Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eMethods Additional Methods

We excluded patients who had lost 4.5 kg or more in the previous six months, completed an intensive weight management program in the previous six months, undergone a weight loss surgery or procedure in the previous two years, or had medical conditions that could make weight loss unsafe (e.g., pregnant or metastatic cancer). A full list of exclusion criteria is available in the protocol, along with a detailed description of recruitment methods and study design.

Participants randomized to receive outcome-based incentives could earn up to $750 over six months for weight loss, as confirmed at monthly check-in visits. At one month, they received $50 if they lost ≥1.5% to <2.5% or $100 if they lost ≥2.5% of baseline weight. The weight loss outcomes at one month were more modest to discourage overly rapid weight loss. At two and three months, they received $50 per month if they lost ≥2.5% to <5% or $100 if they lost ≥5% of baseline weight. At four, five, and six months, they received $100 per month if they lost ≥2.5% to <5% or $150 if they lost ≥5% of baseline weight.

The effect of incentives was enhanced by (1) incorporating the behavioral economics concept of *immediacy* (payments provided as soon as possible), so that participants could more readily associate a payment with the behavior that triggered it, and by (2) providing feedback to participants using *regret aversion* (avoidance of regret from losing an anticipated reward), in which we communicated the amount they would have earned had they met a goal or outcome. The communication strategy of regret aversion anticipates that participants will, on average, be motivated to meet their goals or outcomes so as to avoid the regret associated with losing an anticipated reward.

We also leveraged the behavioral science construct of *emergency reserves* (building "slack" into goals for use as needed) for all participants by communicating to patients that they had two emergency "skip days" per week for self-monitoring. Goals with emergency reserves are perceived as more attainable and lead to increased goal persistence. In addition, because incentives are more likely to be effective when patients understand the actions that trigger them, we communicated behavioral goals and weight loss targets both verbally and in writing, and then asked for the participant's understanding using the teach-back method. Payments were made within 48 hours of goal verification via a secure prepaid debit card system (ClinCard by Greenphire).

All three study groups were assigned identical follow-up visit schedules (monthly check-in visits in the first six months) in order to limit potential confounding attributable to different intensities of human interaction. However, the provision of feedback specifically related to incentives was limited to the financial incentive groups.

Because of the structure of the interventions, it was not possible to blind study participants or research staff from the randomization assignment.

At each in-person visit, weight was measured in pounds using a calibrated digital scale after the participant removed heavy garments and shoes. Height was measured once at the baseline visit.

Waist circumference and blood pressure were also measured. Weight loss program attendance was verified via the program's paper or electronic attendance record. Adherence to self-monitoring of diet and weight was verified via participants' paper or app-based logs. Physical activity goal adherence was verified using weekly active minute counts in the Fitbit app. Intrinsic motivation for weight management and self-monitoring were assessed using a modified Treatment Self-Regulation Questionnaire (TSRQ). Financial well-being was assessed using the Consumer Financial Protection Bureau (CFPB) Financial Well-being Scale.

We monitored for adverse events by asking the participants at 3,6,9, and12 month visits to self report any discomfort, in-patient hospitalizations, emergency department visits, surgeries, life-threatening experiences, suicidal attempts or ideation, or new disabilities. We also surveyed patients about potentially dangerous weight management behaviors (i.e., binge eating, purging, skipping meals, laxative use, and excessive exercise).

Baseline and follow-up data were collected by telephone and during in-person visits which occurred monthly through the first six months and then at nine months and 12 months after randomization.

During the Covid-19 pandemic, we modified the protocol to halt recruitment early and permit collection of weight during video visits using the digital scale that patients received at enrollment. When patients had limited video access, we accepted real-time pictures of their digital scale reading. We were unable to collect waist circumference or blood pressure.

