finding

Combining a lottery incentive with protection against losing the lottery improves exercise adherence

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Methods & Analysis

Method

Table S1. Exercise Class Participant Comprehension Questionnaire: Loss-protection condition

	(Check the appropriate box)	
	True	False
1. Lottery tickets are handed out to people who attend class on Monday and Tuesday.		
2. If you attend a second class during the week, you will earn a Lottery Protection Ticket.		
3. In order to win the lottery, you must be present when the lottery is played.		
4. If you play the lottery on Lottery Day and pull out a green ball, you win $20.		
5. If you play the lottery on Lottery Day and pull out a red ball, you win $20.		
6. If you pull out a red ball on Lottery Day, you can still win $20 if you have a Lottery Protection Ticket.		

Note. Correct responses are as follows: 1. True. 2. True. 3. False. 4. True. 5. False. 6. True.

Table S2. Exercise Class Participant Understanding Questionnaire: Control condition

	(Check the appropriate box)	
	True	False
1. Lottery tickets are handed out to people who attend class on Monday and Tuesday.		
2. If you attend a second class during the week, you will earn a $2 voucher ticket.		
3. In order to win the lottery, you must you present when the lottery is played.		
4. There is no reward for showing up at the exercise class on Wednesday or Thursday.		
5. If you play the lottery on Lottery Day and pull out a green ball, you win $20.		
6. If you play the lottery on Lottery Day and pull out a red ball, you win $20.		
7. You do not get a lottery ticket for showing up on Wednesday or Thursday.		

Note. Correct responses are as follows: 1. True. 2. True. 3. False. 4. False. 5. True. 6. False. 7. True.

Experimental Design & Randomization

Consenting patients were randomized at the time of enrollment to one of two study arms: *loss protection* or *control*. Randomization was at the participant level: Individual participants were randomly assigned to one of nine classrooms in total, five loss protection and four control. Masking was not possible due to the intervention design. We used the generalized Freedman's urn model for rolling randomization (Wei & Lachin, 1988). Participants were randomized using adaptive randomization to ensure balanced allocation. Classrooms then served as independent observations (clusters) in our analysis. Enrollment of 70 participants per arm in five independent classrooms, each offering 24 classes over 12 weeks, confers a priori power of more than 0.80 to detect a 15% difference between groups, assuming a Type I error rate of 5% and intracluster correlation of 0.10. No post-experimental data were obtained due to an end in program funding. The Institutional Review Board at the University of Southern California approved all study procedures (HS-11-00478), and the study was registered with ClinicalTrials.gov (NCT01823458) prior to study commencement. All participants were referred by their physicians to the exercise classes.

Statistical Analyses

We tested for differences in exercise class attendance between the two study conditions using a two-level hierarchical mixed effects logistic regression model on chance of attendance, which controlled for study week and day of week. This model accounted for repeated measures and random effects of individual participants nested in classrooms. Differences in attendance rates and 95% confidence intervals for exercise class attendance were estimated. All analyses were conducted using the Stata 15 statistical software package. In secondary analyses, we estimate the impact of the intervention on program attrition, comparing monetary value of participation for each week in the program. To ensure the results were not driven by a particular model specification, we also conducted an analysis on the proportion of participant-days of exercise class attendance. For this, we used a linear model specification with clustered standard errors. We evaluated the validity of second model using Q-Q plots to identify if there was skewness in the dependent variable. The aforementioned statistical analyses were masked. After these tests were conducted, the robustness of the result was evaluated with randomization inference to calculate *p* values. We used the "ritest" command in Stata 15 to conduct randomization inference.

