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Combined incentives versus no-incentive exercise programs on objectively measured physical activity and health-related variables

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HIGHLIGHTS

- A worksite exercise program improved body composition and push-ups
- A worksite exercise program revealed participants engaged in recommended physical activity
- Combined reinforcements did not improve health-related variables or physical activity

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ABSTRACT

Incentivized exercise program interventions have recently led to mixed findings with regard to increasing physical activity, attendance, and improving healthy lifestyles. However, in this area limited research exists on implementing a combined negative reinforcement strategy, using a "buy-in" and positive reinforcement system.
Purpose: To determine the effect of comparing a non-incentivized reward system with an incentivized reward system using combined positive and negative rewards on physical activity, attendance, and health and performance outcomes.
Methods: 15 Previously sedentary faculty and staff of a large public research university participated in two separate 12-week exercise interventions and wore a program accelerometer throughout the entire day during the 12 weeks. During the first intervention, there were no incentives offered to participants. The second intervention consisted of an incentivized program. Positive reinforcements included various rewards for meeting achievements related to physical activity levels. A program rebate worth $25 for achieving 450 miles was used as the negative reinforcement "buy-in" incentive.
Results: A two-way repeated measures ANOVA demonstrated a main effect of time for percent body fat ($p < 0.001$) and push-ups ($p = 0.018$). All other variables revealed no differences between conditions or from pre to post testing. There was no difference between conditions with physical activity or attendance.
Conclusion: No differences in physical activity or health-related variables were found within the incentivized and non-incentivized conditions.

1. Introduction

A large body of research has recently emerged regarding the lack of physical activity among varied populations [2,14,39,47,56]. This is of great concern since the benefits of exercise and physical activity are well documented [15,28,36,54,58]. Physical inactivity leads to a variety of diseases, including cardiovascular disease and type 2 diabetes [33,35]. Physical inactivity also places a large burden on healthcare systems [41,46]. Thus, it is important to focus on research related to increasing physical activity and health among inactive individuals.

The lack of participation in physical activity may also be due to a number of psychological factors which may influence the individual's motivation to exercise. The use of operant conditioning [52] by way of social influence [12], and behavioral economics techniques [16,27,38,51,52,60] have been utilized to incentivize individuals into performing more physical activity and improving health. An incentive is used as an extrinsic motivator and external regulator to change the behavior of individuals. This incentive is used to help reinforce positive behavior, searches to motivate individuals to perform a behavior more frequently, and make improvements [52]. Many investigations have used monetary incentives as a positive reinforcement, extrinsic motivation reward system to increase physical activity amounts and improve health-related variables [20,21,26,29,44,50,60]. This method has been used in a variety

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Table 1
* Denotes a main effect of time for body fat ($p < 0.001$) and push-ups ($p = 0.018$).

Variable	No incentives		Combined incentives	
	Pre	Post	Pre	Post
Body weight	84.5 ± 16.5	83.2 ± 15.2	83.6 ± 14.8	83.1 ± 13.9
Body fat percent	31.5 ± 6.5	*27.8 ± 6.7	30.4 ± 6.3	*27 ± 6.2
RHR	69.1 ± 12.2	71.3 ± 9.2	70.5 ± 6.4	68.9 ± 9
SBP	127.1 ± 12.2	127 ± 9.7	125.1 ± 8.8	123.9 ± 7.7
DBP	74.2 ± 8	73.2 ± 9.7	76.9 ± 9.9	76 ± 7.3
Push-ups	26.5 ± 12.1	*30.3 ± 12	18.7 ± 9.3	*24 ± 8
Partial curl-ups	44.7 ± 15	38.1 ± 16.7	52 ± 16.6	48.9 ± 22.9
Sit-and-reach	29.6 ± 13	27.1 ± 12.1	31.4 ± 10	32.6 ± 10.5

of ways in many exercise behavior investigations as a way to increase physical activity [16,44,26].

Furthermore, one form of operant conditioning is negative reinforcement, which involves an individual receiving punishment if he/she does not succeed in the guidelines of the behavior warranted [52]. A negative reinforcement "buy-in" deposit contract system, in which participants pay a fee to enroll, provides the opportunity to earn money back for meeting exercise goals and may even improve exercise behavior [10,20,50]. The evidence regarding this healthy behavior strategy is varied, with some studies showing the deposit to be more beneficial than the control groups and others finding no difference between groups [10]. Thus, it is unknown in specific populations, whether or not the deposit contracts may work to improve healthy behavior.

