International Journal of Obesity (2018) **42**, 462–468

www.nature.com/ijo

ORIGINAL ARTICLE

An experimental therapeutics test of whether adding dissonance-induction activities improves the effectiveness of a selective obesity and eating disorder prevention program

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OBJECTIVE: Compare the *Healthy Weight* obesity and eating disorder prevention program, which promotes participant-driven gradual lifestyle changes to bring energy intake and expenditure into balance, to a new intervention, *Project Health*, which adds activities to create cognitive dissonance about unhealthy eating, a sedentary lifestyle, and excess body fat, and an obesity education video-control condition.
METHOD: College students at risk for both outcomes because of weight concerns ($N = 364$, 72% female) were randomized to condition, completing pretest, posttest, and 6, 12 and 24-month follow-up assessments.
RESULTS: *Project Health* participants showed significantly smaller increases in measured body mass index (BMI) through 2-year follow-up than both *Healthy Weight* participants and controls (both $d = -0.18$), and significantly lower onset of overweight/obesity over 2-year follow-up than *Healthy Weight* participants and controls (13 vs 21% and 22%). *Healthy Weight* and *Project Health* participants showed significantly greater eating disorder symptom reductions than controls through 2-year follow-up. *Healthy Weight* and *Project Health* participants showed marginally lower eating disorder onset over follow-up than controls (3 and 3% vs 8% respectively).
CONCLUSIONS: The reduced increases in BMI and future overweight/obesity onset for *Project Health* relative to both an active matched intervention and a minimal intervention control condition are noteworthy, especially given the short 6-h intervention duration. The reduction in eating disorder symptoms for Healthy Weight and Project Health relative to controls was also encouraging. Results suggest that adding dissonance-induction activities increased weight loss effects. Yet, effects for both were generally small and the eating disorder onset prevention effects were only marginal, potentially because intervention groups included both sexes, which reduced eating disorder incidence and sensitivity.

International Journal of Obesity (2018) **42,** 462–468; doi:10.1038/ijo.2017.251

INTRODUCTION

Obesity and eating disorders are prevalent chronic conditions associated with impairment, distress, morbidity, and mortality[1,2] prompting a need for prevention programs that reduce onset of these two public health problems. Although several prevention programs have sought to reduce future onset of both obesity and eating disorders, only one has affected both outcomes. The 3 h *Healthy Weight* selective prevention program reduced body mass index (BMI) increases versus assessment-only controls and alternative interventions through 3-year follow-up and obesity onset versus assessment-only controls and an alternative intervention at 1-year follow-up (1% vs 12% and 9%, respectively) and assessment-only controls at 3-year follow-up (8 vs 18%[ref.3,4]). *Healthy Weight* also reduced eating disorder symptoms versus assessment-only controls through 3-year follow-up and eating disorder onset versus assessment-only controls through 3-year follow-up (7% vs 15%[ref.3,4]). In *Healthy Weight* young women with body image concerns make small, permanent healthy changes to dietary intake and exercise that bring caloric intake and expenditure into balance, which should reduce weight gain and risk for eating pathology. The lifestyle change plan is participant-driven to promote internalization of the health goals and executive control over lifestyle choices. It is implemented in groups to increase accountability and cost-effectiveness. A refined version of *Healthy Weight* resulted in less weight gain through 6-month follow-up, greater weight gain prevention through 1-year follow-up for initially overweight youth, greater eating disorder symptom reductions, and a 60% reduction in eating disorder onset over 2-year follow-up versus educational brochure controls.[5,6] An expanded six-session version of *Healthy Weight* produced greater reductions in BMI and eating disorder symptoms than the cognitive reappraisal-based *Minding Health* prevention program, as well as greater reductions in body fat and eating disorder symptoms than educational video controls.[7]

We tested whether the efficacy of the *Healthy Weight* program could be enhanced by adding activities designed to promote cognitive dissonance about consuming unhealthy foods, a sedentary lifestyle, and excess weight. An eating disorder prevention program designed to promote dissonance about pursuing the unrealistic beauty ideal reduced eating disorder symptoms through 2-year follow-up and future eating disorder onset through 3-year follow-up versus assessment-only controls