We estimated that enrolling 795 patients would provide 80% power to detect a 10-percentage point difference in rates of obtaining a 5% reduction in baseline weight by 6 months between the incentive arms with a two-sided significance level of 0.05 and a 10% loss-to-follow-up rate. More details are available in the protocol. Because of the Covid-19 pandemic, we stopped enrollment earlier than planned.

Two sensitivity analyses were performed for the primary endpoint to address the uncertainty caused by missing data. The first analysis was based on a pattern mixture model where the missing data were multiply imputed assuming no incentive effect with all missing data following the distribution of observed data in the control (resources only) arm. Ten complete data sets were generated with multiple imputation, and the final estimates were calculated according to Rubin's rules. The second analysis imputed all missing outcomes as the worst outcome, that 5% reduction in baseline weight was not achieved.

eTable 1. Characteristics of Study Participants, by Having 6-Month Visit Missing or Not

Characteristic	Missing (n=170)	Not Missing (n=498)	Everyone (n=668)	P-value
Mean age, yr (SD)	45.45 (12.43)	48.46 (12.35)	47.69 (12.43)	0.006
Female, n (%)	145 (85.29%)	396 (79.52%)	541 (80.99%)	0.098
Initial weight measures, mean (non-missing n)				
Weight, kg	99.41 (20.79)	98.81 (20.47)	98.96 (20.54)	0.744
BMI	38.02 (6.32)	37.92 (6.63)	37.95 (6.55)	0.861
Waist circumference, cm	112.48 (14.35)	113.60 (14.57)	113.32 (14.51)	0.387
Race/ethnicity, n (%)	170	498	668	0.045
Non-Hispanic White	6 (3.53%)	35 (7.03%)	41 (6.14%)	
Non-Hispanic Black	25 (14.71%)	74 (14.86%)	99 (14.82%)	
Hispanic	134 (78.82%)	351 (70.48%)	485 (72.60%)	
Other	5 (2.94%)	38 (7.63%)	43 (6.44%)	
Spanish-speaking, not proficient in English, n(%)	66 (38.82%)	165 (33.13%)	231 (34.58%)	0.157
Education, n (%)	170	497	667	0.062
High school or less	110 (64.71%)	273 (54.82%)	383 (57.34%)	
Some college	24 (14.12%)	103 (20.68%)	127 (19.01%)	
College graduate	36 (21.18%)	121 (24.30%)	157 (23.50%)	
Median household income of census tract ($)	34,241	34,622	34,622	0.629
Marital status	170	497	667	0.967
Married	64 (37.65%)	188 (37.75%)	252 (37.72%)	
Not married	106 (62.35%)	309 (62.05%)	415 (62.13%)	
Preferences for incentive design	170	498	668	0.549
Goal-directed	99 (58.24%)	303 (60.84%)	402 (60.18%)	
Outcome based	71 (41.76%)	195 (39.16%)	266 (39.82%)	
Health insurance	170	498	668	0.005
Private	12 (7.06%)	41 (8.23%)	53 (7.93%)	
Medicare	15 (8.82%)	47 (9.44%)	62 (9.28%)	
Medicaid	85 (50%)	309 (62.05%)	394 (58.98%)	
Other	19 (11.18%)	42 (8.43%)	61 (9.13%)	

Uninsured/Unknown	39 (22.94%)	59 (11.85%)	98 (14.67%)	
Intrinsic Motivation, mean (SD)				
Intrinsic motivation for weight loss TSRQ score, mean	3.19 (0.77)	3.17 (0.79)	3.17 (0.78)	0.704
Intrinsic motivation for monitoring diet and activity TSRQ score, mean	1.54 (1.46)	1.42 (1.52)	1.45 (1.51)	0.371
Financial well-being score, mean (SD)	58.23 (9.84)	58.66 (10.26)	58.55 (10.15)	0.635

Table Notes

* All percentages out of total n, including missing values
* Considered missing at 6-month if no weight measured at 6-month visit.