Results

Figure 1. CONSORT diagram

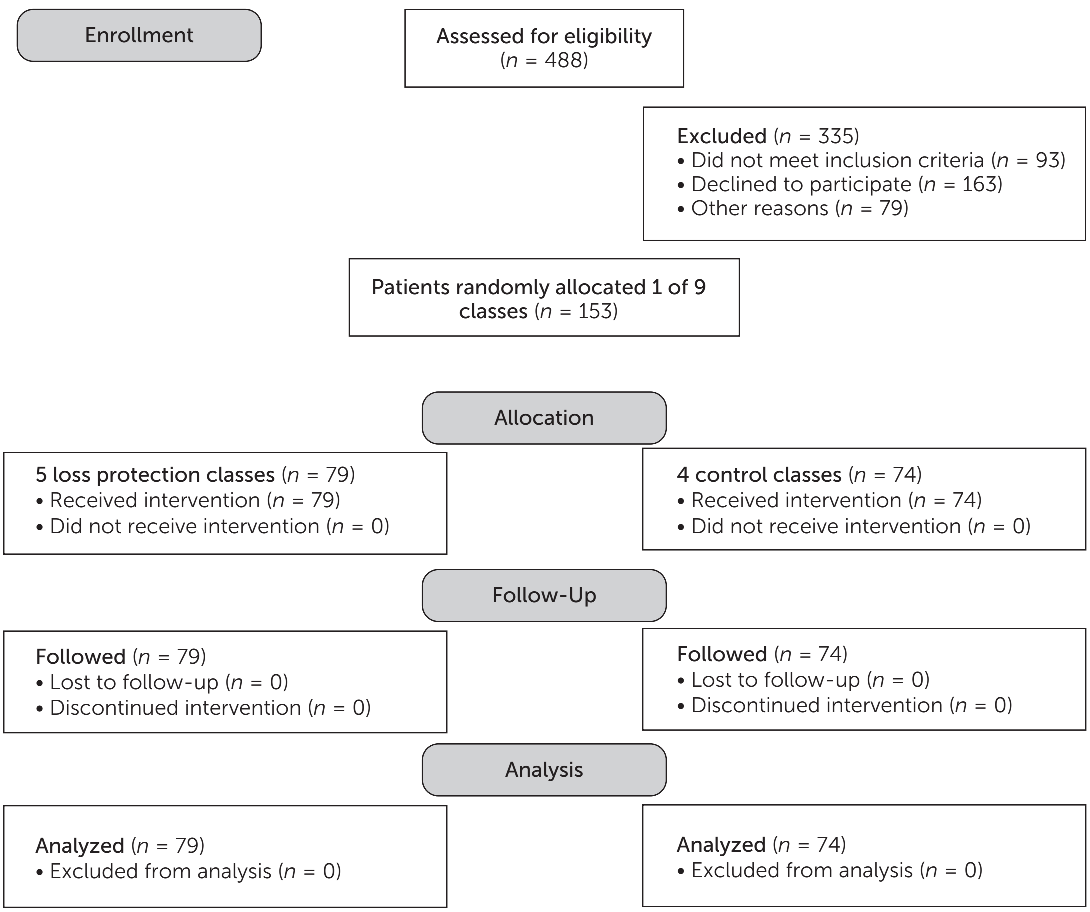


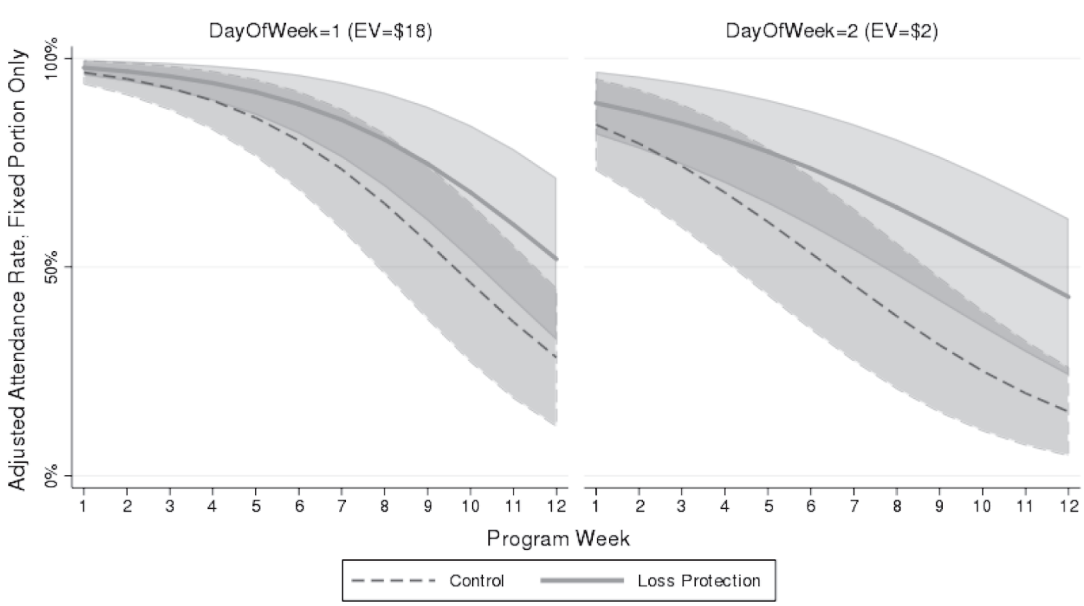
Table S3. Adjusted & unadjusted proportions of exercise sessions attended by study arm & day

