OPEN

A Retrospective Analysis of Employee Education Level on Weight Loss Following Participation in an Online, Corporately Sponsored, Weight Loss Program

Conrad P. Earnest, PhD and Timothy S. Church, MD, PhD

Objective: To examine weight loss characteristics relative to education for employees participating in an online weight loss program. **Methods:** We examined percent weight loss (primary outcome), the achievement of clinical cut-points (secondary outcome) by class attendance, and education strata (High School and Trade through Post-Graduate). **Results:** Overall, the pooled cohort lost a significant percentage of their starting weight (−2.05%, 95% CI, −2.07, −2.04). Women (−1.95%, 95% CI, −1.97, −1.94) lost significantly less than men (−2.38%, 95% CI, −2.141, −2.35). Those attending less than or equal to seven classes lost significantly less weight (0.75% [95% CI, −0.77, −0.74] vs more than or equal to eight classes attendees [−3.50%, 95% CI, −3.52, −3.48]). Class attendance was significantly correlated to weight loss ($r = 0.57$, $P < 0.001$) and was consistent across education strata. **Conclusions:** Online weight loss programming is effective across education strata and class participation is essential to participant success.

Keywords: corporate health, digital health, education, online, prevention, web-based, weight loss

It is well recognized that obesity is a modifiable disease.[1,2] It is also well documented that multicomponent behavioral interventions in adults with obesity can lead to significant improvements in weight status, subsequently reducing the prevalence of various comorbidities.[3] Despite advances in obesity treatment, less is known about online, workplace programming efforts targeting weight loss, and weight management. Previous work by our group has demonstrated that an online, commercially available, worksite weight loss program is a viable means of reducing body weight, as well as comorbidities.[4–7] Others have also demonstrated similar findings in overweight and obese employees,[8,9] where active participants lost an average of 3.5% body weight, a cut point synonymous as ''clinically beneficial,'' with 29% of participants achieving 5% weight loss or what is considered to be ''clinically significant.''[10–12] Finally, the aforementioned analysis showed that program completers lost an average of 4.3% body weight, with 36% of the cohort achieving a 5% weight loss. While findings such as these attest to the utility of online, worksite programming, further elucidation towards specific worksite sub-populations is needed. In this paper, we will examine the effects of such online programing in employees stratified by their education level.

Overall, studies examining weight loss and education level have shown that lower educational achievement is associated with a higher prevalence of obesity.[13,14] In a 2017 report, Ogden et al[13] published a report via the Centers for Disease Control and Prevention showing that education strata categorized as (1) high school graduate or less, (2) some college, and (3) college graduates, that the prevalence of obesity was lower among women (27.8%) and men (27.9%) who were college graduates versus women and men with some college (41.2%, 40.0%, respectively). The prevalence for male and female graduates or with less than a high school education was 45.3% and 35.5%, respectively. It is interesting to note that the reported desire to lose or maintain weight in the Ogden study increased with education level.

Serdula et al[15] have reported that among men and women, the odds of trying to maintain versus doing nothing about losing weight increases with education. Specifically, the odds ratios of those trying to lose weight increased versus less-than-high school educations (odds ration [OR] 1.0, referent) versus high school graduates (OR 1.24 [95% confidence interval (CI), 1.11, 1.38]), some college or technical school (OR 1.54 [95% CI, 1.38, 1.72]), and college graduates (OR 2.18 [95% CI, 1.95, 2.44]). Similar findings were observed for women: less-than-high school education (OR 1.0, referent) versus high school (OR 1.53 [95% CI, 1.40, 1.66]), some college or technical school (OR 1.94; 95% CI, 1.78–2.12) and college graduate (OR 2.12, 95% CI, 1.93, 2.33). These findings present a potentially interesting scenario relative to the year of a participant's completed education and the availability of online/internet access.

If one back-calculates the publication dates of these studies, it is reasonable to postulate that much of the education data for these studies was obtained from individuals receiving their education at the cusp of the internet's broad popularity (ie, mid-1990s). This is of potential importance as Madden[16] at the Pew Research Center reported that internet penetration for adults in the United States only reached approximately 13% of adults in 1995. This number has increased to 89% of adults in 2018.[17] Finally, it was not until approximately 1994 that the advocacy for the internet's use for medical education was advocated in a paper by Kruper et al.[18] Though the exact date for such advocacy may not be precise, the early trends for internet education on weight loss were in its infancy, if not yet existent. Moving forward to today's technology environment, the internet now lends itself to delivering programming efforts directly to one's home, mobile phone, and the workplace. These assertions lend themselves to two considerations.

First, online worksite programming is now clearly considered to be a viable means of program delivery.[5,9,19,20] Second, program

From the Department of Health and Kinesiology, Texas A&M University, College Station (Dr Earnest); Naturally Slim, Inc., Dallas (Dr Church), Texas.

Ethical Considerations: The study was reviewed by an ethics committee (Chesapeake IRB, Columbia, MD) and determined not to require IRB oversight according to the tenets of the US Department of Health and Human Services regulations at 45 CFR 46. Data were fully de-identified and did not contain employee names, respective places of employment, or the city/state of their residence.

Funding: Funding for this study was provided by Naturally Slim, Inc. (Dallas, TX).

Conflicts of interest: Professor Earnest is a paid consultant for Naturally Slim, Inc. Dr Church is the Chief Medical Officer and Chief Strategy Officer for Naturally Slim, Inc.

Clinical significance: Online, worksite, weight loss programming is effective for promoting weight loss, regardless of the employee education level. Individuals attending more than or equal to eight classes achieved a greater percentage of clinically beneficial and clinically significant weight loss. Those attending less than or equal to seven classes demonstrated a significantly greater likelihood of achieving less-than-3% weight loss.

Address correspondence to: Timothy S. Church MD, PhD, Naturally Slim, Inc., Dallas, TX (tchurch@naturallyslim.com).