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The first 61 participants assigned to the *Healthy Weight* condition and the first 62 participants assigned to the educational video condition from the present trial were included in a preliminary evaluation of the *Minding Health* obesity prevention program, which focuses on cognitive reappraisal techniques. It should also be noted that due to a malfunction in the Bod Pod, we were not able to collect valid body fat data for all participants in the present trial, which was an outcome in the preliminary evaluation of *Minding Health*.
Received 22 May 2017; revised 5 September 2017; accepted 17 September 2017; accepted article preview online 9 October 2017; advance online publication, 31 October 2017

(6% vs 15% respectively[3,4]). Most effects replicated in independent trials (for example, refs 8–10), suggesting dissonance is a robust method of changing health behaviors. According to dissonance theory,[11] discussing costs of pursuing the beauty ideal reduces subscription to this ideal because people change their attitudes to align with their publically displayed behavior. In support of the intervention theory, participants assigned to versions of this intervention designed to maximize versus minimize dissonance induction show greater reductions in eating disorder symptoms[12,13] and completing this intervention reduces fMRI-assessed reward region response to thin models.[14]

We developed a novel 6 h intervention (*Project Health*) that retained the participant-driven gradual healthy lifestyle modification plan, but added exercises designed to create dissonance regarding behaviors that contribute to weight gain. Participants discuss the health, interpersonal and societal costs of an unhealthy diet, sedentary behavior and excess body fat, and the benefits of a healthy diet, physical activity and leanness, which should prompt participants to align their actions with the perspectives assumed in the sessions, resulting in healthier lifestyle choices. This randomized experimental therapeutics trial is the first to test whether *Project Health* produces greater decreases in BMI and eating disorder symptoms, and lower future onset of overweight/obesity and eating disorders than a 6-session version of the original *Healthy Weight* program lacking dissonance-induction activities. Experimental therapeutics trials examine the effect of manipulating one intervention element (for example, dissonance-induction activities) while holding other intervention elements constant (personalized lifestyle improvement plan). We also tested whether both interventions produced larger effects than an educational video-control condition. This is the first trial to experimentally test whether adding activities designed to promote dissonance about behaviors that contribute to obesity improves the effectiveness of a dual obesity and eating disorder prevention program.

MATERIALS AND METHODS

Participants and procedures

Participants were 364 young women and men (*M* age = 19.1, s.d. = 1.2; *M* BMI = 23.5, s.d. = 2.5; 72% female; 15% Asian/Pacific Islander, 3% American/Alaskan native, 3% African American, 0.5% native Hawaiian/Pacific Islander, 11% Hispanic, and 68% European American. *A priori* calculations indicated that we would need 300 participants for a power of.80 to detect a moderate effect size ($r = 0.20$); we therefore over-recruited slightly to ensure complete data from at least 300 participants. Because obesity and eating disorders affect both males and females,[15] we included both sexes, a first for this program of research. From August 2012 to March 2014, participants were recruited from 3 universities in 2 states using mailings, flyers, and leaflets inviting students aged 17–23 years with weight concerns to participate in a weight gain prevention trial. Informed written consent was obtained for this Institutional Review Board approved study. Students were eligible if they reported concern about their weight during an initial phone screen, defined as: (a) agreeing/strongly agreeing with at least one of the following: 'I would like to be thinner/have less body fat' and/or 'I am worried about gaining weight/body fat,' and (b) affirming one of the following: 'Have you experienced any weight gain within the past year?' and/or 'Do you believe that there is room for improvement in your diet and exercise habits?' The first two questions confirmed weight concerns and the latter two questions confirmed a positive energy balance or room for improvement in their lifestyle behaviors. We included the last two questions because the personalized lifestyle improvement plan does not work well for students who are already eating a very healthy diet and exercising regularly. Exclusion criteria were a reported weight and height resulting in BMI < 18 or > 30 or a current diagnosis of DSM-IV anorexia nervosa, bulimia nervosa, or binge eating disorder. We allowed participants with a BMI of > 18 (which corresponds to the 10th percentile) to enroll because the data indicate that a low BMI increases risk for future onset of anorexia nervosa,[16] making them ideal candidates for prevention programs designed to dually prevent obesity and eating disorders. There is no evidence of iatrogenic effects of prevention programs dually targeting obesity and eating disorders for low-BMI individuals. Figure 1 describes participant study flow. Participants provided interview and survey data at pretest, posttest (6-weeks later), and 6, 12 and 24 months following posttest. Participants received $30 for each assessment.

