniform, €2.71	Assured	Immediate assessment; incentive at intervention end	Opportunity cost	Factual	Aggregative	Objective, indirect, behavioral assessment

Note: The Charness 2009 paper reported on two studies, so results are given for each.
[a]To facilitate comparisons between studies, incentive quantities are reported in 2013 U.S./Canadian dollars and British pounds per week; Incentive 1 and Incentive 2 are incentives for treatment groups; (a), (b), and (c) denote different components of mixed-incentive schemes.
Reimb., reimbursement

Study or subgroup	Incentive Mean	Incentive SD	Incentive Total	Control Mean	Control SD	Control Total	Weight (%)	Mean difference IV, Fixed, 95% CI	Year
Epstein (1980)[21]	76.5	20.75	7	57.5	26.05	8	6.3	19.00 (-4.71, 42.71)	1980
Epstein (1980)[21]	79	21.6	5	57.5	26.05	8	5.2	21.50 (-4.66, 47.66)	1980
Wing (1996)[18]	60.7	29.2	21	52.2	30.7	16	9.2	8.50 (-11.05, 28.05)	1996
Courneya (1997)[28]	45.42	40.83	100	31.42	30.25	100	35.6	14.00 (4.04, 23.96)	1997
Jeffery (1998)[19]	44.4	27.6	37	34.67	27.7	42	23.7	9.73 (-2.49, 21.95)	1998
Charness (2009)[16]	108.89	40.83	40	33.33	30.25	40	0.0	75.56 (59.81, 91.31)	2009
Charness (2009)[16]	145	40.83	60	18.75	30.25	60	0.0	126.25 (113.39, 139.11)	2009
Daryanto (2010)[31]	148.88	21.6	25	143	26.05	25	20.1	5.88 (-7.39, 19.15)	2010
Total (95% CI)			**195**			**199**	**100.0%**	**11.55 (5.61, 17.50)**	

Heterogeneity: Chi² = 2.05, df = 5 ($p = 0.84$); I² = 0%
Test for overall effect: $z = 3.81$ ($p = 0.0001$)

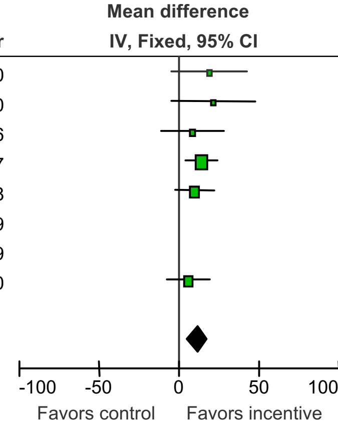

Figure 2. Exercise session attendance (%; 4–26 weeks) comparing use of incentives versus no incentives
Note: The Charness 2009 paper reported on two studies, so results are given for each.

appear to distinguish positive from null effect studies. First, seven of the eight positive studies rewarded objectively assessed behaviors (i.e., supervised exercise session attendance [*n*=2][19,21]; computerized gym attendance [*n*=4][16,28,31]; and aerobic minutes by pedometer [*n*=1][30]). This was not the case for two of the three null-effect studies, where financial incentives were contingent on self-reported behaviors.[27,29] Next, although 75% of studies (three of four) implementing chance-, or lottery-, based financial incentives (whether exclusively or combined with an assured incentive) did not increase exercise adherence,[18,27,29] all of the studies (seven of seven) offering assured, or "sure thing," financial incentives produced a favorable effect.[16,19,26,28,30,31] In addition, 100% of interventions targeting previously inactive adults yielded a positive effect (*n*=4).[16,26,30]

Larger incentives (i.e., $26.75–$46.82 per week) appeared to yield larger effects.[16,30] Financial incentive magnitude, however, ranged from $2.79 to $46.82 per week for positive studies, suggesting that even modest incentives (when combined with more-potent feature attributes) may increase exercise adherence in adults. Though limited by the extant literature, several promising design feature attributes were identified in this review. In particular, incentive schemes incorporating indexed/escalating incentives,[19,30] cash[16,19,21,30]/reimbursement[28,31]-type incentives, and escrow incentives[21] (i.e., deposit contracts) may optimize effectiveness (see Table 3 for attribute definitions).[25]

