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A Primary Care–Based, Multicomponent Lifestyle Intervention for Overweight Adolescent Females

AUTHORS: Lynn L. DeBar, PhD, MPH,[a] Victor J. Stevens, PhD,[a] Nancy Perrin, PhD,[a] Philip Wu, MD,[b] John Pearson, MD,[a,b] Bobbi Jo Yarborough, PsyD,[a] John Dickerson, MS,[a] and Frances Lynch, PhD[a]

[a]Kaiser Permanente Center for Health Research, Portland, Oregon; and [b]Permanente Northwest, Portland, Oregon

WHAT'S KNOWN ON THIS SUBJECT: Clinic-based weight control treatments for youth have largely been designed for preadolescent children and their families by using family-based care, a strategy that may be less appealing to adolescents as they become increasingly motivated by peer acceptance rather than parental influence.

WHAT THIS STUDY ADDS: To our knowledge, this is the first study to demonstrate the efficacy of a primary care–based, multicomponent lifestyle intervention specifically tailored for overweight adolescent females and demonstrating a sustained effect (at 12 months) extending beyond the active 5-month intervention.

abstract

BACKGROUND AND OBJECTIVE: Most clinic-based weight control treatments for youth have been designed for preadolescent children by using family-based care. However, as adolescents become more autonomous and less motivated by parental influence, this strategy may be less appropriate. This study evaluated a primary care–based, multicomponent lifestyle intervention specifically tailored for overweight adolescent females.

METHODS: Adolescent girls (N = 208) 12 to 17 years of age (mean ± SD: 14.1 ± 1.4 years), with a mean ± SD BMI percentile of 97.09 ± 2.27, were assigned randomly to the intervention or usual care control group. The gender and developmentally tailored intervention included a focus on adoptable healthy lifestyle behaviors and was reinforced by ongoing feedback from the teen's primary care physician. Of those randomized, 195 (94%) completed the 6-month posttreatment assessment, and 173 (83%) completed the 12-month follow-up. The primary outcome was reduction in BMI z score.

RESULTS: The decrease in BMI z score over time was significantly greater for intervention participants compared with usual care participants (−0.15 in BMI z score among intervention participants compared with −0.08 among usual care participants; P = .012). The 2 groups did not differ in secondary metabolic or psychosocial outcomes. Compared with usual care, intervention participants reported less reduction in frequency of family meals and less fast-food intake.

CONCLUSIONS: A 5-month, medium-intensity, primary care–based, multicomponent behavioral intervention was associated with significant and sustained decreases in BMI z scores among obese adolescent girls compared with those receiving usual care. *Pediatrics* 2012;129:e611–e620

Obesity prevalence among youth is at a historic high, with 16% of 6- to 19-year-olds overweight and 19% obese.[1] Treating adolescents has particular public health importance because overweight teens have longer-term health risks and greater probability of adult obesity than youth who develop weight problems earlier in childhood.[2–6] Furthermore, population-based studies have found high rates of psychological symptoms among obese adolescents, especially in females.[7–12] Finally, potential serious social and economic consequences exist for overweight adolescents who, over their lifetimes, have been found to have fewer years of education, lower family income, and higher poverty rates.[13,14]

Youth clinic-based weight control treatments have demonstrated some success, but most have been designed for preadolescent children and their families.[15,16] Although promising, such interventions are usually focused on family-based care, a strategy generally less appealing to adolescents as they become more autonomous and motivated by peer acceptance rather than parental influence.[17–19] Accordingly, some teen weight management studies suggest superior results when teens and parents are seen separately.[20,21] Also, some behaviorally based youth weight management interventions include a mix of adolescents and younger children and are therefore not developmentally tailored to adolescents.[22–25] Furthermore, most interventions have been conducted in specialty settings or academic research clinics rather than primary medical care settings, where weight problems are more often identified and efficiently treated. Two previous primary care–based treatment studies among overweight and obese adolescents reported favorable changes in BMI,[25,26] suggesting the promise of providing adolescent weight management programs within primary care

settings. Some adolescent weight management efforts have achieved limited success, but sustaining longer-term weight loss has been difficult.[27–29]

This study evaluated a primary care–based, multicomponent lifestyle intervention for overweight adolescent females. We hypothesized that, relative to usual care, the intervenztion would reduce BMI and improve selected metabolic health behavior outcomes. We also anticipated that focusing on easily adoptable healthy lifestyle behaviors, rather than stricter adherence to caloric guidelines, might improve sustained weight management.

METHODS

Design

This randomized trial was conducted within a large health maintenance organization (HMO) in the Pacific Northwest between September 2005 and May 2009. The HMO Human Subjects Protection Committee approved and monitored all study procedures. Parents or guardians provided informed consent, and adolescents provided assent. The study design is presented in Fig 1.