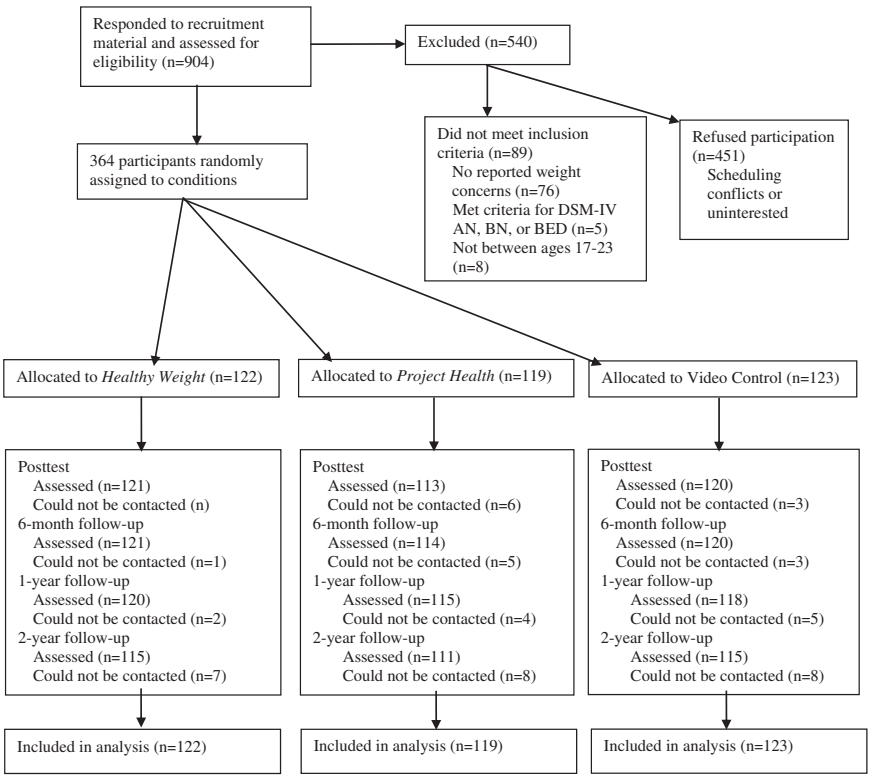

Figure 1. Participant flow throughout the study.

All eligible participants were randomized to *Healthy Weight*, *Project Health* or an educational video-control condition via a random number table, which prevented staff from knowing the allocation sequence prior to randomization. Both interventions consisted of 6 weekly 1 h group sessions with 6–10 participants and 2 facilitators. Twenty clinical graduate students or college mental health staff attended a 4-h training and facilitated groups. If a participant missed a session, brief individual make-up sessions were conducted. Facilitators recorded attendance and whether participants completed home exercises.

Sessions were audio-recorded for fidelity and competence ratings by Drs Rohde and Shaw using scales adapted from prior trials.[5] All sessions of the first group were rated, followed by 66% of sessions when 1 facilitator was new and 50% of sessions when neither facilitator was new. Raters independently coded a randomly selected 66% of rated sessions to obtain inter-rater agreement data. Checklists assessing key components for both interventions were developed (for example, discussed health problems associated with obesity; reviewed the progress of each participant on their individual lifestyle improvement plan) and rated on a 100-point scale (1 = 'No adherence; the section was skipped' to 100 = 'Perfect; all material in the section was presented as written'; a score of 70 was 'good'). Facilitator competence was rated with 12 items (for example, leaders express ideas clearly and at an appropriate pace, leaders attempt to provide equal speaking time for all members), which was the same for both interventions, rated on a 100-point scale (20 = 'Poor; leaders are difficult to follow and session proceeds at an uncomfortable pace' 100 = 'Superior; leaders are unusually articulate and express ideas in way that all group members understand; perfect pace'; a score of 60 was considered 'Good/average'). Supervision, which was based on fidelity and competence ratings, was provided via email.

Interventions

Healthy weight. The main goal of this intervention is to make small, participant-selected sustainable changes to diet and exercise on a weekly basis to achieve balance between caloric intake and output (for example, eating unsweetened yogurt instead of sweetened yogurt). Sessions include educational handouts, in-session discussions (for example, importance of not skipping meals), review of whether participants succeeded in making their behavior change goals, and development of healthy behavior change plans for the next session. Home exercises consist of following participant-selected individualized diet and exercise goals, and keeping a food and exercise log to identify future goals. Although *Healthy Weight* was originally implemented in 3 1-h sessions, it was implemented in 6 1 h sessions to expand lifestyle change practice time, though the content was similar.