DOI: 10.1097/JOM.0000000000001990

attendance appears to be a key component of programing success defined as the amount of weight lost by participants.[4,9] In this paper, we further explore the results of corporately sponsored, online, weight loss programming efforts by accounting for class attendance and education levels. Different from our previous reports, this study examines the effectiveness of online programming based on the foundational component of the program (ie, the first 10 class sessions). Our primary outcome was percent weight loss by educational level. As a secondary outcome, we examined our cohort relative to individuals achieving less-than-3% weight loss, clinically beneficial (3% to 4%), and clinically significant (more than or equal to 5%) weight loss. We hypothesized that (1) online weight loss programming offered to employees would be equally effective across various levels of education and that (2) greater class attendance will impact overall weight loss and that (3) regardless of education level, online programming will demonstrate a similar pattern of effectiveness.

METHODS

Participants and Recruitment

The current report describes the examination of an initial database of 196,058 individuals participating in an online behaviorally oriented, commercialized weight loss course for company employees from various states within the United States. Unlike our previous reports which analyzed longer-term participation, we now describe the effectiveness of weight loss programming relative to the foundational component (ie, the initial 10 class sessions, described below) of the course curriculum. Class attendance was monitored via a centralized system. Ninety-five percent of participants starting a class session completed the session in its entirety. The analysis is categorized by self-reported education level: (1) high school graduate, (2) some college, (3) college graduate, (4) some postgraduate, (5) postgraduate and (6) trade. The study was reviewed by an ethics committee (Chesapeake IRB, Columbia, MD) and determined not to require IRB oversight according to the tenets of the US Department of Health and Human Services regulations at 45 CFR 46. Bodyweight was assessed throughout the program and recorded individually by each participant online. Data were fully de-identified and did not contain employee names, respective places of employment, or the city/state of their residence.

Course Curriculum

Participants volunteered through their employers to participate in a corporately-sponsored weight loss course (Naturally Slim, Inc., Dallas, TX). The Foundational aspect of the program is composed of 10 weekly classes, based on Specific, Measurable, Attainable, Realistic, Time-based (SMART) behavioral goal-setting practices.[21,22] Participants were recruited via emails delivered by their employer, mailers, and flyers placed at the worksites. The foundational curriculum focused on specific elements found in standard behavioral health programs such as self-monitoring, goal setting, stimulus control, modification of eating habits and problem-solving, while concentrating on mindful, healthy eating, and understanding hunger signals. Participants were encouraged to engage in moderate-intensity physical activity, primarily walking, per NIH consensus development panel on physical activity guidelines.[23] The current report examines the effects of weight loss, relative to participant education level.

The foundational aspect of programming is as follows: (1) Mindful Eating and Portion Control, Stimulus Control, Medical Considerations & Weight Loss, (2) Stop Eating Cues, Introduction to Physical Activity, (3) Stress and Emotions, Mindless Eating, Goal Setting and Problem Solving, Physical Activity, (4) Hidden Sugar, Mindful Activities, Energy Balance, (5) Nutrition 10, Stress Management, Physical Activity & Weight Maintenance, (6) Weight Fluctuations, Food Cravings versus Easily Accessible Food, CDC Exercise Recommendations, (7) Emotions and Eating, Importance of Self-Monitoring, Making Exercise A Habit, (8) Grocery Shopping and Meal-Planning, Metabolic Syndrome, Cognitive Behavioral Techniques, (9) Serving Sizes, Social Support, Dealing with Saboteurs, and (10) Review of Eating Skills and Tools, Maintaining Motivation, and Long-Term Action Planning. An outline of all course objectives has been previously published (4).

While the classes do not eliminate or focus on a specific food group or macronutrient, per se, an emphasis is placed on reducing carbohydrate and sugar intake, particularly refined sugar, and maintaining a protein intake of 25% to 30% of total calories. Curriculum lessons used a web-based, distance-learning platform, and participants could watch their lessons any place with Internet access based on individual convenience and did not have to be watched continuously. All participants were examined via a self-reporting questionnaire regarding their awareness of metabolic risk factors as communicated to them by their physician which specifically asked, ''Has a health care provider ever told you have'': (1) high blood pressure, (2) low HDL-C, (3) NAFLD, (4) osteoarthritis, (5) pre-diabetes, (6) sleep apnea, (7) high triglycerides, (8) Type 2 diabetes, or (9) gestational diabetes?

STATISTICS

We prioritized our analysis to examine percent weight loss (primary outcome) relative to educational level and class attendance. As a secondary outcome, we examined our cohort relative to individuals achieving less-than-3%, clinically beneficial (3% to 4%), and clinically significant (more than or equal to 5%) weight loss.[10–12] Class attendance was defined as attending less than or equal to seven classes or more than or equal to eight classes. This cut point was chosen based on a mean and median class attendance of seven. While the primary outcome was stratified by sex, our secondary outcome analysis of clinical benefits was not stratified by sex given a paucity of data within each cell to adequately perform the analysis and therefore represents the pooled data for the whole cohort. Eligible participants presented to the study with a BMI more than or equal to 25 kg/m^2. All analyses were performed using Chi-Square General Linear Models (GLM) analyses. Between-group comparisons were corrected for potential experiment-wise error rates using Bonferonni methods. Finally, as a tertiary exploration, we examined the relationship between class attendance and percent weight loss via Pearson correlations. Data were initially examined without adjustments. All reported levels of significance are two-sided and reported as mean (SD), mean change (95% CI), or N (%) unless otherwise noted.

RESULTS

We initially examined 196,058 (25% male) participants who registered for the program. After accounting un-recorded follow-up weight data, 140,445 participants were subsequently analyzed. Participants in the study averaged 47 years[12] of age, weighed 97.37 kg (22.32), and had a body mass index (BMI) of 34.66 kg/m^2 (7.48). Examination by BMI further demonstrated that 40,998 (30%) were overweight, 42,174 (30%) were class I obese, 27,682 (20%) were class II obese, and 27,476 (20%) were class III obese (Table 1). Further, 70,040 (53%) of the cohort attended seven or fewer classes, while 47% ($n = 66,405$) attended more than eight classes. Finally, 99,071 (71%) of the cohort achieved less-than-3% weight loss. Sixteen percent ($n = 22,551$) achieved clinically beneficial weight loss and 13% ($n = 18,823$) achieved clinically significant weight loss. We have presented the overall characteristics of the cohort, stratified by sex, in Table 1. Similar tables are by education strata for women (Table 2) and men (Table 3). Our analysis of the clinical cut points, by education, is presented in Table 4.