Study Participants, Recruitment, Screening, and Randomization

Eligibility was limited to female health plan members aged 12 to 17 years with
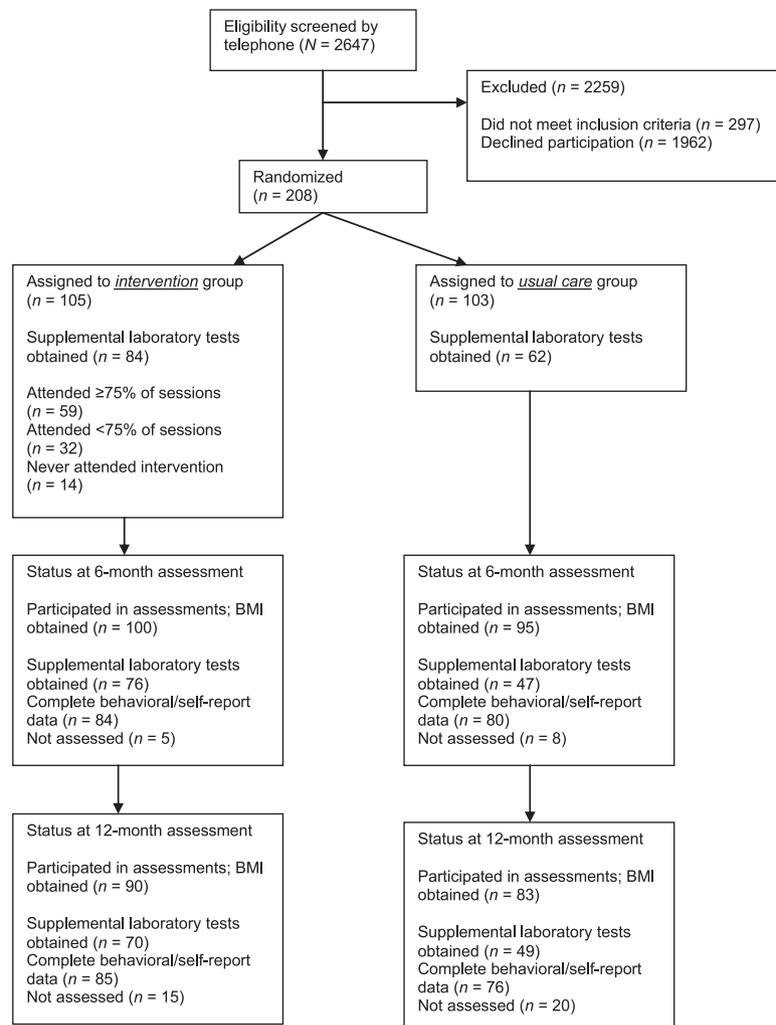
FIGURE 1
Study design and participant flow.

an age- and gender-adjusted BMI ≥90th percentile. At the study's outset, the Centers for Disease Control and Prevention guidelines identified youth with adjusted BMI at or above the 95th percentile as overweight. However, we lowered the eligibility criteria to the 90th percentile to accommodate HMO pediatricians' requests and to increase the findings' generalizability. Exclusion criteria included: significant cognitive impairment or psychosis, severe obesity (BMI >45), use of medications known to affect body weight, and pregnancy.

Potential participants who met selection criteria were identified by using the HMO's electronic medical record. As part of the baseline assessment, all participants received physical examinations from their pediatric primary care providers (PCPs), who were asked to review each potential recruit's medical record before determining appropriateness for study inclusion. In addition, PCPs were encouraged to refer their BMI-eligible adolescent female patients to the study, and recruitment posters in pediatric primary care clinics prompted self-referral. Individuals who met selection criteria were mailed study invitations, which were followed by telephone calls from research staff.

An informational meeting for interested families preceded randomization. Eligible adolescents were randomized to the intervention or control condition by a computer program using a well-validated procedure to balance age and obesity severity.[30] Project interventionists informed participants of treatment assignment to keep assessors masked.

Multicomponent Developmentally Tailored Behavioral Intervention

The teen intervention compromised 90-minute group meetings conducted over 5 months. Groups met 16 times, weekly for 3 months and biweekly during months 4 and 5. At each session, teens were weighed and reviewed dietary and physical activity self-monitoring records. If unable to attend a particular session, teens were offered telephone sessions. The multicomponent intervention included the following: (1) change in dietary intake and eating patterns; (2) increasing physical activity by using developmentally tailored forms of exercise (eg, exergaming); (3) addressing issues associated with obesity in adolescent girls (eg, depression, disordered eating patterns, poor body image); and (4) training participants' PCPs to support behavioral weight management goals collaboratively (Table 1).