Project health. Mirroring *Healthy Weight*, participants in *Project Health* commit to making small participant-identified gradually increasing improvements to their dietary intake and activity levels. Verbal, written, and behavioral activities were added to *Project Health* to induce cognitive dissonance about engaging in lifestyle behaviors that contribute to weight gain and promote lifestyle behaviors that contribute to a healthy weight. Each session begins with a verbal commitment to participate and includes exercises in which participants discussed health, interpersonal and societal costs of overeating high-calorie foods, sedentary behaviors, and obesity, as well as health, interpersonal and societal benefits of consuming low-calorie foods, regular exercise and a lean physique (for example, the group discusses the main medical problems that result from obesity, such as heart attacks, strokes, cancer, and diabetes). (The intervention scripts can be found at http://www.bodyprojectsupport.org/). Activities are shared with the group and video-recorded to create accountability and maximize dissonance.

Educational video-control condition

Participants were provided a link to a free video, called *The Weight of the World*, which is a 51 min documentary produced in 2003 by the National Film Board of Canada (NCB) on the costs of obesity.

Measures

Body mass. BMI scores were used to reflect height-adjusted weight. After removal of shoes and coats, height was measured to the nearest millimeter using stadiometers and weight was assessed to the nearest 0.1 kg using digital scales. BMI correlates with direct measures of body fat ($r = 0.80$–0.90) and health measures such as blood pressure.[17] BMI was used to identify participants who transitioned from a healthy weight (BMI < 25) to either overweight (BMI > 25 and < 30) or obese (BMI > 30) or from overweight to obese over 2-year follow-up versus remaining in their original weight category.

Eating disorder symptoms and diagnosis. The Eating Disorder Diagnostic Interview, a semi-structured interview, assessed DSM-IV eating disorder symptoms on a month-to-month basis over the past 3 months at baseline and since the last interview during the follow-up. Items assessing symptoms in the past month were summed to form a composite, which was a primary outcome. This composite has shown internal consistency ($\alpha = 0.92$), 1-week test–retest reliability ($r = 0.90$), sensitivity to intervention effects, and predictive validity. It showed internal consistency ($\alpha = 0.70$ at T1), inter-rater agreement (ICC $r = 0.90$), and 1-week test–retest reliability (ICC $r = 0.93$) in the present trial. We also used this data to determine the month during which a participant first met criteria for a threshold or subthreshold DSM-IV eating disorder, as operationalized in Stice *et al*.[6] EDDI eating disorder diagnoses have shown 1-week test–retest reliability ($\kappa = 0.79$) and inter-rater agreement ($\kappa = 0.75$) for eating disorders and sensitivity to intervention effects.[6] Female assessors, masked to condition, attended 24 h of training and demonstrated high inter-rater agreement ($k > 0.80$) with supervisors before collecting the data.

Cognitive dissonance. The 14-item Dissonance Regarding Unhealthy Lifestyle Behaviors scale, developed for this trial, measures subjective experience of cognitive dissonance from engaging in unhealthy dietary practices and sedentary behaviors (sample item: 'I feel guilty when I watch TV instead of working out'; the scale is provided in Supplementary Materials). It showed internal consistency ($\alpha = 0.80$) and 1-month test–retest reliability ($r = 0.93$) in a pilot study ($\alpha = 0.84$ at baseline).

Data analysis

Multiple imputation was used to replace missing values for outcomes following best-practice recommendations.[18] Missing data were imputed using the IVEWare[19] to create 20 imputed data sets, which were analyzed separately. Model parameters and standard errors, which incorporate within and between model parameter variability, were combined following Rubin[20] using SAS PROC MIANALYZE. A P value of < 0.05 was used throughout. Given that we only conducted 24 tests of intervention effects, we did not adjust for multiple testing because only 1 effect would have occurred by chance.

Random effects growth models were fit with SAS PROC MIXED for continuous primary outcomes; individual variability in change in BMI, eating disorder symptoms, and cognitive dissonance from posttest to 2-year follow-up, with pretest scores as a covariate were nested within individuals, and individuals nested within intervention groups, and modeled as a function of condition. To accommodate the partially nested design, wherein intervention participants were nested within groups and controls were not, control participants were treated as a group of 1 and study condition treated as a random effect.[21] Three planned contrasts were tested (each coded '1' vs '0'): *Healthy Weight* versus control, *Project Health* versus control, and *Project Health* versus *Healthy Weight*. Time was coded 0 at posttest so that the main effect for condition represents condition differences at posttest. The condition × time interaction, with time coded in months since posttest, represents condition differences in change between posttest and 2-year follow-up. Effect sizes were derived equivalent to Cohen's d.[22]

Onset of overweight or obesity was examined using logistic regression models. Onset of any threshold or subthreshold eating disorder was examined using Cox proportional hazard models. As hazard models accommodate right censoring, we did not impute missing incidence data. The model specified onset of any eating disorder in months since the baseline assessment and was fit with STATA software.[23] Effect sizes were estimated as odds ratios for these primary outcomes, with 1.44, 2.48 and 4.28 represent small, medium and large effects, respectively.