eTable 2. Subgroup Analysis at 6-Months and 12-Months, Adjusted Values with Model Estimation in R

	Before COVID			After COVID			Before vs. After COVID		
Proportion at least 5% below Baseline Weight (Including both Physical Visit and Self Measurements)	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value
6 Months									
Resources-only vs. Goal-Directed	13.62%	(4.20, 23.04)	0.005	30.45%	(13.61, 47.28)	<0.001	16.83%	(-0.96, 34.62)	0.064
Resources-only vs. Outcome-Based	25.26%	(15.78, 34.75)	<0.001	34.58%	(17.59, 51.58)	<0.001	9.32%	(-8.66, 27.30)	0.310
Goal-Directed vs. Outcome-Based	11.65%	(2.16, 21.13)	0.016	4.14%	(-12.10, 20.37)	0.618	-7.51%	(-24.79, 9.77)	0.394
12 Months									
Resources-only vs. Goal-Directed	16.25%	(4.40, 28.10)	0.007	3.80%	(-9.25, 16.86)	0.568	-12.45%	(-28.26, 3.37)	0.123
Resources-only vs. Outcome-Based	13.95%	(2.10, 25.80)	0.021	5.63%	(-7.78, 19.04)	0.410	-8.32%	(-24.43, 7.80)	0.312
Goal-Directed vs. Outcome-Based	-2.30%	(-14.43, 9.83)	0.710	1.83%	(-11.88, 15.55)	0.794	4.13%	(-12.44, 20.70)	0.625
	Male			**Female**			**Male vs Female**		
Proportion at least 5% below Baseline Weight (Including both Physical Visit and Self Measurements)	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value
6 Months									
Resources-only vs. Goal-Directed	18.66%	(-1.66, 38.98)	0.072	16.63%	(6.75, 26.51)	<0.001	-2.04%	(-24.64, 20.57)	0.860
Resources-only vs. Outcome-Based	22.76%	(3.91, 41.51)	0.018	28.05%	(17.97, 38.13)	<0.001	5.29%	(-16.09, 26.68)	0.628
Goal-Directed vs. Outcome-Based	4.09%	(-17.30, 25.48)	0.708	11.42%	(1.76, 21.09)	0.021	7.33%	(-16.14, 30.80)	0.540
12 Months									
Resources-only vs. Goal-Directed	18.41%	(-2.77, 39.58)	0.089	8.12%	(-2.80, 19.03)	0.145	-10.29%	(-34.13, 13.54)	0.397
Resources-only vs. Outcome-Based	18.91%	(-2.41, 40.23)	0.082	7.50%	(-3.50, 18.49)	0.182	-11.42%	(-35.42, 12.58)	0.351
Goal-Directed vs. Outcome-Based	0.50%	(-23.20, 24.21)	0.967	-0.62%	(-11.51, 10.27)	0.911	-1.13%	(-27.21, 24.96)	0.933

Proportion at least 5% below Baseline Weight (Including both Physical Visit and Self Measurements)	Non-Hispanic White			Non-Hispanic Black			Hispanic		
	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value
6 Months									
Resources-only vs. Goal-Directed	1.30%	(-34.04, 36.63)	0.943	-6.94%	(-30.27, 16.39)	0.560	23.52%	(13.09, 33.96)	<0.001
Resources-only vs. Outcome-Based	9.23%	(-24.27, 42.73)	0.589	5.29%	(-19.83, 30.42)	0.680	31.62%	(21.17, 42.06)	<0.001
Goal-Directed vs. Outcome-Based	7.93%	(-25.54, 41.40)	0.642	12.24%	(-9.61, 34.08)	0.272	8.10%	(-2.35, 18.55)	0.129
12 Months									
Resources-only vs. Goal-Directed	14.35%	(-23.78, 52.49)	0.461	-8.13%	(-33.87, 17.61)	0.536	13.71%	(2.23, 25.19)	0.019
Resources-only vs. Outcome-Based	22.17%	(-13.92, 58.25)	0.229	-10.33	(-37.88, 17.21)	0.462	11.47%	(0.03, 22.91)	0.050
Goal-Directed vs. Outcome-Based	7.81%	(-3.10, 46.61)	0.693	-2.20%	(-25.88, 21.47)	0.855	-2.24%	(-14.03, 9.54)	0.709