In addition to caloric guidelines (1600–1800 kcal daily), we emphasized 3 main areas for dietary change: decreasing portion sizes, limiting consumption of energy-dense foods, and increasing consumption of lower energy–dense foods.[31] Other dietary strategies included: establishing regular meal patterns (especially breakfast),[32] substituting water for sugar-sweetened beverages, reducing fast-food consumption, and increasing frequency of family meals and fruit and vegetable consumption. Physical activity goals included: 30 to 60 minutes of physical activity at least 5 days a week; 15 minutes of daily yoga; limiting screen time to 2 hours per day; and increasing "found exercise" opportunities whenever possible (eg, taking stairs instead of elevators). Because obese youth report fear of peer victimization, embarrassment, and low self-confidence as reasons for not participating in physical activity and organized sports,[33–35] we chose core activities designed to overcome these obstacles. We also chose to integrate exercise with play to help distract participants from the initial discomfort of increased physical activity.[36] Participants were provided with exergaming equipment (Konami Dance Dance Revolution; Konami Digital Entertainment, Inc, El Segundo, CA) to encourage fun activity they could do at home, either alone or with peers or family members. We also included yoga-based stretching and

TABLE 1 Study Intervention Components

Intervention Components	Core Intervention Targets	Supplemental Targets
16 group sessions for teens (weekly for the first 3 months, bi-weekly thereafter)	Establish regular eating patterns (including breakfast daily)	Generalizing skills (i.e., eating at school, dining out, high-risk situations)
In-session yoga	Eat family meals whenever possible	Broader psychosocial issues:
Dance Video Games & Play Stations provided to families as aid to meet physical activity targets	Reduce portion sizes	○ Mood regulation ○ Body image ○ Self esteem
	Use energy density as a guide in making decisions about healthy eating	○ Media education ○ Sleep
12 group sessions for parents		
Physician visits (baseline, post-treatment)	Limited focus on decreased calorie consumption	
	Reduce fast food consumption	
Health education and psychoeducational materials	Replace high calorie beverages with water	
	Increase physical activity to 30-60 minutes per day	
	Practice yoga 15 minutes / day	
	Limit screen time	
	Lose 10-15 lbs. over 6 months	

strength training as in-session physical activities to increase body awareness, core strength, and coordination. By providing teens with training in safe and basic yoga practices, equipment, an instructional booklet, and CD, we encouraged yoga practice outside the study sessions. In addition, interventionists introduced strategies for increasing physical activity (eg, pedometers, resistance bands) to encourage participants to set goals tailored to their interests. Every session included reviewing goals and problem solving to overcome barriers and challenges to increased activity.

The intervention included discussion of topics particularly pertinent to adolescent girls (eg, recognizing and avoiding disordered eating patterns, promoting body image, coping with family and peer teasing, minimizing emotional eating). We also taught specific behavioral and cognitive tools for coping, including: (1) regular self-monitoring of dietary intake, physical activity, and screen time; (2) stimulus control and environmental changes, stepwise goal-setting, and problem solving; (3) setting goals for increasing pleasant activities (as self-reward and alternatives to eating/screen time); and (4) cognitive restructuring techniques to combat negative self-talk.

Teens were required to attend 5 of the first 6 intervention sessions and complete diet and exercise self-monitoring records to receive the exergaming equipment. Interventionists included master's level nutritionists and health educators and doctoral level clinical psychologists.

Parent Support Meetings

Over the intervention's first 3 months, parents were invited to separate, weekly group meetings, during which staff explained the nutritional and physical activity principles the teens would learn so that parents could help support their daughters and reduce potential barriers to success. In addition, parents were encouraged to increase or maintain the frequency of family meals, which are associated with improved nutrition and decreased risk for unhealthy weight control practices among youth.[37–39] Finally, because high levels of parental monitoring of teen eating behavior are associated with more disordered eating among overweight adolescent girls,[40,41] we worked with parents to encourage appropriate teen autonomy and healthier family interactions and improve understanding of how parents' own attitudes, eating behaviors, monitoring, and comments regarding their teen's weight and shape may affect their daughters.

Pediatrician Involvement

To improve interactions with all of their overweight teen patients, pediatric providers received study-sponsored training in motivational enhancement techniques for health behavior change. This training used the FRAMES approach (provide feedback about personal risk, responsibility of patient, advice to change, menu of strategies, empathic style, and promote self-efficacy). Study staff scheduled individual sessions for each intervention participant and her PCP at study onset and 6 months later (after completion of the group sessions). They also provided PCPs with summaries of the teen's current health habits (eg, meal patterns, physical activity) and areas that could be targeted for improvement. PCPs were encouraged to assist patients in selecting 1 or 2 of these behavioral targets (eg, reducing screen time, increasing physical activity, eating more fruits and vegetables, establishing regular meals).

