Return on Investment: Medical Savings of an Employer-Sponsored Digital Intensive Lifestyle Intervention for Weight Loss

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Objective: This study aimed to determine the medical cost impact and return on investment (ROI) of a large, commercial, digital, weight-management intensive lifestyle intervention (ILI) program (Real Appeal).
Methods: Participants in this program were compared with a control group matched by age, sex, geographic region, health risk, baseline medical costs, and chronic conditions. Medical costs were defined as the total amount paid for all medical expenses, inclusive of both the insurers' and the study participants' responsibility.
Results: In the 3 years following program registration, the intent-to-treat (ITT) cohort had significantly lower medical expenditures than the matched controls, with an average of −$771 or 12% lower costs ($P = 0.002$). Among 4,790 ITT participants, a total savings of $3,693,090 compared with total program costs of $1,639,961 translated into a 2.3:1 ROI. Program completers ($n = 3,990$), who attended more sessions than the overall ITT group, had greater mean weight loss (−4.4%), greater cost savings (−$956 or 14%), and an ROI of 2.0:1 over the 3-year time frame compared with matched controls.
Conclusions: The findings demonstrated that the digital weight-management ILI was associated with a significantly positive ROI. Employers and payers willing to cover the cost of an ILI that produces both weight loss and demonstrated cost benefits can improve health and save money for their population with overweight or obesity.

Study Importance

What is already known?

► Participation in an employer-offered benefit (called the Real Appeal weight-management intensive lifestyle intervention [ILI]) provided to >38,000 individuals was associated with significant weight loss, and greater participation was associated with greater weight loss.

► Models of the cost benefit of employer-funded weight management have predicted reduction in medical costs, but no real-world studies have demonstrated a return on investment (ROI).

What does this study add?

► On an intention-to-treat basis, compared with 4,790 propensity-matched controls, 4,790 individuals participating in this program had:
  ◦ 3% greater weight loss on average,
  ◦ 12% lower medical costs (−$771 per individual) over 3 years,
  ◦ representing 2.3:1 ROI over a 3-year time frame.

How might these results change the direction of research or the focus of clinical practice?

► All commercially offered, employer-delivered ILIs should study and report on ROI with real-world medical cost analysis.

► When health benefits and medical cost savings have been demonstrated by commercial ILI programs, employers and insurers should consider offering these programs to individuals with overweight or obesity.

Introduction

In 2018, the Centers for Disease Control and Prevention (CDC) determined that the prevalence of adult obesity (defined as BMI ≥ 30 kg/m^2) among US adults, adjusted for age, was 42.4%. For severe obesity (BMI ≥ 40 kg/m^2), the rate was 9.2% (1). These figures represent a dramatic rise in less than two decades. The 2000 CDC survey reported that 30.5% met criteria for obesity and 4.7% met criteria for severe obesity. For US employers, this means an employee base with a high likelihood of serious health issues because the link between obesity and the risk of developing diabetes, cardiovascular diseases, cancer, and many other diseases is strong (2).

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Unhealthy employees cost employers. Van Nuys et al. found that as obesity (BMI > 30) increased, health care costs increased exponentially (3).

A strategy for reducing health care costs associated with obesity is reducing body weight safely and effectively, by using, for example, lifestyle-modification programs such as intensive lifestyle interventions (ILIs) and meal-replacement programs (2,4,5). Improvements in glycemia and triglycerides begin at 3% weight loss (6). Modest weight loss of 5% to 10% can produce improvements in glycemia, blood lipids, and blood pressure and reduce the need for medications for control of these chronic diseases (6). Weight loss of 5% to 10% has been shown to improve measures of quality of life and feeling and function (improvement in sexual function, loss of mobility, and symptoms of urinary incontinence) (6). Further, weight loss was shown to reduce hospitalization costs and pharmacy costs in persons with type 2 diabetes (7). Individuals without diabetes incurred lower medical costs than those with diabetes, but increases in BMI were more costly in those with diabetes than in those without (8).