Proportion at least 5% below Baseline Weight (Including both Physical Visit and Self Measurements)	Other Race		
	Mean Difference	95% CI	p-value
6 Months			
Resources-only vs. Goal-Directed	28.15%	(-6.29, 62.59)	0.109
Resources-only vs. Outcome-Based	36.96%	(6.33, 67.59)	0.018
Goal-Directed vs. Outcome-Based	8.81%	(-28.46, 46.07)	0.643
12 Months			
Resources-only vs. Goal-Directed	24.02%	(-13.17, 6.12)	0.206
Resources-only vs. Outcome-Based	23.31%	(-12.77, 59.39)	0.205
Goal-Directed vs. Outcome-Based	-0.71%	(-43.90, 42.48)	0.974

Proportion at least 5% below Baseline Weight (Including both Physical Visit and Self Measurements)	White vs. Hispanic			Black vs. Hispanic			Other Race vs. Hispanic		
	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value	Mean Difference	95% CI	p-value
6 Months									

Resources-only vs. Goal-Directed	-22.23%	(-59.07, 14.62)	0.237	-30.46%	(-56.02, -4.91)	0.020	4.63%	(-31.35, 40.62)	0.801
Resources-only vs. Outcome-Based	-22.39%	(-57.49, 12.70)	0.211	-26.33%	(-53.54, 0.89)	0.058	5.34%	(-27.03, 37.71)	0.746
Goal-Directed vs. Outcome-Based	-0.17%	(-35.23, 34.90)	0.993	4.14%	(-20.08, 28.36)	0.738	0.71%	(-37.99, 39.41)	0.971
12 Months									
Resources-only vs. Goal-Directed	0.64%	(-39.19, 40.47)	0.975	-21.84%	(-50.02, 6.34)	0.129	10.31%	(-28.62, 49.24)	0.604
Resources-only vs. Outcome-Based	10.70%	(-27.16, 48.55)	0.580	-21.80%	(-51.63, 8.03)	0.152	11.84%	(-26.01, 49.69)	0.540
Goal-Directed vs. Outcome-Based	10.06%	(-30.49, 50.61)	0.627	0.04%	(-26.41, 26.49)	0.998	1.53%	(-43.24, 46.30)	0.947

Table Notes

* Visits on or after 03/07/2020 for NY sites and 03/16/2020 for LA site considered as After COVID

eTable 3. Sensitivity Analysis to Address Uncertainty Caused by Missing Data

	Resources-only		Goal-directed		Outcome-based		P-Value		
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Goal-directed vs. Resources-only	Outcome-based vs. Resources-only	Goal-directed vs. Outcome-based
Worst Outcome Model: Proportion at least 5% below Baseline Weight with Missing as "No", Adjusted Values									
6 mo	16.34	(11.23, 21.46)	29.73	(24.63, 34.83)	36.39	(31.32, 41.46)	< 0.001	< 0.001	0.069
12 mo	19.51	(14.40, 24.62)	23.42	(18.32, 28.52)	19.95	(14.88, 25.01)	.288	0.905	0.343
Pattern Mixture Model: Proportion at least 5% below Baseline Weight with Multiple Imputation, Adjusted									
6 mo	18.73	(13.03, 24.41)	33.92	(28.36, 39.47)	40.31	(34.45, 46.17)	< 0.001	< 0.001	0.114
12 mo	27.88	(20.99, 34.76)	36.08	(28.29, 43.87)	37.16	(30.27, 44.04)	0.064	0.042	0.811