Usual Care

Usual care participants received a packet of materials, including outlines of evidence-based approaches to weight management for youth and adults, a parents' guide to help adolescents make healthy lifestyle changes, local resources for weight management and healthy activity, and suggested books and online materials on healthy lifestyle change. Usual care participants also met with their PCPs at the study onset to encourage healthy lifestyle changes, although PCPs were not given the tailored patient assessment summaries described earlier in the intervention arm for use in their visit nor were usual care participants scheduled for a 6-month study-related session with their PCPs.

Measures

Baseline measurements occurred before randomization, and follow-up data were collected by staff blinded to participant treatment assignment.

Anthropometry and Metabolic Measures

Height and weight were measured with participants lightly clothed and without shoes and taken 3 times for quality assurance. Height was measured to the nearest 0.5 cm by using a Harpenden portable stadiometer (Holtain Limited, Crosswell, Crymych, Pemborokeshire, UK) calibrated monthly. Weight was measured to the nearest 0.25 lb with a Healthometer electronic scale (Health-0-Meter 400kl, Sunbeam Products CO LLC, Toledo, OH) calibrated monthly. BMI was converted to z score during analysis.[42] Blood samples were obtained after a minimum 10-hour overnight fast.

Dietary Intake, Physical Activity, and Health Behaviors

Certified dietary interviewers conducted 3 unannounced 24-hour telephone dietary recalls at baseline and again at 6-month follow-up. Participants were trained to estimate portion size by using real food and food models at the screening visit and received visual aids for estimating portion sizes during recalls. Recall data were entered into the

ESHA database (ESHA Food Processor, version 8.1, 2003; ESHA Research Inc, Salem, OR). We adapted a 24-hour telephone physical activity recall from the 7-day physical activity recall.[43,44] To limit participant study burden, diet and physical activity recalls were collected at baseline and 6-month follow-up only. Other questionnaire measures included: hours per week of screen time and average days per week breakfast was eaten (both adapted from the Youth Risk Behavior Survey[45]), average times per week a "family" meal was eaten together, and average times per week fast food and sweetened beverages/sodas were consumed (adapted from the Project EAT Student Survey[46]). Use of other professional weight management services was assessed by using questions adopted from a previous health care utilization survey.[47] Information on health/lifestyle behaviors and utilization of weight management services was collected at each major assessment point (baseline, 6-, and 12-month follow-ups).

Psychosocial Assessments

Self-report questionnaires at baseline, posttreatment, and 12-month follow-up assessed eating and mood disorder symptoms, body satisfaction, internalization of sociocultural attitudes toward appearance, self-esteem, and quality of life. Unhealthy attitudes and eating practices were assessed by using the Questionnaire of Eating and Weight Patterns–Adolescent Version (QEWP-A[48]) with binge-related eating disorders categorized as "disordered eating." We examined changes in mood by using the depression section of the Patient Health Questionnaire for Adolescents (PHQ-A[49]), with major depression categorized as a "mood disorder." Body satisfaction was assessed by using a modified version of the Body Satisfaction Scale.[50,51] We measured perceived pressure to conform to social norms regarding female attractiveness by using

the Sociocultural Attitudes Towards Appearance Scale (SATAQ-3).[52] The Rosenberg Self-Esteem Scale[53] and the Pediatric Quality of Life Inventory–(PedsQL[54–56]) were also included.

Sample Size and Statistical Analyses

Power computations were performed by using PASS 2000 (NCSS, LLC, Kaysville, UT) for a repeated measures analysis of variance design, assuming an α level of 0.05 (2-tailed) and a correlation across time of 0.50. Enrolling 100 participants per study condition allowed power of 0.98 to detect difference between a mean 3% increase in BMI z score in the control group and a mean 3% decrease in BMI z score in the intervention group. Baseline comparisons between usual care and intervention groups were conducted by using χ^2 and t tests. Generalized estimating equations were used to test for differences across 3 time points in usual care and intervention. Specifically, we examined if the pattern of outcomes change over time differed between the usual care and intervention groups. Because these equations do not require subjects to have data at each time point, all randomized participants were included in the analyses consistent with an intention-to-treat approach.