The majority of the positive studies dispensed incentives at the end of the intervention period (aggregative dispensing type), rather than with each achievement (reset dispensing type), suggesting that the immediacy of the tangible incentive may not be critical if participants are promptly and regularly informed of their reward "status." Because ten of the 11 included studies offered aggregative incentives, though, it is not known whether more immediate, reset incentives would have increased intervention effectiveness. Lastly, in the one study reporting personal income data,[30] lower-income adults (<$50,000, in 2008 dollars) accumulated more aerobic minutes than their higher-income counterparts (>$50,000 in 2008 $) in the presence of a financial incentive contingency.

Discussion

The best effect estimate from the meta-analysis suggests that financial incentives increase exercise session attendance for interventions short in duration (i.e., 4–26 weeks) by approximately 11.55% (95% CI=4.60%, 18.96%). Similarly, among all the included studies (studies reporting various exercise-related outcomes, not just exercise session attendance), a simple count of positive- and null-effect studies suggests that financial incentives increase exercise in adults in the short term. This is consistent with findings from previous systematic reviews that generally observed improved dietary behaviors,[13] smoking cessation,[11] and weight loss,[12] respectively, in the short term and while financial incentives remained in place.

The applicability of this overall finding is limited, however, by the homogeneity of study population characteristics and the wide range of incentive design feature attributes in the included studies. Vulnerable groups (e.g., chronic disease, low-SES populations) in particular were under-represented in the included studies, limiting the generalizability of the results to predominantly young, white, healthy, and educated U.S. adults. Given the scarcity of research examining incentives for exercise, the data are insufficient to draw conclusions regarding the influence of incentive design features and contextual factors (e.g., income-level, baseline activity levels) on incentive effectiveness.

Table 3. Financial incentive design features and range of attributes for each

Features	Attributes
1. Benefit type	(a) Direct (cash) (b) Indirect (noncash, e.g., voucher) (c) Reimbursement (existing expense reimbursed)
2. Quantity of benefit	(a) Uniform ($50 lump sum for meeting goal) (b) Indexed ($1 for each exercise session attended) (c) Escalating ($1 for first ten sessions, $2 for next ten) (d) Random ($1–$50 for session attendance)
3. Probability of distribution	(a) Assured ($50) (b) Chance (1 in 4 chance of $200) (c) Mix ($50 and a 1 in 4 chance of $200)
4. Timing of assessment and reward	(a) Completion of program (6 months) (b) Set intervals (**daily**/weekly visits) (c) Random intervals (ten visits in 6 months) (d) Dependent intervals (varying intervals based on previous performance) * Consider when (1) behavior/outcome assessed, (2) when it is rewarded, and (3) whether there is a delay between assessment and reward.
5. Participant investment	(a) Opportunity cost only (time, uncomfortable feelings) (b) Escrow (own money lost if fail to achieve goal) (c) Matching ("double or nothing"; $50 of own money lost if fail, $50 extra gained if successful)
6. Information disclosure	(a) Factual (information given about meeting or failing to meet goal) (b) Counterfactual (information given about reward lost by failing to meet goal, i.e., regret)
7. Dispensing type	(a) Resetting (discreet reward at time of each achievement) (b) Aggregative ("passbook saving"–information on running tally given)
8. Type of assessment	(a) Self-report (exercise diary submission) (b) Objective, direct assessment (face-to-face) (c) Objective, indirect assessment (pedometer)

Note: Examples of each attribute are in parentheses. Recommended adjustments to the features and attributes published by Klein and Karlawish[24] are in bold.