The US ACTION Study, in which 153 employer representatives were asked to comment on the statement "The weight loss of our employees with obesity is partially our responsibility" showed that only 18% agreed, 37% somewhat agreed, and 46% did not agree (9). Among the concerns expressed by representatives of employers in that study were the very high prevalence of obesity and potential impact on medical claims, lack of convincing long-term results, lack of return on investment (ROI) data, and lack of data on potential benefits and risks of treatment (9). With the exception of ROI, all of these issues have been addressed in guidelines from national health care organizations recommending obesity treatment (2,4).

Horstman and colleagues published an earlier study of the first 12 months of experience with an employer-based online weight-management intervention with 69,598 adults (10). Real Appeal is a large-scale online ILI program for overweight and obesity with a 1-year curriculum modeled after recent ILIs such as the Diabetes Prevention Program (11) and Look AHEAD (12). Employers offer the ILI program as an employee benefit with no cost to the employee. Program features include inclusion and exclusion criteria; a combination of virtual group and individual sessions; use of "live" online counseling by human coaches who have been trained and supervised; use of a structured curriculum; employment of structured procedures to enhance adherence; use of digital self-monitoring tools; a formal set of treatment procedures, including manuals, videos, and meal plans and/or recipes; and provision of "tools" for the program (e.g., body weight and food scales). The program is not an incentivized employee-wellness program (10). The study (10) demonstrated that intent-to-treat (ITT) participants (N = 52,461) lost an average of 2.8% of body weight, with 23% achieving 5% weight loss, which is conventionally used to define a minimal clinically meaningful amount of weight loss (13). Active participants (n = 38,836) lost an average of 3.5% of body weight, with 29% achieving 5% weight loss. Program completers (n = 27,164) lost an average of 4.3% of body weight, with 36% of the cohort achieving 5% weight loss. The cohorts were overlapping, meaning that participants in the ITT analysis included both the active participants and program completers, and active participants included completers. This paper demonstrated that online weight-management ILIs can simultaneously reach large numbers of individuals, indicating that the program is scalable, by targeting employee groups and offering services as an employer-sponsored health benefit (10).

In order to overcome resistance to covering the cost of weight-management ILIs, analyzing an ROI equips employers with the ability to evaluate their investment in the programs described herein. This ROI analysis should be performed from the perspective of the payer of the online program (i.e., employers, government programs, insurers, etc.). If one solution to the obesity epidemic is to integrate health care in the clinic with resources in the community that make it easier for people to prevent unhealthy weight gain or lose weight and keep it off, then employers and other stakeholders must play a key role, and ROI is an important metric (14).

The primary aim of the study was to determine whether study participants who participated in the ILI had significantly lower medical expenditures than a matched cohort of study participants who did not participate in the ILI. If a significant reduction in medical costs occurred between the two cohorts, a secondary analysis was used to compare the savings amount with the cost of the program by calculating an ROI for study participants who participated in the ILI.

Methods

Study design

The study was reviewed and exempted by the United Health Group Institutional Review Board (IRB), and the exemption was received on the basis of criteria outlined in Title 45, Part 46.101 of the Code of Federal Regulations. This retrospective, quasiexperimental study focused on calculating the total medical expenditures, inclusive of medical conditions covered under health plan benefits and insurer and study participant responsibility, relative to the cost of the ILI (i.e., the ROI). A difference-in-differences (DID) design compared preintervention and postintervention medical expenditures for participants who enrolled and participated in the program for at least one session with participants who enrolled in the program but did not participate (for even one session).

Sample

Eligible study participants registered for the program between July 2015 and June 2016, were aged 18 to 64, and were continuously enrolled in their health plan at least 1 year prior to the registration date and 3 years following their registration date. People who met the inclusion and exclusion criteria were grouped into two cohorts: participants and nonparticipants. Participants completed the registration process, enrolled, qualified for the program, and attended at least one session. Nonparticipants were those who completed the registration process but did not enroll in the program and therefore did not attend any sessions. Participants were further segmented into overlapping cohorts on the basis of the minimum number of sessions attended using standards established by the CDC Diabetes Prevention Recognition Program when comparing outcomes (15). Standard definitions employed by the CDC Diabetes Prevention Recognition Program include "active" participant, a person who attended a minimum of four sessions, and program "completer," a participant who attended nine or more sessions.