RESULTS

Preliminary analysis

Eating disorder symptom scores were normalized with a log base_{10} transformation. We tested whether conditions differed at pretest on outcomes and demographic variables. *Healthy Weight* participants were more likely to be Hispanic versus *Project Health*

($P = 0.049$); and *Healthy Weight* participants were less likely to be female versus controls ($P = 0.016$). Subsequent models controlled for baseline non-equivalency. Most participants provided data at all assessments (92%). Analyses that compared participants with complete versus incomplete data revealed no significant differences on demographics or outcomes at baseline.

Mean fidelity rating for *Healthy Weight* and *Project Health* were 75.9 (s.d. = 7.8) and 76.2 (3.4), respectively, which did not differ ($t[72] = 0.18$, $P = 0.858$); mean competence rating for the two conditions were 71.2 (s.d. = 10.4) and 72.6 (5.7), respectively, which did not differ ($t[74] = 0.43$, $P = 0.671$). Scores were reliable (ICCs of .76 and .82 for fidelity and competence, respectively). Data suggest that both interventions were presented with competence.

Healthy Weight participants attended an average of 4.6 sessions; 48% attended all 6 sessions. *Project Health* participants attended an average of 4.0 sessions; 36% attended all 6 sessions. Homework completion was 68% and 66% for participants in *Healthy Weight* and *Project Health*, respectively. *Healthy Weight* versus *Project Health* participants attended significantly more sessions ($t[239] = 2.00$, $P = 0.046$, $d = 0.27$ (small effect)), but groups did not differ on percent that completed all sessions ($\chi^2[1,241] = 3.22$, $P = 0.072$) or percent of homework completed ($\chi^2[7,241] = 7.86$, $P = 0.164$). Among participants in the control condition, 55% indicated they watched the entire video; 25% watched none of the video.

Intervention effects for continuous outcomes

Table 1 shows means and s.d. for the primary outcomes and Tables 2–4 the condition and condition × time fixed effects from the growth models. *Healthy Weight* participants showed significantly lower eating disorder symptoms at posttest than controls, a small effect ($d = -0.19$). The non-significant condition × time interaction indicated the lower symptoms for the *Healthy Weight* group maintained through 2-year follow-up.

The condition × time effect for BMI for *Project Health* versus control participants was significant and the condition × time effect for *Project Health* versus *Healthy Weight* had a *P*-value of 0.05, meaning it was just on the threshold of significance. The fact that the condition effects for both of these two comparisons did not reach significance indicated that *Project Health* participants showed significantly less increases in BMI by 2-year follow-up versus *Healthy Weight* and control participants. The latter two effects were small (both *d*'s = −0.18). *Project Health* participants showed significantly lower eating disorder symptoms and greater dissonance regarding engaging in unhealthy lifestyle behaviors at posttest than controls, which were also small effects ($d = -0.15$ and 0.15, respectively); both effects persisted through follow-up.

Intervention effects for dichotomous outcomes

Six participants (2%) were excluded from the logistic models because they met criteria for obesity at baseline per measured BMI and 12 (3%) were excluded because they lacked follow-up BMI data. By 2-year follow-up, 65 participants (19%) showed onset of either overweight or obesity (50 transitioned from healthy weight to overweight, 1 from healthy weight to obese, and 14 from overweight to obese). Overweight or obesity onset occurred for 25 *Healthy Weight* participants (21.2%), 14 *Project Health* participants (12.6%) and 26 controls (22.2%). Overweight or obesity onset did not differ for *Healthy Weight* versus controls (odds ratio = 0.94, 95% confidence interval (CI) = 0.51–1.76, $P = 0.424$). *Project Health* participants showed significantly lower onset of overweight or obesity than controls (odds ratio = 0.51, 95% CI = 0.28–0.92, $P = 0.030$), a moderately small effect (1/0.51 = 1.96), and *Healthy Weight* participants (odds ratio = 0.53, 95% CI = 0.29–0.92, $P = 0.042$), also a moderately small effect (1/0.53 = 1.89). Thus, *Project Health* participants showed a 41–43% reduction in overweight or obesity onset over 2-year follow-up versus *Healthy Weight* and control participants, respectively.