Combinations of incentives, using both positive and negative reinforcements, have been shown to be more effective than no-incentives to promote weight loss [29,57] and physical activity [21]. However, when a variety of lifestyle changes are measured, the combination of incentives provides no further benefit compared with control groups [22]. There may be a need for future research which assesses combined incentives in measuring physical activity and health-related variables.

Kuroda [34] concluded that an individual stuck in the action stage of the transtheoretical model may need multidimensional motivation to reach the maintenance stage of exercise. Although incentives have been found to effectively motivate health and physical activity behaviors, there is a gap in the literature concerning lasting consistency related to behavior change as a result of implemented strategies via a long-term intervention with the use of incentives (earning rewards) for achieving specified amounts of physical activity [45]. To our knowledge, there has not been a comparison of offering no incentives with offering a combination of a positive gift reward system and a negative reinforcement deposit contract when measuring a variety of variables such as physical activity, attendance, and the change of health-related responses. Thus, the purpose of this study is to quantify the difference of physical activity, attendance, and other health-related variables of a 12-week non-incentivized exercise program to a 12-week incentivized exercise program with combined positive and negative reinforcement opportunities among previously sedentary adults in a University setting. Our hypothesis is that the 12-week incentivized (positive and negative reinforcement) program will elicit greater attendance, physical activity, and improvements in the health-related variables compared to the non-incentivized program.

2. Methods

Prior to enrolling in the program, all participants submitted standardized Physician's Consent, Health History Questionnaire, Informed Consents, and Exercise Questionnaire to participate in the exercise classes. This study was approved by the Institutional Review Board.

Fifteen self-reported previously sedentary (<150 min/week of moderate exercise) adults participated in two separate interventions, each lasting 12 weeks. Participants met with a group exercise staff three times per week for 60 min. At each session, participants self-selected into one of four exercise classes: boot camp, weight training, circuit training, or cardio dance. The classes included a five minute warm-up and five minute cool-down. All classes were led by one or two members of the research staff who were trained in the specific area of exercise. The boot camp class used exercise equipment with a high intensity approach in providing drills and circuits to participants. Weight training incorporated stationary exercises using dumbbells and body weight. The circuit training class consisted of classic circuit training using machines, free weights, and cardio machines. The cardio dance class involved following the instructor in moving to the beat of the music. Pre- and post-testing measures were collected before and after both 12-week interventions. The variables collected were body weight, body fat percentage, blood pressure, resting heart rate, push-ups, curl-ups, sit-and-reach, attendance, and physical activity, expressed as miles.

2.1. Participants

15 Previously sedentary faculty and staff (n = 2 males and 13 females), age 48.7 ± 1 participated in both of the two 12-week interventions. Table 1 depicts the information of the participants.

2.2. Equipment and techniques

To objectively measure physical activity throughout both 12-week periods, participants wore an accelerometer called the Movband (Movable technology, Cleveland OH). This device has been validated as a reliable accelerometer [6]. Investigators constantly encouraged participants to wear the Movband as much as possible throughout each day during the 12-week interventions. Physical activity was recorded as moves and a built-in algorithm was used to convert the movement data from moves to miles, which is more widely understood. The criterion for this study includes wearing the Movband for at least 10 h per day. At the end of each week, the participants were asked to record on a questionnaire how often they wore their Movband on each day of the week. If participants did not wear the Movband for at least 10 h per day they were excluded from this study [13,56].

Body fat percentage is the relative amount of fat to lean body tissue on the body. This was measured with the Lange skinfold calipers using the 3-site measurement [43]. The Brozek equation was used to quantify each participant's percentage [24].

Blood pressure was assessed using Prestige Sphygmomanometer and stethoscope (Prestige Medical, Northridge CA). Two measurements with at least a 60-second rest period were used to assess blood pressure, with systolic and diastolic blood pressures of both readings needing to be within 5 mmHg in order for the variable to be recorded [32].

Heart rate was assessed by a trained investigator using the 60 s palpitation method along the radial artery [3]. The average of two measurements was recorded.

The maximal number of push-ups to failure was recorded according to the ACSM guidelines, (2010). Males were instructed to complete the test from their toes while females were to perform the push-ups from their knees. All participants were instructed to maintain a straight line from the shoulders through the hips to either the knees or toes. The Research staff supervised the test and commented on incorrect form. If the participant was not able to make the instructed correction, the test was ended. Participants will complete as many push-ups as possible without pausing. A completed push-up counted if the arms are bent to 90° in the down position and extended fully in the starting position. Participants were instructed to keep a steady pace for the duration of the test. Any pause or break in form is not acceptable. If the corrections were not made immediately, the test will be ended [11]. The research staff counted the number of repetitions.