During the registration process, the program obtained informed consent, allowing access to program, diagnostic, health care use, and cost data. Therefore, study participants were limited to people who registered for the program. Health plan data were essential to the study design; study participants were limited to registrants with 4 years of continuous enrollment in their health plan. In order to objectively compare medical

expenditures between participants and nonparticipants during the year prior to registering for the program with the 3 years following registration, exclusion criteria were applied to all participants and nonparticipants. Exclusion criteria were based on medical conditions affecting weight loss or gain and chronic or terminal conditions requiring costly treatment. Excluded from the study were study participants who had been given a diagnosis of or treated for any of the following conditions: dementia and organic brain disorders; HIV; inflammatory or degenerative central nervous system disease; congestive heart failure, schizophrenia, or end-stage renal disease; hemophilia; transplants; hospice care; cancer; pregnancy and birth; congenital disorders; bariatric surgery; and high-cost claimants who had medical expenditures greater than $100,000 in a calendar year or a $50,000 difference from the prior year. Study participants with missing demographic data were excluded from the study.

Data collection

Health plan data were used to identify enrollment dates, health-risk scores, diagnoses and procedures, and site of medical care and to obtain medical expenditures for both inpatient and outpatient medical care. Program data were used to collect demographic information about the participants, the number of sessions attended, and self-reported weight. Total weight loss was calculated by subtracting the last weight recorded from baseline weight in kilograms. Medical costs were defined as the total amount paid for all medical expenses, inclusive of both the insurers' and the study participants' responsibility. Baseline costs were medical expenditures incurred in the 12 months prior to registering for the program, whereas the postintervention period contained the medical costs incurred in the 36 months following registration. Pharmacy costs were excluded because of incomplete pharmacy data in the baseline and follow-up periods for eligible study participants.

Analysis

Propensity score matching. Propensity score matching aims to reduce bias in observational studies in which participants' characteristics may influence treatment selection. The matching process creates a similar distribution of baseline covariates between treatment groups, allowing for the direct comparison of outcomes between treated and untreated participants within the propensity score–matched sample, mimicking a randomized controlled trial (16). The estimated propensity score is the predicted probability of treatment derived from the logistic regression model (16). For every study participant, a propensity score was calculated using a logistic regression model of participant age, sex, geographic region (because of differences in use patterns and cost), health risk, baseline medical costs, and chronic conditions using the Agency for Healthcare Research and Quality Chronic Care Indicator (17). Using a greedy, nearest-neighbor process, participants were matched one-to-one without replacement to nonparticipants by propensity score, sex, age, and diabetes. All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, North Carolina). Statistical analyses were performed to ensure that participants and nonparticipants had similar distributions of baseline covariates after the matching process, a Student's *t* test was used in analyses for continuous variables, and a χ^2 test was used in analyses for categorical variables.

DID

In econometrics, a DID approach compares the average change in medical costs over time in the participant cohort with the average change in medical costs for the nonparticipant cohort group. A DID measurement was used to account for the upward trend in year-over-year medical expenditure. For each matched cohort, a preintervention/postintervention difference was calculated. Costs incurred during the 12-month baseline period were subtracted from costs incurred during the following 36-month period. General linear modeling was used to calculate and compare the mean postintervention cost difference for each matched cohort. The final step in the computation was the DID calculation, which examined the preintervention/postintervention difference in cost between the participants and nonparticipants in each matched cohort. The resulting DID dollar amount was the difference in the medical expenditures between the two cohorts. The total savings was calculated by multiplying the DID dollar amount by the total number of study participants in the relevant cohort (ITT, active, completer).