TABLE 1. Characteristics of the Study Participants ($N = 140,445$)

	All ($N = 140,445$)		Women ($n = 108,222$)		Men ($n = 32,225$)	
	Mean/*N*	SD/%	Mean/*N*	SD/%	Mean/*N*	SD/%
Age, y	47.28	11.70	47.14[a]	11.60	47.77[b]	12.01
Age group, y						
<35 y	22,880	16%	17,733	16%	5,147	16%
35–44 y	33,701	24%	26,139	24%	7,562	23%
45–54 y	41,388	29%	32,200	30%	9,188	29%
55–65 y	34,751	25%	26,643	25%	8,108	25%
>65 y	7,723	5%	5,506	5%	2,217	7%
Race						
White	103,166	77%	77,252	75%	25,914	85%
Black	24,196	18%	21,743	21%	2,453	8%
Asian	3,561	3%	2,215	2%	1,346	4%
Native American	3,067	2%	2,407	2%	660	2%
Ethnicity						
Non-Hispanic	128,762	92%	99,361	92%	29,401	91%
Hispanic	11,683	8%	8861	8%	2822	9%
Class attendance	6.10	3.74	6.09[a]	3.72	6.11[a]	3.81
Height, m	1.68	0.1	1.64[a]	0.07	1.79[b]	0.08
Height, cm	167.53	9.63	164.08[a]	7.17	179.09[b]	7.6
First weight, kg	97.37	22.32	94.05[a]	21.12	108.54[b]	22.64
Last weight, kg	95.39	22.13	92.24[a]	21.02	105.97[b]	22.47
Absolute weight loss, kg	−1.98	2.61	−1.81[a]	2.4	−2.56[b]	3.15
Relative weight loss (%)	−2.05	2.61	−1.95[a]	2.53	−2.38[b]	2.84
First BMI, kg/m^2	34.66	7.48	34.91[a]	7.67	33.79[b]	6.75
Last BMI	33.96	7.45	34.24[a]	7.63	32.99[b]	6.73
BMI category						
Overweight	40,998	30%	30,933	29%	10,065	32%
Class I obesity	42,174	30%	31,409	29%	10,765	34%
Class II obesity	27,682	20%	21,486	20%	6,196	20%
Class III obesity	27,476	20%	22,784	21%	4,692	15%
Elevated blood pressure	58,161	41%	42,478	39%	15,683	49%
Pre-diabetes	21,772	16%	17,392	16%	4,380	14%
Type-2 diabetes	13,988	10%	10,298	10%	3,690	11%
Gestational diabetes	7,502	5%	7,502	7%	0	0%
Low HDL-C	36,553	26%	26,440	24%	10,113	31%
Elevated triglycerides	34,578	25%	24,593	23%	9,985	31%
NAFLD	6,625	5%	5,139	5%	1,486	5%
Osteoporosis	42,134	30%	34,516	32%	7,618	24%
Sleep apnea	32,490	23%	21,027	19%	11,463	36%

Values in the same row and sub-table not sharing the same subscript are significantly different at $P < 0.05$ in the two-sided test of equality for column means.
BMI, body mass index; HDL-C, high density lipoprotein cholesterol; NAFLD, non-alcoholic fatty liver disease.

Primary Outcome: Percent Weight Loss

Upon examination, the pooled cohort lost a significant percentage of their starting weight (−2.05%, 95% CI, −2.07, −2.04). Further examination showed that women (−1.95%, 95% CI, −1.97, −1.94) lost significantly less of their starting weight than men (−2.38%, 95% CI, −2.141, −2.35). Those attending less than or equal to seven classes lost significantly less weight (0.75%, 95% CI, −0.77, −0.74) versus more than or equal to eight classes attendees (−3.50%, 95% CI, −3.52, −3.48). These patterns were consistent across education strata (Fig. 1). Class attendance was significantly correlated to percent weight loss ($r = 0.57$, $P < 0.001$, Fig. 2A) and was consistent for education (Fig. 2B). Collectively, the average weight loss by participating more than or equal to eight classes would be classified as clinically beneficial.[10–12]

Secondary Outcome: Clinical Significance

When examined by clinical cut points, 99,071 (71%) participants lost less-than-3% of their starting weight, 22,551 (16%) achieved clinically beneficial weight loss, and 18,823 (13%) achieved clinically significant weight loss. When examined by sex, 77,814 (72%) of women achieved less-than-3% weight loss, with 17,034 (16%) and 13,374 (12%) achieving clinically beneficial and clinically significant weight loss, respectively. For men, 21,257 (66%) achieved less-than-3% weight loss, with 5517 (17%) and 5449 (17%) achieving clinically beneficial and clinically significant weight loss, respectively. When examined by class attendance, 92% ($n = 67,829$) of individuals attending less than or equal to seven classes achieved less-than-3% weight loss versus significantly fewer of participants attending more than or equal to eight class attendees 31,242 (47%, $P < 0.001$). For those achieving ''clinically beneficial'' weight loss, 6% ($n = 1640$) were less than or equal to seven class attendees versus a significantly greater number of individuals in the eight-or-more class attendee group ($n = 17,980$, $P < 0.001$). This pattern of achievement was similar for those achieving ''clinically significant'' weight loss: less than or equal to seven class attendees ($n = 1640$ [2%]) versus more than or equal to eightclass attendees ($n = 17,183$, 26%, $P < 0.001$).