Twenty participants (6%) were excluded from the survival analyses because they met criteria for subthreshold bulimia nervosa or binge eating disorder at baseline and two were excluded because they lacked follow-up data. By 2-year follow-up, 15 participants (5%) showed onset of threshold or subthreshold eating disorder: 3 *Healthy Weight* (3%; 1 threshold AN, 2 subthreshold BN), 3 *Project Health* (3%; 3 subthreshold BN), and 9 controls (8%; 1 threshold BN, 3 threshold purging disorder, 4 subthreshold BN, 1 subthreshold BED). The survival functions are graphed in Figure 2. Both *Healthy Weight* participants ($HR = 0.36$, 95% CI = 0.09–1.37, $P = 0.068$) and *Project Health* participants ($HR = 0.36$, 95% CI = 0.10—1.34, $P = 0.064$) showed marginally lower eating disorder onset than controls. Eating disorder onset did not differ significantly between *Project Health* and *Healthy Weight* participants ($HR = 0.98$, 95% CI = 0.20–4.84, $P = 0.489$).

DISCUSSION

Healthy Weight participants showed greater reductions in eating disorder symptoms than controls, with effects persisting though 2-year follow-up. Although this effect was small, it showed good persistence for a 6 h intervention and replicates findings from earlier trials of *Healthy Weight*,[3–6] which is encouraging given problems with replication.[24] The reduction in eating disorder symptoms is noteworthy because only one other prevention program has produced this effect in multiple trials.[3–5,25] It is possible that delivering this program to mixed-sex groups contributed to the smaller effects in the present trial, as the

Table 1. Means (s.d.) for outcomes in the control, healthy weight, and project health conditions

Variable	*Condition*	*Pretest*	*Postest*	*6 months*	*1 year*	*2 year*
		M (s.d.)	*M (s.d.)*	*M (s.d.)*	*M (s.d.)*	*M (s.d.)*
BMI	Control	23.31 (2.66)	23.43 (2.73)	23.37 (2.72)	23.86 (2.89)	24.27 (3.30)
	Healthy Weight	23.85 (2.67)	23.95 (2.78)	23.99 (2.82)	24.37 (3.03)	24.80 (3.06)
	Project Health	23.23 (2.56)	23.23 (2.58)	23.16 (2.38)	23.42 (2.64)	23.63 (2.96)
Eating disorder symptoms	Control	9.86 (9.20)	6.48 (5.92)	6.51 (5.49)	6.53 (5.78)	6.79 (6.60)
	Healthy Weight	9.12 (7.66)	5.10 (4.05)	5.72 (5.54)	5.74 (6.78)	5.52 (5.02)
	Project Health	9.80 (8.00)	5.48 (4.48)	5.99 (6.12)	5.93 (7.99)	5.95 (6.93)
Cognitive dissonance	Control	3.83 (0.57)	3.83 (0.54)	3.85 (0.56)	3.80 (0.57)	3.82 (0.59)
	Healthy Weight	3.81 (0.54)	3.93 (0.54)	3.83 (0.56)	3.79 (0.57)	3.79 (0.57)
	Project Health	3.81 (0.56)	3.99 (0.51)	3.83 (0.62)	3.79 (0.57)	3.86 (0.50)

Abbreviation: BMI, body mass index. Means and s.d. are based upon averaged values across the 20 imputed data sets. Non-transformed eating disorder symptom scores and physical activity scores are report.

Table 2. Condition and time parameters from growth models for continuous outcomes comparing healthy weight and control participants

Variable	*Parameter*	*B*	*s.e.*	t	P	d
BMI	Condition	0.032	0.171	0.19	0.427	0.012
	Condition × time	< −0.001	0.011	−0.03	0.486	−0.003
Eating disorder symptoms	Condition	−0.137	0.073	−1.88	0.030	−0.194
	Condition × time	0.001	0.004	0.26	0.601	0.037
Cognitive dissonance	Condition	0.065	0.048	1.36	0.087	0.118
	Condition × time	−0.004	0.003	−1.40	0.080	−0.198

Abbreviations: B, beta; BMI, body mass index; *d*, *d*-statistic; *t*, *t*-value; *P*, *P*-value.