Similarly, there is limited evidence to draw conclusions regarding longer-term incentive interventions (>6 months). Indeed, the majority of the studies demonstrating a positive effect did so in the short term only (n=6; 4–12 weeks).[16,21,28,30,31] Financial incentives did sustain exercise adherence for more than 1 year in one study, however, underscoring the *potential* for incentives to promote exercise maintenance.[19] In this study,[19] Jeffery et al. offered assured, indexed, and escalating cash incentives (worth $9.61 per week) for objectively assessed walking session attendance. This combination of feature attributes may have increased the "perceived value" of the incentive enough to stimulate sustained exercise. Indexed and escalating financial incentive schedules (i.e., $1 for first ten walks, $1.50 for next ten) in particular have promoted continued financial incentive program participation in the past[32,33] and have recently been used to promote gym attendance among first-year college students.[34]

In addition to demonstrating the potential long-term effectiveness of financial incentives, Jeffery et al.[19] make a novel contribution to the literature given the sometimes cited "habituation" effect of continuous incentive intervention, in which financial incentive effectiveness deteriorates as individuals become familiarized with the external motivator.[10,35] Concluding that financial incentives drive long-term exercise, however, is premature given that only one RCT has demonstrated their long-term effectiveness.

The dearth of research exploring the post-intervention effects of incentive intervention, arguably the most important gap in the literature, precludes conclusions regarding the sustained effectiveness of time-limited incentive interventions. While acknowledging the very limited amount of research in this area, lessons may be learned from the only positive studies measuring exercise in the critical post-incentive period. Charness and Gneezy[16] found that the increase in gym attendance observed among university students persisted for 5 and 16 weeks, respectively, following separate 5-week interventions (i.e., assured, aggregative cash incentives valued at $26.75–$46.82 per week and contingent on prompt, objective behavioral assessment).[16]

This finding is notable given that the most commonly reported weakness of financial incentive intervention is the potential for new, external motivators to depress intrinsic motivation and harm, rather than sustain, post-intervention behaviors. Indeed, there is strong evidence to support this so-called "crowding out" effect.[10,36,37] Such a possibility is in line with self-determination theory (SDT), which would suggest that rewarding individuals for participating in potentially intrinsically interesting tasks may reduce intrinsic motivation once the financial incentive is no longer offered.[38] Interestingly, according to Charness and Gneezy,[16] the risk of undermining intrinsic motivation may be lower for financial incentives targeting previously *inactive* adults.[16] This is likely because inactive adults have lower levels of intrinsic motivation to exercise.[4]

In addition to considering physically inactive populations as the initial targets for intervention, future research should examine how the features of financial incentive programs could be manipulated to maintain or increase, rather than harm, intrinsic motivation. SDT provides a valuable theoretic framework to consider when designing incentive interventions with this aim. According to SDT, intrinsic motivation is in part shaped by the extent to which individuals fulfill the basic psychological needs of competence (experiencing mastery); autonomy (a sense of ownership over behavior); and social relatedness (feeling socially connected to others).[38] By rewarding the achievement of *realistic* self-regulatory goals (e.g., exercise self-monitoring), for example, or by providing choice (e.g., *Which vouchers would you prefer?*) or rewards related to social outcomes (e.g., group contingencies or charitable donations),[39] incentives may serve to fulfill these basic psychological needs and maintain or increase intrinsic motivation. These theoretically promising "manipulations," however, require empirical support before widespread recommendation.

Implications

Western nations and corporations are implementing financial incentive–based public health and workplace wellness polices with much greater frequency. This review supplies decision makers with a summary of the current state of the literature examining the impact of financial incentives on exercise adherence in adults. Financial incentives appear to increase exercise adherence in adults in the short term. Larger, assured, indexed, and cash or reimbursement-type incentives contingent on objectively assessed behaviors may optimize incentive interventions. However, in the absence of research that directly compares design feature attributes (e.g., assured versus chance incentives, cash versus noncash incentives, incentives for behaviors versus outcomes, with all other features held constant), recommendations cannot be made.

In addition, too few studies have examined the longer-term and post-intervention effects of financial incentive intervention on exercise adherence to draw conclusions. One and two RCTs, respectively, though, demonstrate the potential for incentives to drive long-term behavior change as well as to sustain exercise after incentives are withdrawn. Incentive design feature attributes possibly promoting these novel effects were noted. In particular, escalating incentives may offer a practical approach to counteract the sometimes-cited "habituation" effect of incentive intervention.