DISCUSSION

In the current study, we examined the efficacy of class attendance on weight loss relative to the education level of study participants undertaking the foundational portion of the Naturally

TABLE 2. Characteristics of Female Characteristics by Education

	High School Graduate ($n = 9,377$)		Some College ($n = 20,090$))		College Graduate ($n = 36,510$)		Some Postgraduate ($n = 6,247$)		Postgraduate ($n = 29,036$)		Trade ($n = 6,962$)	
	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)
Age, y	49.52[a]	11.52	47.48[b]	12.05	45.53[c]	11.36	47.80[b]	12.21	47.69[b]	11.37	48.48[d]	11.02
Age group, y												
<35 y	1,142	12%	3,385	17%	7,230	20%	1,050	17%	4,007	14%	919	13%
35–44 y	1,722	18%	4,333	22%	9,226	25%	1,431	23%	7,977	27%	1,450	21%
45–54 y	2,828	30%	5,811	29%	11,139	31%	1,743	28%	8,417	29%	2,262	32%
55–65 y	3,167	34%	5,556	28%	7,808	21%	1,529	24%	6,582	23%	2,001	29%
>65 y	518	6%	1,005	5%	1,107	3%	494	8%	2,052	7%	330	5%
Race												
White	7,480	85%	14,397	76%	25,920	74%	4,480	74%	20,018	71%	4,957	75%
Black	1,122	13%	3,804	20%	7,281	21%	1,302	22%	6,859	24%	1,375	21%
Asian	49	1%	180	1%	968	3%	90	1%	888	3%	40	1%
Native American	199	2%	580	3%	804	2%	144	2%	471	2%	209	3%
Ethnicity												
Non-Hispanic	8,242	88%	17,727	88%	33,758	92%	5,909	95%	27,583	95%	6,142	88%
Hispanic	1,135	12%	2,363	12%	2,752	8%	338	5%	1,453	5%	820	12%
Class attendance	6.62[a]	3.36	6.44[b]	3.36	6.80[c]	3.31	6.62[a]	3.31	6.84[c]	3.28	6.60[a]	3.33
Height, m	1.63[a]	0.07	1.64[b]	0.07	1.64[c]	0.07	1.64[c, d]	0.07	1.65[d]	0.07	1.63[a]	0.07
Height, cm	163.10[a]	7.09	163.76[b]	7.1	164.22[c]	7.15	164.38[c, d]	7.1	164.54[d]	7.27	163.42[a]	7.08
First weight, kg	93.74[a]	20.52	95.81[b]	21.8	93.90[a]	21.09	94.42[a, d]	21.31	92.79[c]	20.67	95.06[b, d]	21.36
Last weight, kg	91.84[a]	20.46	94.00[b]	21.7	92.07[a]	20.97	92.70[a, d]	21.25	91.03[c]	20.6	93.21[b, d]	21.23
Absolute weight loss, kg	−1.90[a]	2.48	−1.81[b, c]	2.48	−1.82[a, b]	2.41	−1.72[c]	2.32	−1.76[c, d]	2.3	−1.84[a, b, c]	2.47
Relative weight loss (%)	−2.07[a]	2.64	−1.92[b, c]	2.56	−1.97[b]	2.55	−1.87[c]	2.47	−1.94[b, c]	2.47	−1.97[a, b, c]	2.56
First BMI, kg/m^2	35.23[a,e]	7.57	35.68[b]	7.66	34.80[c]	7.59	34.93[a,c]	7.55	34.28[d]	7.79	35.56[b,e]	7.56
Last BMI	34.51[a,e]	7.55	35.01[b]	7.62	34.12[c]	7.54	34.29[a,c]	7.52	33.62[d]	7.75	34.87[b,e]	7.5
BMI category												
Overweight	2408	26%	4832	24%	10754	30%	1830	30%	9395	33%	1714	25%
Class I obesity	2,815	31%	5,783	29%	10,516	29%	1,787	29%	8,508	30%	2,000	29%
Class II obesity	1,976	21%	4,360	22%	7,178	20%	1,184	19%	5,288	18%	1,500	22%
Class III obesity	2,025	22%	4,809	24%	7,527	21%	1,353	22%	5,430	19%	1,640	24%
Metabolic risk scores												
Elevated blood pressure	4,067	43%	8,257	41%	13,449	37%	2,531	41%	11,186	39%	2,988	43%
Pre-diabetes	1,357	14%	3,287	16%	5,549	15%	1,103	18%	4,852	17%	1,244	18%
Type-2 diabetes	1,037	11%	2,234	11%	3,171	9%	641	10%	2,414	8%	801	12%
Gestational diabetes	540	6%	1,376	7%	2,525	7%	459	7%	2,075	7%	527	8%
Low HDL-C	2,417	26%	4,953	25%	8,825	24%	1,504	24%	6,858	24%	1,883	27%
Elevated triglycerides	2,231	24%	4,566	23%	8,003	22%	1,525	24%	6,527	22%	1,741	25%
NAFLD	504	5%	1,095	5%	1,623	4%	330	5%	1,141	4%	446	6%
Osteoporosis	3,239	35%	6,740	34%	10,766	29%	2,101	34%	9,049	31%	2,621	38%
Sleep apnea	1,936	21%	4,185	21%	6,649	18%	1,303	21%	5,448	19%	1,506	22%

Values in the same row and sub-table not sharing the same subscript are significantly different at $P < 0.05$ in the two-sided test of equality for column means.
Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.
BMI, body mass index; HDL-C, high density liporotein cholesterol; NAFLD, non-alcoholic fatty liver disease.

Slim program. The primary outcome of our study was the percentage of weight loss relative to education relative to class participation. Our secondary was the examination was the achievement of three clinical cut-points defined as less-than 3%, clinically beneficial (3% to 4%), and clinically significant (more than or equal to 5%). Overall, we observed that regardless of the education level, those participating in more than or equal to eight classes were significantly more likely to achieve a clinically beneficial and clinically significant percentage of weight loss versus those attending less than or equal to seven classes. Further, those attending less than or equal to seven classes were significantly less likely to achieve clinically beneficial or clinically significant weight loss and significantly more likely to achieve a less-than-3% weight loss irrespective of education level. In summary, the online weight loss program we examined is effective for workplace individuals across various educational stratum. Therefore, we accept our research hypothesis.

These findings are important for several reasons relative to societal internet penetration and worksite internet-based programming efforts for all employees of various educational levels within the workplace. Our findings also help to fill the gap cited by the US Preventive Services Task Force (2011), which concluded that there a significant gap related to understanding the characteristics of employees participating in worksite intervention studies.[24] Specifically, the internet has now evolved to a point where programming can be delivered to the worksite and personal devices such as home computers, mobile phones and tablets, showing within all educational strata. Though it could be argued that internet access is not available to everyone, data from the Pew Research Centers Internet and Technology Generations study report several characteristics that are important to our findings.