RESULTS

Sample Characteristics

Adolescents ($N = 208$) 14.1 ± 1.4 years of age, with a mean BMI percentile of 97.09 ± 2.27, were randomized into the trial (Table 2). Compared with usual care participants, intervention participants reported higher use of professional weight management services during the 6 months before enrollment as well as more regular breakfast eating, but no other baseline characteristics differed significantly according to treatment assignment. Randomized participants represented only a modest

proportion (8%) of the 2467 initially screened (Fig 1). Although most community-conducted weight management trials rely only on self-referrals from an undefined population, in contrast, we contacted all teens and families for whom health records indicated potential eligibility ($\geq$90th percentile BMI). This recruitment method included those unmotivated to enroll in this type of study. Furthermore, unlike recruitment of adults (or even younger children and families) in which an adult can independently elect to participate or have their child and family participate, the interest and willingness of both parent(s) and teen to participate are critical for recruitment into this type of trial. Of those randomized, 195 (94%) completed the 6-month posttreatment assessment, and 173 (83%) completed the 12-month follow-up.

Acceptability and Treatment Expectations

Participants attended a mean $\pm$ SD of 10.3 ± 5.1 of 16 intervention sessions for teens and 7.9 ± 3.9 of 12 sessions for parents. Posttreatment ratings suggested that most participants rated the intervention services as high quality (4.4 ± 0.8 for teens and 4.4 ± 0.8 for parents on a 1–5 scale [5 being "excellent"]) and reported that the program met their needs (4.0 ± 1.0 for teens and 3.9 ± 1.1 for parents on a 1–5 scale [5 being "definitely met needs"]).

Primary and Secondary Outcomes

The primary outcome, age-adjusted BMI z score, is shown in Fig 2, and secondary outcomes are shown in Table 3. The decrease in BMI z scores over time was significantly greater for intervention participants compared with usual care participants ($P = .01$); however, the intervention effect size was low-to-moderate (Cohen's $d = -0.18$ for BMI z

TABLE 2 Baseline Characteristics of Study Participants

Characteristic	Intervention (n = 105)	Usual Care (n = 103)	Test Statistic	P
Anthropometric measures				
Weight, mean ± SD, lb	189.68 ± 33.47	186.4 3 ± 34.39	$t = 0.69$	.492
BMI, mean ± SD, kg/m^2	32.03 ± 4.79	31.84 ± 4.63	$t = 0.29$	.771
BMI percentile, mean ± SD	97.09 ± 2.27	97.10 ± 2.29	$t = -0.03$	.977
Obese (≥95th percentile BMI), n (%)	88 (83.81)	87 (84.47)	$\chi^2 = 0.02$	.897
Severely obese (≥97th percentile BMI), n (%)	65 (61.90)	70 (67.96)	$\chi^2 = 0.84$	.360
Demographic				
Age, mean ± SD, y	14.12 ± 1.48	14.03 ± 1.50	$t = 0.46$	.647
Grade in school, n (%)			$\chi^2 = 0.00$	.948
6th–8th	55 (52.88)	54 (52.43)		
9th–12th	49 (47.12)	49 (47.57)		
Race/% white, n (%)	75 (71.43)	75 (72.82)	$\chi^2 = 0.05$	.824
Family income >$75 000, n (%)	40 (40.0)	35 (36.46)	$\chi^2 = 0.26$	.610
Menarche (% yes), n (%)	93 (88.57)	86 (85.15)	$\chi^2 = 0.53$	.467
Psychosocial functioning				
Disordered eating (QEWP-A), n (%)	13 (12.38)	13 (12.62)	$\chi^2 = 0.01$	.937
Mood disorder (PHQ-A), n (%)	10 (9.52)	12 (11.65)	$\chi^2 = 0.27$	.601
Quality of life (PedsQL), mean ± SD	71.11 ± 16.22	68.81 ± 16.55	$t = -1.02$	.311
Health behaviors				
Screen time, mean ± SD, h/wk	30.54 ± 14.91	32.23 ± 15.43	$t = -0.80$	.423
Physical activity recall, mean ± SD, min/day	55.35 ± 51.81	49.68 ± 39.47	$t = -0.88$	.379
MET^a/day, mean ± SD	4.28 ± 3.97	3.80 ± 3.13	$t = 0.97$	.334
Team sports participation, n (%)	33 (31.73)	33 (32.35)	$\chi^2 = 0.01$	.924
Eat breakfast, mean ± SD, days/wk	4.86 ± 2.47	4.17 ± 2.60	$t = 1.97$	.051
Family meals, mean ± SD, times/wk	3.85 ± 2.55	4.34 ± 2.51	$t = -1.42$	.158
Fast-food, mean ± SD, times/wk	1.17 ± 1.06	1.27 ± 1.12	$t = -0.69$	.489
Total kilocalories per day (24-h dietary recall), mean ± SD	1601.36 ± 452.73	1583.95 ± 502.92	$t = 0.26$	.795
% of calories from fat (24-h dietary recall), n (%)	NA (32.53)	NA (32.78)	$\chi^2 = -0.27$	.790
Self-reported dieting in previous 6 mo, n (%)	93 (88.57)	83 (81.37)	$\chi^2 = 2.04$	.147
Use of professional weight management services during previous 6 mo, n (%)	37 (35.24)	20 (19.42)	$\chi^2 = 6.54$	.011

Data are presented as mean ± SD unless otherwise indicated. MET, metabolic equivalent; NA, not applicable.