Table 3. Condition and time parameters from growth models for continuous outcomes comparing project health and control participants

Variable	*Parameter*	*B*	*s.e.*	t	p	d
BMI	Condition	−0.089	0.142	−0.63	0.265	−0.034
	Condition × time	−0.020	0.011	−1.84	0.033	−0.180
Eating disorder symptoms	Condition	−0.109	0.057	−1.91	0.028	−0.153
	Condition × time	< −0.001	0.004	−0.02	0.492	−0.003
Cognitive dissonance	Condition	0.086	0.051	1.70	0.045	0.153
	Condition × Time	−0.003	0.003	−1.04	0.850	−0.148

Abbreviations: B, beta; BMI, body mass index; *d*, *d*-statistic; *t*, *t*-value; *P*, *P*-value.

Table 4. Condition and time parameters from growth models for continuous outcomes comparing project health and healthy weight participants

Variable	*Parameter*	*B*	*s.e.*	t	p	d
BMI	Condition	−0.121	0.129	−0.94	0.175	−0.046
	Condition × time	−0.019	0.012	−1.65	0.050	−0.179
Eating disorder symptoms	Condition	0.039	0.069	0.57	0.284	0.056
	Condition × time	−0.001	0.004	−0.28	0.392	−0.033
Cognitive dissonance	Condition	0.024	0.052	0.46	0.322	0.044
	Condition × time	0.001	0.003	0.39	0.348	0.048

Abbreviations: B, beta; BMI, body mass index; *d*, *d*-statistic; *t*, *t*-value; *P*, *P*-value.

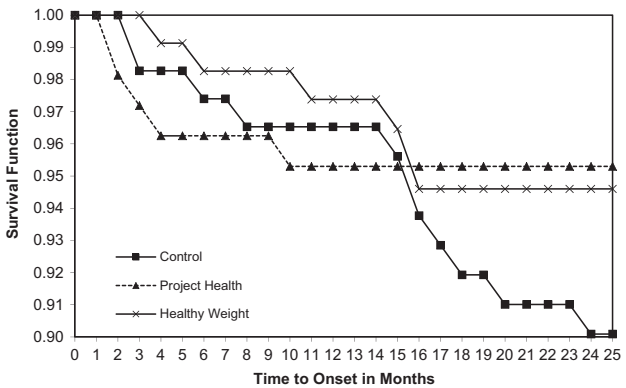

Figure 2. Survival function by condition for full-syndrome or subthreshold eating disorder.

effects for *Healthy Weight* were larger in past trials in which groups contained only females.

Project Health participants showed smaller increases in BMI through 2-year follow-up than controls and *Healthy Weight* participants, which represent preventive effects (both a $d = 0.18$). On average, *Project Health* participants gained over 0.50 BMI units less than *Healthy Weight* or control participants by 2-year follow-up. This is noteworthy because 79% of obesity prevention programs have not reduced future increases in BMI versus increases observed in controls.[26] Obesity prevention programs that have significantly reduced increases in BMI compared to controls also produced a small effect (for example, Gow *et al*.[27]). The fact that *Healthy Weight* participants did not show the reductions in BMI increases observed in *Project Health* participants, and instead showed the 1-unit increase in BMI observed in controls, supports the hypothesis that adding intervention activities designed to promote dissonance about consumption of unhealthy foods, sedentary behavior, and excess body fat would improve weight control. It should be noted that the superior effects for *Project Health* relative to *Healthy Weight* did not appear to be due to greater acceptability of the dissonance-enhanced intervention; the two interventions did not differ on percent of completed sessions or homework and the mean number of attended sessions for *Project Health* was slightly lower.

Project Health participants also showed greater reductions in eating disorder symptoms and greater increases in dissonance regarding engaging in unhealthy lifestyle behaviors than controls through 2-year follow-up. Although these effects were small, few prevention programs have reduced eating disorder symptoms through longer-term follow-up. Further, the greater increase in cognitive dissonance about engaging in unhealthy lifestyle behaviors for *Project Health* versus controls provides support for the intervention theory of this new dissonance-based prevention program.