In a 2016 report, Horrigan reported that 52% of ''personal learners'' used the internet for learning, but observed a 15% gap when examining education.[19] Specifically, 43% of those who did

TABLE 3. Characteristics of Male Characteristics by Education

	High School Graduate ($n = 2,668$)		Some College ($n = 5,173$)		College Graduate ($n = 11,085$)		Some Postgraduate ($n = 1,726$)		Postgraduate ($n = 8,741$)		Trade ($n = 2,830$)	
	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)	Mean (*N*)	SD (%)
Age, y	47.33[a]	11.88	47.12[a]	12.01	46.35[b]	11.88	49.91[c]	12.5	49.46[c]	12.16	48.42[d]	10.99
Age group, y												
<35 y	425	16%	883	17%	2,163	20%	253	15%	1,094	13%	329	12%
35–44 y	630	24%	1,236	24%	2,594	23%	304	18%	2,101	24%	697	25%
45–54 y	764	29%	1,448	28%	3,254	29%	465	27%	2,387	27%	870	31%
55–65 y	741	28%	1,325	26%	2,517	23%	514	30%	2,217	25%	794	28%
>65 y	108	4%	280	5%	557	5%	190	11%	942	11%	140	5%
Race												
White	2,171	88%	4,079	86%	9,050	86%	1,396	85%	6,921	82%	2,297	89%
Black	219	9%	458	10%	808	8%	152	9%	633	8%	183	7%
Asian	17	1%	60	1%	443	4%	59	4%	734	9%	33	1%
Native American	54	2%	147	3%	216	2%	43	3%	122	1%	78	3%
Ethnicity												
Non-Hispanic	2,319	87%	4,538	88%	10,209	92%	1,602	93%	8,185	94%	2,548	90%
Hispanic	349	13%	635	12%	876	8%	124	7%	556	6%	282	10%
Class attendance	6.40[a]	3.46	6.31[a]	3.45	6.78[b]	3.37	6.77[b]	3.39	6.87[b]	3.35	6.69[b]	3.4
Height, m	1.78[a]	0.08	1.79[b,c]	0.08	1.79[b]	0.08	1.80[b]	0.07	1.79[c]	0.08	1.79[b,c]	0.07
Height, cm	178.19[a]	8.09	179.14[b,c]	7.68	179.38[b]	7.53	179.70[b]	7.5	178.87[c]	7.53	179.05[b,c]	7.42
First weight, kg	111.97[a]	23.28	112.78[a]	23.91	108.20[b]	22.2	108.86[b]	22.41	104.23[c]	21.26	112.01[a]	23.13
Last weight, kg	109.34[a]	23.24	110.29[a]	23.77	105.61[b]	22.02	106.37[b]	22.31	101.75[c]	21.06	109.18[a]	22.9
Absolute weight loss, kg	−2.64[a,b]	3.34	−2.49[a]	3.16	−2.59[a]	3.14	−2.49[a]	3.1	−2.48[a]	3.02	−2.83[b]	3.44
Relative weight loss (%)	−2.40[a,b]	2.99	−2.23[a]	2.75	−2.41[b]	2.84	−2.32[a,b]	2.81	−2.39[b,c]	2.83	−2.53[b,d]	2.95
First BMI, kg/m^2	35.34[a]	9.21	35.09[a]	7.05	33.57[b]	6.39	33.66[b]	6.29	32.51[c]	5.99	34.85[a]	6.45
Last BMI	34.50[a]	9.17	34.32[a]	7.08	32.77[b]	6.37	32.88[b]	6.27	31.73[c]	5.93	33.98[a]	6.41
BMI category												
Overweight	595	23%	1,182	23%	3,532	32%	553	33%	3,533	41%	670	24%
Class I obesity	861	33%	1,754	35%	3,789	35%	572	34%	2,823	33%	966	35%
Class II obesity	644	25%	1,135	22%	2,109	19%	327	19%	1,342	16%	639	23%
Class III obesity	520	20%	1,011	20%	1492	14%	242	14%	913	11%	514	18%
Metabolic risk scores												
Elevated blood pressure	1,372	51%	2,668	52%	5,128	46%	903	52%	4,129	47%	1,483	52%
Pre-diabetes	366	14%	725	14%	1,382	12%	276	16%	1,202	14%	429	15%
Type-2 diabetes	381	14%	734	14%	1,092	10%	246	14%	849	10%	388	14%
Gestational diabetes	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Low HDL-C	881	33%	1,587	31%	3,371	30%	563	33%	2,790	32%	921	33%
Elevated triglycerides	747	28%	1,507	29%	3,374	30%	596	35%	2,914	33%	847	30%
NAFLD	126	5%	233	5%	478	4%	85	5%	419	5%	145	5%
Osteoporosis	752	28%	1,404	27%	2,269	20%	437	25%	1,931	22%	825	29%
Sleep apnea	935	35%	2,014	39%	3,844	35%	632	37%	2,933	34%	1,105	39%

Values in the same row and sub-table not sharing the same subscript are significantly different at $P < 0.05$ in the two-sided test of equality for column means.
Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.
BMI, body mass index; HDL-C, high density liporotein cholesterol; NAFLD, non-alcoholic fatty liver disease.

not proceed past high school used the internet for a personal learning activity versus 58% among those with college degrees higher. Forty percent of employed adults in the high school graduate group pursued professional learning via the internet versus 64% for college-educated individuals. It was further noted that ''college or more'' obtained such training at venues away from the workplace (49%) versus 35% those with ''some college'' and ''high school or less'' educations. These findings were also associated with economic status as ''college or more'' individuals earning more than or equal to $75,000 versus those with ''some college'' ($50,000 to $74,999) and ''high school or less'' education ($30,000 to $49,999). These observations align with those of Cohen et al,[14] who reported in a meta-analysis, that an inverse association was more common in studies of higher-income countries. These reports support the idea that worksite, educationally-focused programming surrounding ''personal learning,'' or in this case, better health through weight loss, are a viable and powerful means of delivering useful information to employees, regardless of educational attainment by making ''personal learning experiences'' directly available to employees without imposing a need for travel or attendance at learning programs outside the workplace. Several reports have also demonstrated the utility of internet-based programming.[25–27]