Program fees and ROI

The program's pay-for-performance model is unique. It required participants to log their weight, attend sessions, and to be on track for 5% weight loss in order for the program to receive reimbursement. For employers, the program's pay-for-performance model meant that not every session the participant attended cost the payer. For the participant cohort covered in this study, payers paid only for sessions attended that represented participants' being on track for 5% weight loss, with a maximum program fee of $695 per participant. Participants were encouraged to log their weight but were not informed about the relationship among weight loss, session attendance, and program costs, thus minimizing the economic motivation for recording inaccurate, self-reported weights. Total program fees were the summed totals charged to payers for participants. Registering for the program was free; thus, employers of nonparticipants did not incur any program fees. The ROI calculation was the total savings divided by the total program fees. Cost savings are attributed to the entity responsible for the payment of medical claims. Pearson correlation statistics were used for correlations.

Results

A total of 14,893 study participants who registered for the program between July 2015 and June 2016 and met the inclusion criteria were eligible for the study; 9,833 were deemed participants, and 5,060 were deemed nonparticipants (Table 1). Participants in this study had baseline characteristics (age, sex, and starting BMI) that were comparable with those of study participants described in a previous analysis of the program (10). Table 2 describes the participant and nonparticipant study populations before matching. Study participants were predominantly female, with all regions represented. As described in Table 2, at baseline, a higher proportion of participants were female ($P<0.0001$), were older ($P<0.0001$), and had higher risk scores ($P<0.0001$) compared with the nonparticipants. Participants had a significantly higher proportion of type 2 diabetes compared with nonparticipants: 54% and 43%, respectively ($P<0.0001$) (Table 2).

The matching process produced cohorts of participants and nonparticipants with similar distributions of baseline covariates, resulting in 4,790 ITT study participants, those who attended at least one session, matched to 4,790 nonparticipants; 4,481 active-cohort participants, those who attended 4 or more sessions, matched to 4,481 nonparticipants; and 3,990 completer-cohort participants, those who attended 9 or more sessions, matched to 3,990 nonparticipants (Table 3).

TABLE 1 Study sample eligibility

	Participants	Nonparticipants
Registered	68,386	30,609
Qualified for the program and attended 1+ session	51,539	NA
Were continuously enrolled for 48 months in their health plan	19,728	10,458
Met inclusion criteria	9,833	5,060

This table summarizes the total number of participants who met some of the key inclusion criteria.
NA, not applicable.

Weight loss increased with participation, defined by total sessions attended. Average weight-loss percentages were 3% for the ITT sample, 3.7% for active participants, and 4.4% for the completer cohort. Furthermore, 37% of program completers achieved at least 5% weight loss. Participation had a strong positive correlation with program costs (r [4,790]=0.68, $P<0.0001$), and program costs were strongly correlated with the percentage of weight loss (r [4,790]=0.56, $P<0.0001$). The percentage of weight loss was moderately correlated with total sessions attended (r [4,790]=0.39, $P<0.0001$).

Mean difference in health care costs for participants and matched controls

When health care costs over 3 years minus costs at the baseline year were calculated, participants in the program had lower average costs for health care. The average differences in costs for 3 years are depicted in Figure 1 for the 4,790 participants who attended at least one session and their matched controls. The costs for the group that attended 4 or more sessions and those that attended 9 or more sessions, along with their matched controls, are shown in Table 4.

Medical cost savings using DID for participants and matched controls

Using general linear modeling, medical costs from a cohort of participants were compared with those incurred by a propensity-matched cohort of nonparticipants. The 3-year savings increased with session attendance (Figure 2). Table 4 presents the average medical expenditures. The ITT cohort ($N=4,790$) had significantly lower average medical expenditures ($771, $P=0.002$) in the 3 years following their program registration, compared with nonparticipants. Participants attending at least four sessions (active participants) realized $847 ($P=0.0006$) in savings, and the completer cohort realized $956 ($P=0.0004$) in savings compared with nonparticipants. The majority of the savings were allocated as outpatient expenditures (Table 4). Outpatient expenditures were 13% lower for the active participants, 12% lower for the completer cohort, and 11% lower for the ITT cohort.