[a] MET is equivalent to a metabolic rate consuming 1 calorie per kilogram of body weight per hour (http://www.sizes.com/units/metequiv.htm).

score and −0.27 for BMI percentile). The 2 study groups did not differ significantly on change over time on any secondary metabolic outcomes. For psychosocial outcomes, those in the intervention group reported greater body satisfaction (P = .03) and less internalization of social norms regarding female attractiveness (P = .02) posttreatment compared with those in usual care. For health behaviors, differences were observed in frequency of family meals (P = .03) and fast-food consumption (P = .02); those in the intervention reported less reduction in family meals frequency and less fast-food intake compared with usual care.

DISCUSSION

This medium-intensity, multicomponent behavioral intervention resulted in a modest decrease in weight status among overweight teen-aged girls (−0.15 in BMI z score among intervention participants compared with −0.08 among usual care participants). To our knowledge, this is the first study to demonstrate the efficacy of a behaviorally based intervention specifically targeting teen-aged girls and demonstrating a sustained effect (at 12 months) beyond the active 5-month intervention. Those in the intervention group reported more frequent family meals and less fast-food consumption. There were no other significant differences in reported health behaviors, and no indication that the intervention increased disordered eating practices. Among intervention participants, changes between baseline and posttreatment (6 months) in the magnitude of screen time reduction (∼5 hours per week) and reduction in reported energy consumption (a decrease of 240 kcal/day) is consistent with changes considered clinically significant by most PCPs. However, given the high variance for these variables, there were no statistically significant differences between the intervention and usual care groups.

Despite the statistical significance of our primary study outcome (BMI z score), the weight reduction magnitude was modest (Cohen's d = −0.27 for BMI percentile and −0.18 for BMI z score), suggesting that a more intensive intervention might achieve more clinically significant outcomes. Previous primary care interventions targeting adolescents found somewhat larger effects,[25,26] although these results may not be comparable because participant populations were at least 50% male and 1 study[25] included younger school-aged children. Furthermore, our participants reported frequent dieting and use of professional weight management services in the 6 months before study enrollment, so they likely had previously adopted some weight management strategies—and therefore achieved more modest effects than those observed in overweight teen boys, who are less likely to report previous weight control attempts.[57,58] A modest proportion (17%–18%) of participants in both study arms reported using ancillary professional services
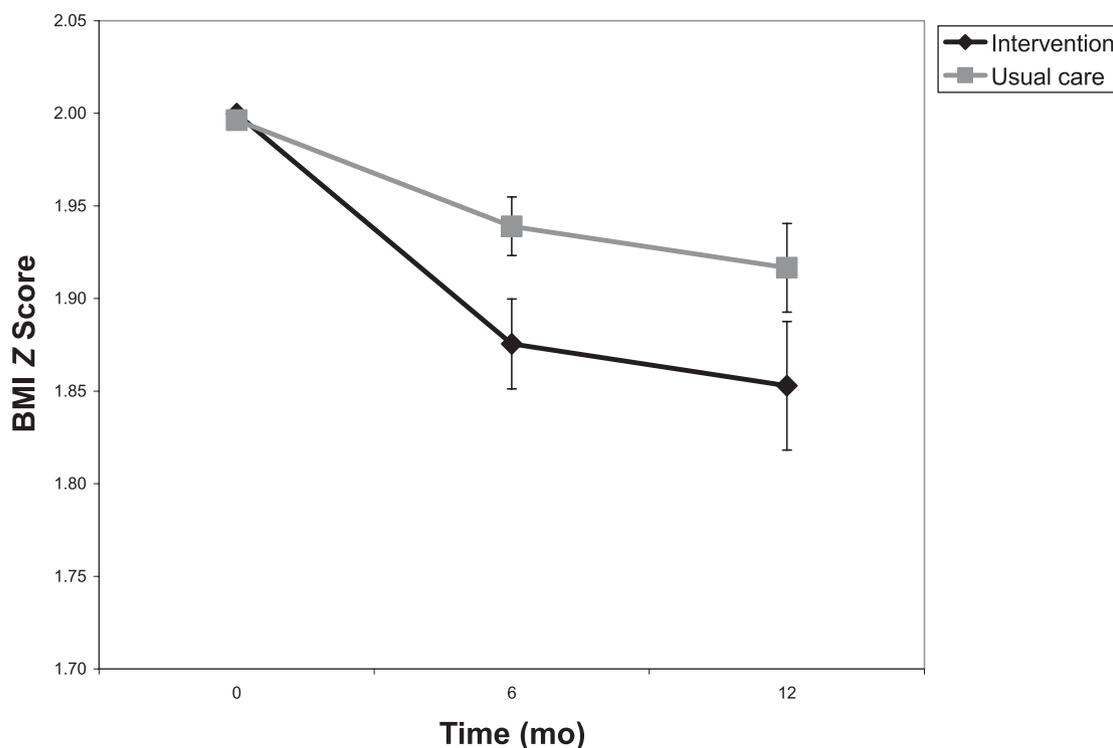
FIGURE 2
Change over time in BMI *z* scores.