Tate et al[20] demonstrated that in a behaviorally-based weight loss program delivered via the Internet to hospital employees, those undertaking a structured behavioral treatment program with weekly contact and individualized feedback demonstrated better weight loss compared with those given website links only. As with our current study, programming efforts focused on the behavioral aspects of losing weight. Other evaluations of online interventions using self-reported weight loss outcomes associated with a commercially intensive lifestyle intervention delivered electronically have shown similar results.[9] For example, in a study examining class attendance and weight loss, participants attending at least one session, lost an average of 2.8% of their body weight, while 23%

TABLE 4. Achievement of Clinically Beneficial or Clinically Significant Weight Loss

	Less Than 3%		Clinically Beneficial (3–4%)		Clinically Significant (>5%)	
	N	Row *N* %	*N*	Row *N* %	*N*	Row *N* %
All	99,071	71%	22,551	16%	18,823	13%
Women	77814	72%	17034	16%	13374	12%
Men	21257	66%	5517	17%	5449	17%
High School Graduate	8,375	70%	1,895	16%	1,775	15%
Seven or fewer classes	5910	91%	397	6%	177	3%
Eight or more classes	2,465	44%	1,498	27%	1,598	29%
Some College	18,078	72%	3,898	15%	3,287	13%
Seven or fewer classes	12,983	91%	889	6%	364	3%
Eight or more classes	5,095	46%	3,009	27%	2,923	27%
College Graduate	33,506	70%	7,682	16%	6,407	13%
Seven or fewer classes	22,489	92%	1,496	6%	497	2%
Eight or more classes	11,017	48%	6,186	27%	5,910	26%
Some postgraduate	5,656	71%	1,312	16%	1,005	13%
Seven or fewer classes	3,931	92%	261	6%	90	2%
Eight or more classes	1,725	47%	1,051	28%	915	25%
Postgraduate	26,670	71%	6,143	16%	4,964	13%
Seven or fewer classes	17,765	92%	1,182	6%	368	2%
Eight or more classes	8,905	48%	4,961	27%	4,596	25%
Trade	6,786	69%	1,621	17%	1,385	14%
Seven or fewer classes	4,751	91%	346	7%	144	3%
Eight or more classes	2,035	45%	1,275	28%	1,241	27%

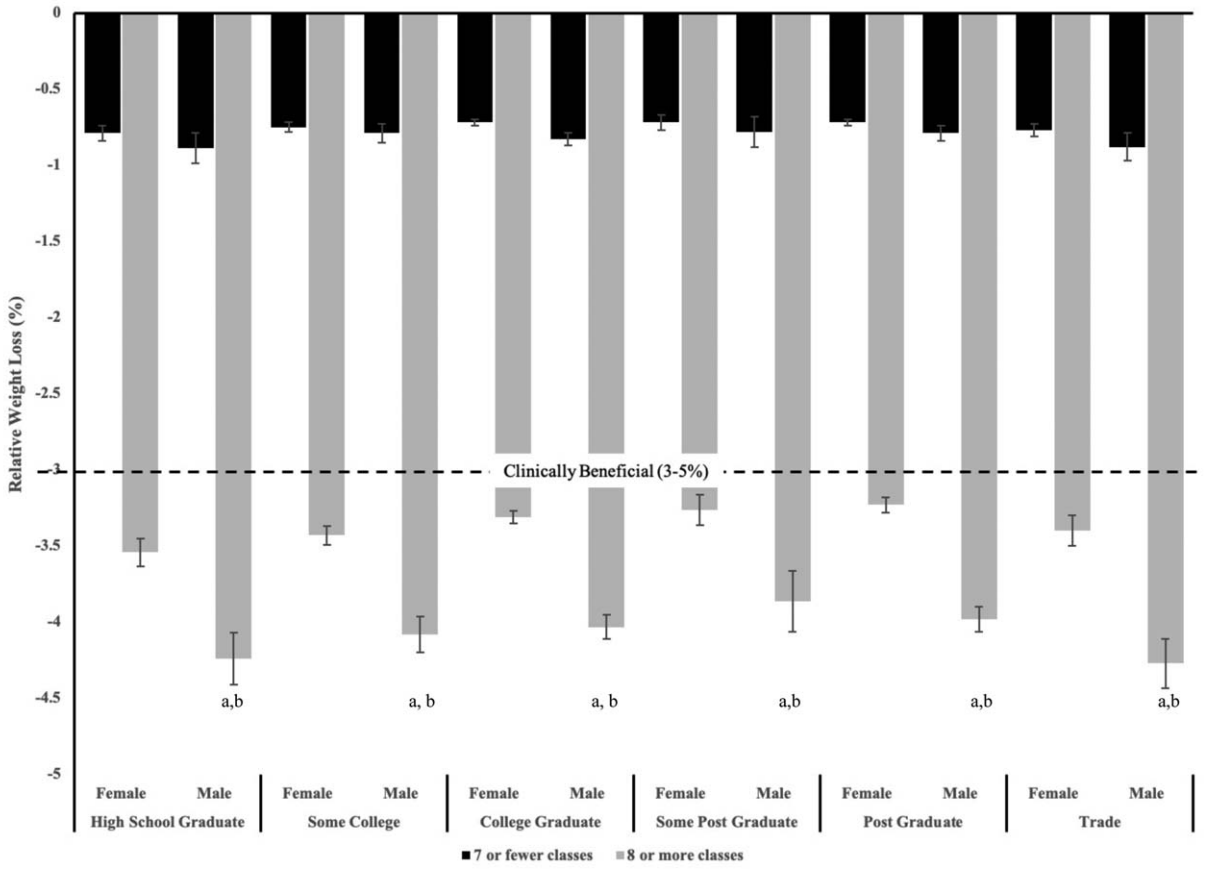

FIGURE 1. Data represent relative weight loss by education and class participation. Data are mean percent weight lost (95% CI). Data presented with the notations ''a'' (between gender difference) and ''b'' (between class attendance categories) are significantly different ($P < 0.001$).