Project Health participants showed less onset of overweight and obesity than both *Healthy Weight* and control participants. Incidence of overweight/obesity onset was 12.6% for *Project Health* participants, 21.2% for *Healthy Weight* participants, and 22.2% for controls. It is encouraging that *Project Health* produced a 41% reduction in overweight or obesity onset versus *Healthy*

Weight participants and a 43% reduction versus controls, particularly because most obesity prevention programs have not produced this effect.[26,28] These reductions are similar to the 50% reduction in obesity onset found for the original *Healthy Weight* prevention program versus controls,[3] though *Healthy Weight* did not reduce obesity onset in the present trial, potentially because the groups included both sexes, rather than just females, as in the earlier trial. Other prevention programs have produced larger effects when delivered solely to females versus in mixed-sex groups.[29,30]

Incidence of onset of any eating disorder was 3% for *Project Health* participants, 3% for *Healthy Weight* participants, and 8% for controls, a 62% reduction in eating disorder onset for both prevention programs. Although these reductions might be considered clinically meaningful, the differences were only marginal, most likely due to the inclusion of males in this trial, which reduced the incidence of eating disorder onset and sensitivity to detect differences between groups. The finding that eating disorder onset was marginally lower in both prevention programs is important because it provides experimental evidence that promoting healthy reductions in caloric intake and increases in physical activity does not *increase* eating disorder symptoms or eating disorder onset, a concern voiced by some researchers.[31,32] Indeed, these marginal effects taken together with the fact that *Healthy Weight* prevention program significantly reduced future eating disorder onset in two separate trials[5,6] communicates that reducing overeating and encouraging increased physical activity represents an effective way to reduce eating disorders.

Project Health did not produce larger reductions in eating disorder outcomes than *Healthy Weight*, potentially because all of the dissonance-induction activities focused on unhealthy lifestyle behaviors. Perhaps if *Project Health* included activities to induce dissonance regarding engaging in disordered eating, it would produce larger symptom reductions.

It is important to consider the study limitations. First, the fact that follow-up was only 2 years likely limited sensitivity to detecting effects for the dichotomous outcomes compared to past studies that followed participants for 3 years. Second, many effects were small, suggesting that the effects may be of limited clinical significance. Third, the cost of paying 2 facilitators to implement these group-based prevention programs may hinder broad implementation. Fourth, the fact that we did not conduct female-only and male-only groups makes it impossible to determine whether the interventions would have been more effective if implemented in single-sex groups. Fifth, we conducted 24 tests of intervention effects, increasing the risk of chance findings. However, 29% of the tested effects were significant, compared to the 5% that would be expected based on chance, and many of the effects replicated findings from prior studies regarding the *Healthy Weight* prevention program, suggesting that it is unlikely that effects were due to chance. Sixth, although most young adults in the United States attend college and we selected this population because it is an easy one to reach with prevention programs, results may not generalize to those who do not attend college.[33]

In sum, the reductions in BMI increases and overweight or obesity onset for *Project Health* and the reductions in eating disorder symptoms for *Healthy Weight* and *Project Health* were encouraging, particularly as both interventions are brief. Although effects were small, they suggest that it is possible to simultaneously prevent excess weight gain and eating disorders. Results provided experimental support for the thesis that adding dissonance-induction activities increased weight loss effects, in that *Project Health*, which added dissonance-induction activities to the personalized healthy lifestyle improvement plan contained in *Healthy Weight* produced greater weight gain prevention effects. Further, *Project Health* is the first prevention program to reduce weight gain and eating disorder symptom growth and overweight/obesity and eating disorder onset relative to a minimal intervention control condition and to reduce weight gain and obesity onset relative to a credible alternative prevention program matched on duration and modality.

There are several directions for future research. First, it would be useful to test whether *Project Health* is more effective when delivered to single-sex groups. Second, research should test whether adding exercises in which participants explore the negative effects of disordered eating behaviors results in stronger eating disorder prevention effects for *Project Health*. Third, effectiveness trials should test whether *Project Health* reduces both overweight/obesity onset and eating disorder onset when real world clinicians implement this prevention program under ecologically valid conditions. Testing whether *Project Healthy* produces these effects when undergraduate peer educators deliver these programs would also be useful, as this is a cost-effective means of broadly implementing prevention programs. With continued systematic research, we hope it will be possible to broadly implement prevention programs that reduce both obesity and eating disorders, as both contribute to excessive morbidity and mortality.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

This study was supported by grant (HD071900) from the National Institutes of Health. We thank project research assistants Juliana Bednarski, Shelley Durant, Julie Pope, and Victoria Perko, as well as the undergraduates who volunteered to participate in this trial. ClinicalTrials.gov Identifier: NCT01680224.

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