ROI

The total program costs were calculated for each participant cohort: the ITT cohort averaged $342 in program costs compared with $407 for the active participants and $471 for the completers cohort. Nine (0.2%) participants had $0 program costs. As described in Table 5, the ROI was at least 2:1 across all cohorts, with the ITT cohort achieving a higher ROI because of lower total program costs. The savings attributed to the ITT cohort totaled $3,693,090 ($771×4,790) compared with total program costs of $1,639,961, which translated into a 2.3:1 ROI. The active cohort achieved a 2.1:1

ROI ($3,795,407/$1,825,250). The total savings for the completer cohort was $3,814,440, whereas their program expenditures totaled $1,878,528, which corresponded to a 2.0:1 ROI.

Discussion

Given the scope of the epidemic of obesity and the difficulty treating it, massively scalable interventions are necessary to impact the negative effect of obesity on the health of the public. (18) Although the United States Preventive Services Taskforce (USPSTF) has recommended intensive, multicomponent lifestyle intervention for adults with obesity (4), a key barrier to implementation of such programs as part of the health care system, and coverage of that care by employers and insurers, has been the potential cost of delivering such a program when upwards of 40% of the population will qualify on the basis of BMI. Here, we demonstrate with analysis of health care expenditure in the real world that delivery of the Real Appeal ILI can produce an ROI. Participation was associated with a reduction in medical expenditures, potentially benefitting insurers, employers who self-insure, and employees who may experience lower out-of-pocket costs. This program has previously shown that participation was associated with significant weight loss and that greater participation was associated with greater weight loss (10). In this ITT analysis, participation was associated with significantly reduced health care costs and produced an ROI of 2.3:1 over a 3-year time frame. For program completers, who attended more sessions than the overall ITT group, the weight loss and cost savings were greater relative to those of nonparticipants; they had greater weight loss and 14% greater cost savings over the 3-year time frame ($956). The ROI differed slightly across the different cohorts, ranging from 2:1 to 2.3:1; there were small decreases in the ROI associated with higher participation, likely due to greater program costs. As described in Table 2, the average session attendance reported for each of the three cohorts in this study was consistent with the results described in a previous analysis of the program (10).

To our knowledge, this study is the first to conduct an ROI analysis for an employment-based online weight-management program that combined program engagement and outcomes with study participants' medical cost data to measure savings to payers. Two other studies of online weight management have reported health care cost savings and costs of program delivery and reported cost savings relative to costs of program delivery (19,20). These studies used estimated savings derived from simulated mathematical models using outcomes and costs reported from independent studies (21-23). Using mathematical models, the cost savings were simulated for 2 to 10 years. Thus, unlike the current study, these studies were based on simulated outcomes and not on observed, real-world data from the participants in the same study. Sacks et al. used medical cost data

TABLE 2 Baseline characteristics of study sample prior to propensity score matching

	ITT			Active			Completers		
	Participant (N=9,833)	Nonparticipant (N=5,060)	P value	Participant (N=7,415)	Nonparticipant (N=5,060)	P value	Participant (N=5,374)	Nonparticipant (N=5,060)	P value
Sex (female), N (%)	7,415 (75)	3,565 (70)	<0.0001	5,684 (77)	3,565 (70)	<0.0001	4,136 (77)	3,565 (70)	<0.0001
Age, mean (SD)	45.3 (9.3)	43.7 (9.8)	<0.0001	46 (9.2)	43.7 (9.8)	<0.0001	46.8 (9)	43.7 (9.8)	<0.0001
Risk score, mean (SD)	1.35 (1.12)	1.21 (1.08)	<0.0001	1.37 (1.14)	1.21 (1.08)	<0.0001	1.39 (1.16)	1.21 (1.08)	<0.0001
Diabetes, N (%)	5,315 (54)	2,178 (43)	<0.0001	3,997 (54)	2,178 (43)	<0.0001	2,872 (53)	2,178 (43)	<0.0001
Baseline cost, mean (SD)	$2,675 (6,233)	$2,497 (6,543)	0.11	$2,647 (6,211)	$2,497 (6,543)	0.12	$2,662 (6,230)	$2,497 (6,543)	0.19
Region, N (%)									
Midwest	3,773 (38)	1,573 (31)	<0.0001	2,924 (39)	1,573 (31)	<0.0001	2,148 (40)	1,573 (31)	<0.0001
Northeast	852 (9)	480 (10)	0.10	667 (9)	480 (10)	0.35	498 (9)	480 (10)	0.70
South	3,937 (40)	2,280 (45)	<0.0001	2,895 (39)	2,280 (45)	<0.0001	2,051 (38)	2,280 (45)	<0.0001
West	1,271 (13)	727 (14)	0.02	929 (13)	727 (14)	0.003	677 (13)	727 (14)	0.008
Outcomes									
Starting BMI, mean (SD)	35.5 (7.5)	NA	NA	35.4 (7.4)	NA	NA	35.4 (7.4)	NA	NA
Sessions attended, mean (SD)	14 (13)	NA	NA	18 (13)	NA	NA	23 (12)	NA	NA
Weight loss, mean (SD)	3.1 kg (5.2)	NA	NA	3.8 kg (5.6)	NA	NA	4.5 kg (6)	NA	NA
Percentage of body weight lost, mean (SD)	3.0% (4.9)	NA	NA	3.7% (5.2)	NA	NA	4.4% (5.6)	NA	NA
Achieved 5% or higher weight loss, N (%)	2,384 (24)	NA	NA	2,242 (30)	NA	NA	1,996 (37)	NA	NA