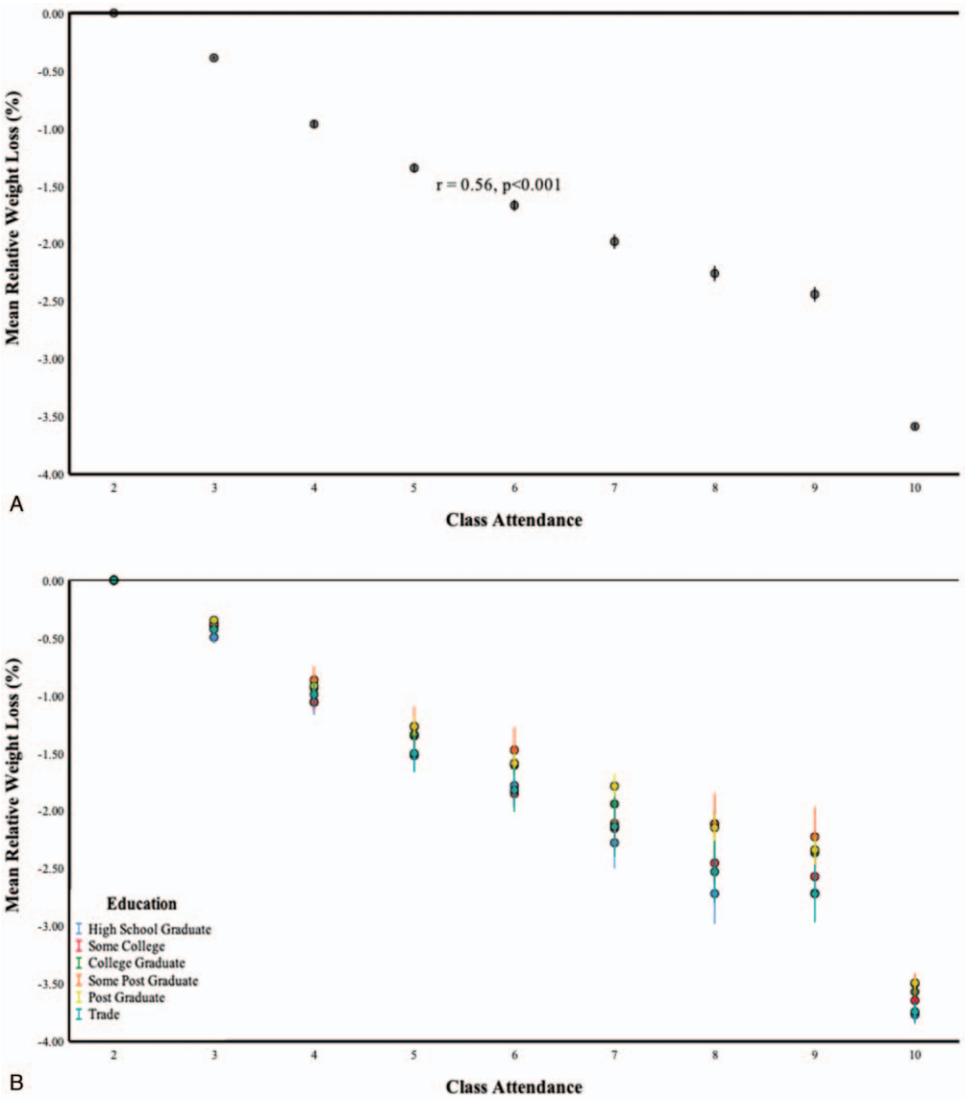

FIGURE 2. Data represent the association between class attendance and relative weight loss. Panel A represents data for the entire cohort. Panel B represents data relative to education.

achieved more than or equal to 5% weight loss. This latter cut point is considered clinically significant.[10] Participants with greater levels of participation lost an average of 3.5% body weight, that is, clinically beneficial,[12] with 29% achieving 5% weight loss. Finally, those completing the program lost an average of 4.3% body weight and 36 achieved more than or equal to 5% weight loss. As with our current study, greater amounts of weight loss were exhibited by individuals engaged in greater levels of participation. An important feature of the current study is the observation that a greater prevalence of those losing weight was present within all education strata for those attending more than eight versus less than or equal to seven classes. This was matched by a significantly greater magnitude of weight loss across education strata. Several factorial challenges should also be considered when examining education levels, obesity, and weight loss.

Empirical studies, for example, suggest that education level has a positive impact on health and general well-being,[28] particularly in poorer communities.[29] This, in turn, interacts with other related health factors such as a decreased likelihood for smoking, excessive drinking, illegal drug use, complemented by a greater likelihood of exercising, obtaining preventive care (eg, flu shots, vaccines, mammograms, pap smears, colonoscopies, etc).[30,31] Further, Swinburn et al[30] have reported that protective etiological factors associated with the strategies targeting the reduction of obesity include regular physical activity, a high intake of dietary non-starch polysaccharides (fiber, and supportive home and school environments for children). To the contrary, risk factors for obesity were considered to be sedentary lifestyles, a high intake of energy-dense, micronutrient-poor foods, heavy marketing of energy-dense foods, sugar-sweetened soft drinks, and fruit juices. Many, but not all of these factors are addressed in the online program examined in this report. While our results reinforce the viability of delivering an internet-based curriculum to the workplace and that class attendance plays a major role in the success of such programming efforts, some limitations should be considered.

LIMITATIONS

Limitations to our study include the lack of a control group and the absence of dietary records. However, a 2012 systematic review and meta-analysis by Waters et al,[32] showed that no change in control group weight is typically observed in trials using control groups and that control groups receiving standard care typically lose ~1 kg more than control groups receiving no intervention. Secondly, our data relied upon self-reporting, which is systematically biased, with overweight and obese people more likely to under-report weight.[33] We also cannot report on follow-up data showing

potential changes or other CVD risk factors; however, in previous reports, we have reported significant reductions in hypertension, metabolic syndrome, and associated risk factors.[6,7] A strength of our study is that we examined a large cohort of individuals demonstrating a net weight synonymous with clinically beneficial and clinically significant weight loss across various educational strata and that worksite programming effectively bringing a behaviorally oriented, personal learning environment to employees of different educational backgrounds.