for weight control during the active intervention. Furthermore, our participants had high overall BMI at study onset (>97th percentile for age and gender on average). Therefore, our sample may have been treatment resistant, as more severely obese youth are significantly more likely to have persistent weight problems as adults[59] and obtaining sustained decreases in obesity in this population has proved difficult.[60] Finally, because our pilot work for the study suggested substantial teen and parent sensitivity to the teen's identification as overweight, we purposefully emphasized goals to improve body image and self-esteem while learning about healthy choices for eating and exercise, and explicitly de-emphasized weight management. Our results suggest that body image was improved by the intervention.

There were important differences in our intervention approach that, although purposeful, may have attenuated its overall impact. Unlike the vast

majority of behavioral weight loss interventions, we de-emphasized calorie counting. We anticipated that dietary changes related to decreasing energy density of consumed foods and establishing healthier eating patterns would produce more achievable and sustainable results; unfortunately, these guidelines may not have been adequate in achieving clinically meaningful caloric reductions and sustained weight loss. Finally, rather than adopting a more family-centric approach, we purposely focused on helping teens manage their weight with more autonomy. Yet previous interventions, particularly with younger children, have demonstrated that the most robust weight management occurs when parents also adopt targeted lifestyle changes.[61] This finding suggests that an intervention which actively targets parent lifestyle changes (rather than focusing, as this intervention did, primarily on supporting the teen's efforts) may have the benefit of allowing teen autonomy while supporting healthy weight

management and lifestyle changes within the broader family.

A limitation of the study was the lack of racial/ethnic and socioeconomic diversity among study participants, particularly given known health disparities related to obesity.[1,62,63] As children of working insured parents, study participants represent this sizable sector of the population. Yet, we acknowledge that the results might not be generalizable to other subpopulations.

A strength of our study was our inclusion of participants with comorbid mood and disordered eating practices; we believe this was important to increase generalizability given the higher incidence of such problems among overweight youth. Also, until recently, most research-based youth obesity interventions have been conducted in university settings and therefore may not have been representative of efforts in the community. Increasingly, however, health plans are adopting practices to identify