Statistically significant differences between participants and nonparticipants were defined using alpha level P<0.05.
ITT, intent-to-treat; NA, not applicable.

TABLE 3 Characteristics of study sample after propensity matching

	ITT, 4,790 matched pairs			Active, 4,481 matched pairs			Completers, 3,990 matched pairs		
	Participant	Nonparticipant	P value	Participant	Nonparticipant	P value	Participant	Nonparticipant	P value
Gender (female), %	72%	72%	1.00	74%	74%	1.00	76%	76%	1.00
Age, mean	44.0	43.9	0.67	44.5	44.4	0.59	45.53	45.41	0.58
Risk score, mean	1.18	1.20	0.24	1.20	1.23	0.19	1.24	1.27	0.21
Diabetes, %	43.9%	43.9%	1.00	45.7%	45.7%	1.00	48.4%	48.4%	1.00
Baseline cost, mean	$1,879	$1,946	0.41	$1,781	$1,867	0.24	$1,847	$1,940	0.26
Region, %									
Midwest	32.8%	31.9%	0.36	32.6%	32.6%	0.95	33.8%	34.0%	0.85
Northeast	9.3%	9.4%	0.94	32.6%	32.6%	0.48	9.6%	9.3%	0.67
South	43.4%	44.9%	0.15	43.6%	44.6%	0.35	42.6%	43.6%	0.39
West	14.5%	13.9%	0.38	13.8%	13.3%	0.52	14.0%	13.1%	0.24

Comparison of these adjusted (after propensity matching) means and other values show that the matching program eliminated group (participants vs. nonparticipants) differences (all P values>0.05). ITT, intent-to-treat.
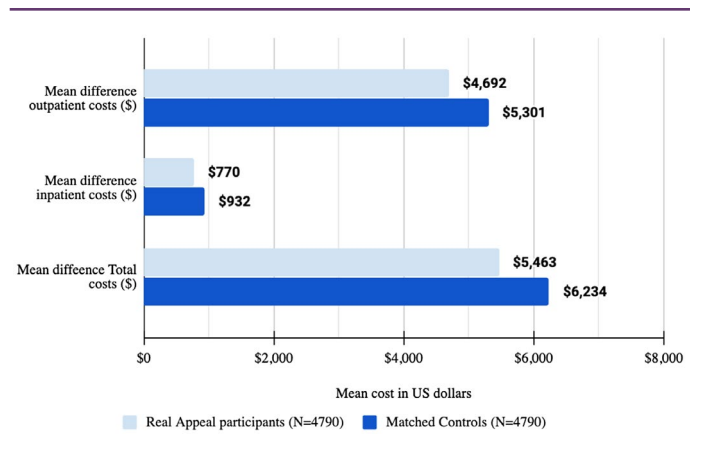

Figure 1 Average differences in health care costs ($) between baseline and 3 years after registration for program participants and matched controls for the intent-to-treat cohort. [Color figure can be viewed at wileyonlinelibrary.com]

to report medical savings associated with program participation but did not conduct an ROI analysis by comparing the total costs of the program with the medical savings (24).