Although much research is still needed to determine for whom financial incentives are most appropriate, the literature suggests that physically inactive adults should be initial intervention targets. Not only may inactive adults be more likely to increase the amount of exercise they do in the presence of an incentive contingency, but they may be more likely to sustain their exercise after the incentive is removed.[16] Similarly, interventionists should be weary of incentivizing current exercisers given the potential to harm intrinsic motivation and decrease post-intervention exercise.[40] Clearly, more research is required to elucidate the conditions under which financial incentives both stimulate *and* sustain exercise.

Future Research

Randomized controlled trials in the "lifestyle" health behavior change arena (e.g., exercise, smoking) should prioritize evaluation in the critical post-incentive period, including tracking the psychological variables known to mediate sustained incentive effectiveness (e.g., self-determined motivation, self-efficacy). In addition to deploying behavioral economics *and* SDT (to stimulate exercise *without eroding intrinsic motivation*), the follow-up periods for these studies should be long enough to detect behavioral decay. Studies should also assess how theoretically promising design feature attributes affect longer-term incentive program engagement, including indexed, escalating, and random (versus uniform) incentive distribution patterns; random (versus set) assessment/reward intervals (e.g., frequent and regular initially, infrequent and irregular as time passes); combination individual/group (versus individual-only) contingencies; and incentives for incremental change (e.g., to promote early success, increase self-efficacy) as well as for self-regulatory behaviors (i.e., behavioral "stepping stones").

Of interest to governments and corporations is the minimum incentive amount required to elicit meaningful change for various behaviors and/or outcomes and for various subpopulations. The potential for novel feature attributes to drive the minimum threshold down, such as reimbursement-type incentives (e.g., gym, public transit reimbursements);[3] desirable voucher incentives (e.g., from a range of participant-driven options);[41] and reset (rather than aggregative) incentives should be explored. Advances in mobile health (mHealth) technology, coupled with the pervasiveness of mobile phones in general, may also be leveraged to more promptly assess and reward behaviors on a population scale, further reducing the need for prohibitively costly incentives. Learning more about how incentive design features can be manipulated for various subpopulations (e.g., by matching feature attributes to individual/group characteristics) may increase intervention effectiveness while lowering intervention costs as well.

Limitations

The search strategy was limited to English-only studies, so language bias might be present. Additionally, there is potential for publication bias given the reliance on searching electronic databases, which may miss relevant gray literature. Attempts to minimize such bias were made by hand-searching of reference sections of relevant articles, as well as by engaging international experts to provide feedback on the included studies. Given their greater potential for selection bias, all nonrandomized studies were excluded, and this did limit the number of studies included in the review.

Conclusion

Collectively, the included studies highlight the potential role of even modest financial incentives in promoting exercise initiation and maintenance in adults. More research is warranted that explores the conditions under which financial incentives are likely to drive long-term, post-incentive exercise adherence. Careful attention should be paid to the incentive design features highlighted in this review. In particular, characteristics of target groups (e.g., income level, baseline activity levels) must be considered. Broader theoretic considerations regarding how rewards motivate human behavior may help to address concerns regarding the potential for poor post-incentive exercise adherence.

The authors acknowledge the contributions of Jason Lacombe to the article search and selection component of this review as well as of Dr. Walter Swardfager to the design, delivery, and interpretation of the meta-analysis. The authors also acknowledge funding from the following sources: University of Toronto Faculty of Kinesiology and Physical Education and Faculty of Medicine, Government of Ontario, Ontario Centres of Excellence (member of the Ontario Network of Excellence), Cookson James Loyalty Inc., founder of BestLifeRewarded®, and Canadian Institutes of Health Research.

Marc Mitchell is supported by the University of Toronto, Faculty of Kinesiology and Physical Education and Faculty of Medicine, the Government of Ontario, the Ontario Centres of Excellence (member of the Ontario Network of Excellence), Cookson James Loyalty Inc., and the Canadian Institutes of Health Research. He is also affiliated with the Toronto Rehabilitation Institute. Cookson James Loyalty Inc., the private sector funding partner, did not influence the design, collection, or interpretation of the data presented. In addition, the authors have no fiduciary interest in the company.

No other financial disclosures were reported by the authors of this paper.

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Appendix

Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.amepre.2013.06.017.