TABLE 3 Twelve-Month Changes in BMI and Secondary Health Outcomes

Measure	Full Intervention (n = 105)			Usual Care (n = 103)			Wald χ^2	Group × Time P value
	Baseline	6 mo	12 mo	Baseline	6 mo	12 mo		
Main outcome measure	n = 105	n = 100	n = 90	n = 103	n = 95	n = 83		
Weight, lb	189.68 (33.47)	190.05 (35.46)	194.56 (38.20)	186.43 (34.39)	190.01 (37.32)	193.50 (37.35)	8.40	0.015
BMI percentile	97.09 (2.27)	95.80 (4.22)	95.19 (6.79)	97.10 (2.29)	96.50 (2.91)	96.28 (3.31)	5.41	0.067
BMI z score	2.00 (0.34)	1.88 (0.41)	1.85 (0.46)	2.00 (0.33)	1.94 (0.38)	1.92 (0.39)	8.77	0.012
Secondary outcome: metabolic (mg/dL)	n = 84	n = 74	n = 69	n = 62	n = 42	n = 48		
Total cholesterol	160.79 (35.25)	159.34 (30.98)	159.80 (30.36)	156.79 (27.77)	160.52 (24.51)	157.35 (19.92)	0.00	0.977
HDL	42.51 (7.96)	43.15 (8.52)	43.10 (7.21)	42.23 (7.53)	44.33 (8.53)	44.85 (9.14)	1.46	0.227
LDL	96.89 (31.42)	95.76 (26.51)	95.96 (26.24)	93.52 (21.85)	94.76 (20.57)	91.40 (19.52)	0.21	0.647
Triglycerides	107.11 (57.69)	102.12 (52.24)	102. 28 (56.07)	105.18 (65.30)	106.88 (58.23)	105.52 (57.10)	0.03	0.872
Fasting glucose	90.51 (14.58)	83.39 (8.23)	84.33 (12.95)	88.74 (7.68)	82.67 (8.88)	85.42 (6.91)	1.15	0.283
Secondary outcome: psychosocial	n = 105	n = 104	n = 85	n = 103	n = 102	n = 76		
Self-esteem (RSE)	2.39 (0.26)	2.40 (0.25)	2.45 (0.26)	2.41 (0.27)	2.39 (0.25)	2.40 (0.24)	2.58	0.275
Body satisfaction (BSS)	2.50 (0.64)	2.83 (0.75)	2.93 (0.66)	2.54 (0.67)	2.75 (0.74)	2.74 (0.74)	7.29	0.026
Appearance attitudes (SATAQ-3)	3.03 (0.98)	2.36 (1.09)	2.18 (0.93)	2.89 (0.95)	2.50 (1.02)	2.43 (0.96)	7.97	0.019
Quality of life (PedsQL)	71.12 (16.22)	77.63 (13.54)	77.80 (13.79)	68.81 (16.55)	73.90 (14.64)	71.67 (16.39)	1.73	0.189
% with disordered eating (QEWP-A)	12.38%	2.24%	0.00%	12.75%	4.82%	1.32%	1.17	0.280
% with mood disorder (PHQ-A)	9.52%	4.49%	7.32%	11.76%	6.02%	5.26%	0.83	0.362
Secondary outcomes: health behaviors								
Screen time, h/wk	30.54 (14.91)	25.44 (12.84)	26.35 (14.04)	32.23 (15.435)	28.30 (14.34)	26.31 (14.23)	2.14	0.343
Physical activity, min/day (PAR)	55.35 (51.81)	64.77 (67.60)	—	49.68 (39.47)	56.39 (53.12)	—	0.14	0.705
Average total MET/day (PAR)[a]	4.28 (3.97)	4.84 (5.11)	—	3.80 (3.13)	4.47 (4.82)	—	0.02	0.889
Eat breakfast, day/wk	4.86 (2.47)	5.07 (2.29)	5.58 (2.11)	4.17 (2.60)	4.39 (2.56)	4.19 (2.69)	2.27	0.322
Family meals, times/wk	3.85 (2.55)	3.76 (2.55)	3.51 (2.60)	4.34 (2.51)	3.23 (2.57)	3.29 (2.49)	7.15	0.028
Fast-food, times/wk	1.17 (1.06)	1.18 (1.32)	1.00 (1.01)	1.27 (1.12)	1.08 (1.17)	1.55 (1.39)	7.70	0.021
Sugar-sweetened beverages/sodas (times/wk)	1.10 (1.43)	0.92 (0.89)	0.97 (1.18)	1.48 (1.68)	1.09 (1.16)	1.22 (1.57)	2.76	0.252
Total kcal/day (ESHA)	1601.36 (452.73)	1361.32 (412.14)	—	1593.95 (502.92)	1425.00 (458.72)	—	0.97	0.325
% of calories from fat (24-h dietary recall)	32.53	32.54	—	32.78	33.77	—	0.59	0.441
Other								
Use of professional weight management services during previous 6 mo, %	35.24	16.48	16.67	19.42	18.07	12.00	3.56	0.169

Data are presented as mean ± SD unless otherwise indicated. BSS, Body Satisfaction Scale; HDL, high-density lipoprotein; LDL, low-density lipoprotein; MET, metabolic equivalent; PAR, physical activity recall; RSE, Rosenberg Self-Esteem Scale; SATAQ, Sociocultural Attitudes Towards Appearance Scale.

[a] MET is equivalent to a metabolic rate consuming 1 calorie per kilogram of body weight per hour; http://www.sizes.com/units/metequiv.htm.

members who may benefit from similar health behavior interventions; therefore, our efforts to expand eligibility may render our results more generalizable.

CONCLUSIONS

A 5-month, medium-intensity, primary care–based multicomponent behavioral intervention was associated with significant and sustained decreases in BMI z score among obese adolescent girls when compared with those randomized to receive usual care. Although the magnitude of the effect was modest, these early findings suggest the promise of interventions delivered within primary care settings tailored specifically for teen-aged girls. Future research should consider more intensive models building on these foundational elements; namely, whether adoption of specific caloric and activity guidelines as well as more active participation of parents and other family members may enhance teen outcomes.

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A Primary Care–Based, Multicomponent Lifestyle Intervention for Overweight Adolescent Females

Lynn L. DeBar, Victor J. Stevens, Nancy Perrin, Philip Wu, John Pearson, Bobbi Jo Yarborough, John Dickerson and Frances Lynch

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