Studies have demonstrated cost savings associated with reduced body weight from an ILI for type 2 diabetes (7). In the Look AHEAD trial, an ILI led to a reduction in annual hospitalizations, fewer hospital days, and fewer medications, resulting in a 10% cost savings for hospitalization and a 7% cost savings for medications. Hospital costs were projected using the Nationwide Inpatient Sample, and the Medicare Physician Fee Schedule was used to calculate outpatient costs (7). The ILI produced a mean relative per-person 10-year cost savings of $5,280 (95% CI: $3,385-$7,175; 2012 US dollars); however, these were not evident among individuals with a history of cardiovascular disease (7).

A meta-analysis of obesity-related health costs reported that the annual medical spending attributable to obesity was, on average, $1,901 per individual ($1,239-$2,582) in 2014 US dollars, accounting for $149.4 billion at the national level, with significant variation in cost estimates (25). Application of an intervention such as this program on a larger, national scale could substantially reduce the contribution of obesity to health care costs and result in significant savings for the health care system. For example, treatment of approximately 1 in 6 patients with obesity in the United States (16 million people) and getting 10 million to be active participants could, based on our trial results, result in savings of over $8 billion health care dollars over 3 years.

The study has some weaknesses, however. First, the study was unable to account for pharmacy costs because prescription drug plans and medical health plans are separate contractual agreements from independent providers. Complete pharmacy data covering the 48 months of this study were not accessible for all study participants; therefore, the total cost of care was unknown. Second, this is an employment-based study that involved a large sample of employees from 96 companies from all regions of the United States. The sample included adults aged 18 to 64 with health insurance coverage through their employer. Therefore, the reported cost savings may not be generalizable to the entire US population, including those at age 65 and older, those without health insurance, or those with non–employer-sponsored health insurance. Finally, the study was not a true randomized comparison, in that participants

TABLE 4 DID for medical cost

	Total medical cost					Outpatient					Inpatient				
	Mean baseline cost	Mean post–3-y cost	Difference	DID	P value	Mean baseline cost	Mean post–3-y cost	Difference	DID	P value	Mean baseline cost	Mean post–3-y cost	Difference	DID	P value
ITT															
Participant	$1,879	$7,342	$5,463	$771	0.002	$1,731	$6,423	$4,692	609	0.005	$148	$918	$770	$162	0.07
Nonparticipant	$1,946	$8,180	$6,234			$1,745	$7,046	$5,301			$202	$1,134	$932		
Active 4+ sessions															
Participant	$1,781	$7,439	$5,658	$847	0.0006	$1,655	$6,448	$4,793	713	0.0006	$126	$992	$866	$132	0.16
Nonparticipant	$1,867	$8,372	$6,505			$1,707	$7,213	$5,506			$161	$1,159	$998		
Completers															
Participant	$1,847	$7,765	$5,918	$956	0.0004	$1,652	$6,764	$5,112	$688	0.001	$196	$1,001	$805	$268	0.04
Nonparticipant	$1,940	$8,814	$6,874			$1,747	$7,547	$5,800			$193	$1,266	$1,073		

Total medical costs = outpatient costs + inpatient costs. Difference = mean 3-year cost − mean baseline cost. DID, difference-in-differences (i.e., participant difference − nonparticipant difference); ITT, intent-to-treat.
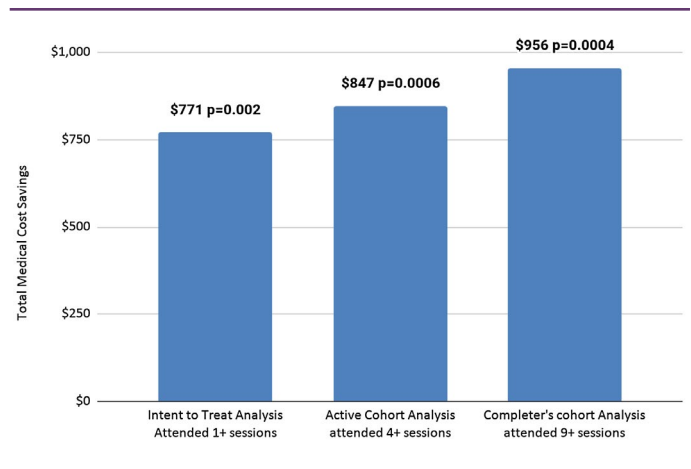
Figure 2 Medical cost savings: the difference-in-differences in health care cost ($) over 3 years between program participants and their matched controls. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 5 ROI