Variable	Unadjusted			Mixed effects logit			Linear regression		
	M	*SD*	*p*	*M*	*SE*	*p*[a]	*M*	*SE*	*p*[a]
Overall attendance									
Proportion treatment	0.65	0.47		0.75	0.04		0.65	0.65	
Proportion control	0.55	0.49		0.59	0.06		0.55	0.01	
Difference	0.10	0.02	<.001	0.16	0.05	.0485	0.10	0.04	.0659
First day attendance									
First day treatment	0.69	0.46		0.81	0.03		0.70	0.02	
First day control	0.60	0.49		0.68	0.04		0.60	0.01	
Difference	0.08	0.02	<.001	0.13	0.05	.0693	0.09	0.02	.0929
Second day attendance									
Second day treatment	0.60	0.49		0.69	0.04		0.60	0.40	
Second day control	0.50	0.50		0.50	0.04		0.49	0.02	
Difference	0.10	0.02	<.001	0.19	0.05	.0415	0.11	0.04	.0586

Note. The table reports the effects of the intervention overall and by day of incentive for each session. The incentives differ between the first and second day of each week. In brief, two exercise sessions are offered each week. On the first day, exercisers earn $20 toward a lottery played the next week. Before the exercise session, a low-risk lottery is held. All participants have a 10% chance of losing $20 and a 90% chance of keeping $20. On the second day, exercisers in the loss-protection group guarantee they will not lose $20 in the subsequent week; exercisers in the control group obtain a fixed payment of same expected value ($2). Regressions estimate interactions of day of week with treatment. We used a mixed logit with binary attendance indicator for each of the 3,655 exercise sessions as the dependent variable and random effects for participants nested within classes. Linear regression collapsed observations across all possible sessions, using 153 participants as the unit of observation and dependent variable of mean attendance rate across all sessions for each participant.

[a]The *p* value for group differences was calculated using randomization inference with 10,000 permutations of linear combination of regression coefficients corresponding to each comparison. Unadjusted analysis uses *t* tests for group differences.

Figure 2. Attendance rates separated by day of week



Note. The expected value for the first day of week is $18. The second day of the week is a fixed payment of $2 (control group) or the loss-protection voucher (intervention group). Expected value of Day 2 is $0 for participants in the loss-protection arm who do not attend the first day.

We conducted a linear analysis as another way to analyze the data. Results under a linear model specification with clustered errors on proportion of participant-days show similar though attenuated results. However, there is a systematic change in the spread of the residuals over the range of measured values (rates) with the linear model (see Figure S3). Because linear regression assumes constant variance, the linear analysis may lack validity.

reference

Wei, L. J., & Lachin, J. M. (1988). Properties of the urn randomization in clinical trials. *Controlled Clinical Trials*, *9*(4), 345–364. https://doi.org/10.1016/0197-2456(88)90048-7

Figure 3. Quantile–quantile plot of attendance rate used in linear model