ACKNOWLEDGMENTS

The authors would like to thank Kendall Ramirez for reviewing the manuscript and Cody Dufour for compiling and organizing the data used in this study.

REFERENCES

1. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Arch Intern Med*. 1998;158:1855–1867.
2. Hales C, Carroll M, Fryar C, Ogden C. Prevalence of obesity among adults and youth: United States, 2015-2016. In: *NCHS Data Brief, no 288*. Hyattsville, MD: National Center for Health; 2017.
3. U. S. Preventive Services Task Force: Behavioral weight loss interventions to prevent obesity-related morbidity and mortality in adults: Us preventive services task force recommendation statement. *JAMA*. 2018;320:1163–1171.
4. Earnest CP, Dufour C, Church TS. The efficacy of re-engaging in an employer sponsored weight loss program. *J Occup Environ Med*. 2019;61:e516–e522.
5. Earnest CP, Church TS. Retrospective examination of class attendance on corporately sponsored weight loss programming: the naturally slim experience. *J Occup Environ Med*. 2020;62:e102–e110.
6. Earnest CP, Church TS. Evaluation of a voluntary work site weight loss program on hypertension. *J Occup Environ Med*. 2016;58:1207–1211.
7. Earnest CP, Church TS. Evaluation of a voluntary worksite weight loss program on metabolic syndrome. *Metab Syndr Relat Disord*. 2015;13:406–414.
8. Merrill RM, Aldana SG, Garrett J, Ross C. Effectiveness of a workplace wellness program for maintaining health and promoting healthy behaviors. *J Occup Environ Med*. 2011;53:782–787.
9. Horstman C, Aronne L, Wing R, Ryan DH, Johnson WD. Implementing an online weight-management intervention to an employee population: initial experience with real appeal. *Obesity (Silver Spring)*. 2018;26:1704–1708.
10. Stevens J, Truesdale KP, McClain JE, Cai J. The definition of weight maintenance. *Int J Obes (Lond)*. 2006;30:391–399.
11. Williamson DA, Bray GA, Ryan DH. Is 5% weight loss a satisfactory criterion to define clinically significant weight loss? *Obesity (Silver Spring)*. 2015;23:2319–2320.
12. Ryan DH, Kahan S. Guideline recommendations for obesity management. *Med Clin North Am*. 2018;102:49–63.
13. Ogden CL, Fakhouri TH, Carroll MD, et al. Prevalence of obesity among adults, by household income and education - United States, 2011–2014. *MMWR Morb Mortal Wkly Rep*. 2017;66:1369–1373.
14. Cohen AK, Rai M, Rehkopf DH, Abrams B. Educational attainment and obesity: a systematic review. *Obes Rev*. 2013;14:989–1005.
15. Serdula MK, Mokdad AH, Williamson DF, Galuska DA, Mendlein JM, Heath GW. Prevalence of attempting weight loss and strategies for controlling weight. *JAMA*. 1999;282:1353–1358.
16. Madden M. *Internet Penetration and Impact*. Washington, DC: Pew Research Center; 2006.
17. Poushter J, Bishop C, Chwe H. *Social Media Use Continues to Rise in Developing Countries but Plateaus Across Developed Ones*. Washington, DC: Pew Research Center: Global Attitudes & Trends; 2018.
18. Kruper JA, Lavenant MG, Maskay MH, Jones TM. Building internet accessible medical education software using the World Wide Web. *Proc Annu Symp Comput Appl Med Care*. 1994;32–36.
19. Horrigan J. *Lifelong Learning and Technology;* 2016.
20. Tate DF, Wing RR, Winett RA. Using Internet technology to deliver a behavioral weight loss program. *JAMA*. 2001;285:1172–1177.
21. Cannioto RA. Physical activity barriers, behaviors, and beliefs of overweight and obese working women: a preliminary analysis. *Hum Kinetic J*. 2010;19:70–85.
22. Conroy MB, Yang K, Elci OU, et al. Physical activity self-monitoring and weight loss: 6-month results of the SMART trial. *Med Sci Sports Exerc*. 2011;43:1568–1574.
23. Physical activity and cardiovascular health. NIH consensus development panel on physical activity and cardiovascular health. *JAMA*. 1996;276:241–246.
24. Anderson LM, Quinn TA, Glanz K, et al. The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *Am J Prev Med*. 2009;37:340–357.
25. Wylie-Rosett J. Weight-loss intervention by telephone: lessons learned. *Diabetes Care*. 2014;37:2078–2080.
26. Goode AD, Winkler EA, Reeves MM, Eakin EG. Relationship between intervention dose and outcomes in living well with diabetes-a randomized trial of a telephone-delivered lifestyle-based weight loss intervention. *Am J Health Promot*. 2014;30:120–129.
27. Eakin EG, Winkler EA, Dunstan DW, et al. Living well with diabetes: 24-month outcomes from a randomized trial of telephone-delivered weight loss and physical activity intervention to improve glycemic control. *Diabetes Care*. 2014;37:2177–2185.
28. Lleras-Muney A. The relationship between education and mortality in the US. *Rev Econ Stud*. 2005;70:189–221.
29. Cutler D, Lleras-Muney A. *Education and Health: Evaluating Theories and Evidence;* 2006.
30. Swinburn BA, Caterson I, Seidell JC, James WP. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr*. 2004;7:123–146.
31. Devaux M, Sassi F, Church J, Cecchini M, Borgonovi F. Exploring the relationship between education and obesity. *OECD J*. 2011;1:1–40.
32. Waters L, George AS, Chey T, Bauman A. Weight change in control group participants in behavioural weight loss interventions: a systematic review and meta-regression study. *BMC Med Res Methodol*. 2012;12:120.
33. Stommel M, Schoenborn CA. Accuracy and usefulness of BMI measures based on self-reported weight and height: findings from the NHANES & NHIS 2001-2006. *BMC Public Health*. 2009;9:421.