	ITT	Active	Completer
Participants (*M*)	4,790	4,481	3,990
Total medical savings	$3,693,090	$3,795,407	$3,814,440
Total program expenditures	$1,639,961	$1,825,250	$1,878,528
ROI	2.3	2.1	2

The ROI calculation was total savings divided by total program fees.
ROI, return on investment; ITT, intent-to-treat.

were not randomly assigned to the intervention and control groups. To account for potential selection bias of those who chose to enroll (participants) compared with those who did not (nonparticipants), propensity score matching was used. As described earlier in the paper, the matching process allowed for the direct comparison of outcomes between treated and untreated participants within the propensity score–matched sample. The intent of propensity matching is to mimic a randomized controlled trial (16). There is no statistical method that can completely eliminate selection bias in a nonrandomized study; therefore, unobserved selection bias may have impacted the results.

The proportion of study participants identified as having type 2 diabetes mellitus was higher than the proportion within the general population. For the purposes of this study, a study participant was defined as having diabetes if they had at least one medical claim with a diabetes-related *International Classification of Diseases Ninth and Tenth Revision, Clinical Modification (ICD9/10-CM)* code during the study time period. Using this definition may have included a rule-out diagnosis. It is well documented that the prevalence of diabetes mellitus increases with age and BMI. Study participants had an average BMI of 35 kg/m^2 and a mean age of 46, both characteristics influencing the prevalence of diabetes.

Another important point from this ROI analysis is that enrollment and active participation in the program may be necessary to achieve an ROI ranging from 2:1 to 2.3:1 over 3 years. We believe that decision-makers should not only offer but also encourage active participation in an evidence-based weight loss ILI. We hope that this collaborative effort among stakeholders will be most likely to achieve the greatest

health benefits with the greatest cost savings. Of course, recruitment and encouragement of participation should be key elements to such programs. For example, this program drives enrollment and participation, resulting in a collaborative effort among the program, the employer, and employees who enroll and participate to lose and maintain excess body weight. Pay-for-performance models put the burden on the program to actively engage with participants and help them achieve weight loss, but support and encouragement from all stakeholders may be required for optimal outcomes. Future research might directly address the hypothesis that collaboration among stakeholders yields the highest level of cost savings and health benefits (26).

One of the strong points of this ROI analysis is that it represents a good example of real-world evidence (RWE) research pertaining to a behavioral/lifestyle intervention (18). Most RWE research in medicine has focused on pharmaceutical trials and the use of electronic health records using quasiexperimental designs or pragmatic research designs (27). The need for RWE research pertaining to behavioral/lifestyle interventions has been recommended, however (28). Some of the preliminary RWE research in the field of weight management has involved tests of the Diabetes Prevention Program lifestyle intervention for prevention of type 2 diabetes in the "real world" (i.e., not in clinic-based efficacy trials) (29,30).This study adds to this research, showing that a digital ILI weight-management program was associated with lowered health care costs and clinically meaningful weight loss in adults who had overweight or obesity (i.e., not exclusively those who are diagnosed with prediabetes).

Addressing the public health challenge of obesity in the United States will require readily accessible, scalable weight-management programs available as a covered medical benefit (4). Providing payers with data on cost savings and ROI will encourage offering weight-management ILIs as a medical benefit. Our documentation of a significantly positive ROI from the program lends strong support to providing this as a medical benefit rather than as an optional activity that relies on the patient to pay for the care.**O**

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