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Six-Month Dietary Changes in Ethnically Diverse, Obese Adolescents Participating in a Multidisciplinary Weight Management Program

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Abstract

This study's objective was to examine dietary and metabolic changes in obese adolescents who completed 6-months of participation in an outpatient multidisciplinary weight management program (N=67). Participants (75% African American, 66% female, M age=13.7) completed 24-hour dietary recalls and underwent measurement of anthropometrics and fasting blood lipid parameters at baseline and after 6 months of participation. General linear models suggested that participants significantly reduced total energy, total fat, saturated fat, carbohydrate, sodium, and sugar intakes, and increased fiber and fruit and vegetable intake ($P<0.05$). Gender stratified models showed differences in fruit/vegetable intake, % calories from fat, sodium and dietary cholesterol intakes by gender. Significant improvements in body mass index percentile and lipid profiles were also found, lending objective support to the dietary changes participants made. Findings suggest that participation in this multidisciplinary treatment helped participants make behaviorally based dietary changes, which were associated with improved dietary intakes and health status.

Keywords

diet; weight management; adolescents; obesity

Introduction

Pediatric overweight and obesity are major public health issues in the United States, particularly among African American and Mexican-American youth.[1–3] Overweight and obese youth are more than 20 times more likely to become obese adults than their non-overweight peers.[4] Furthermore, obesity during childhood and adolescence is associated

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with increased risk of developing metabolic complications both during childhood and as an adult.[5] Moreover, the risk of weight-associated morbidities is higher in certain racial/ethnic groups.[6] Thus, weight management interventions targeting obese youth from ethnic minority groups are essential. Family-based multidisciplinary lifestyle interventions have demonstrated the greatest (although still modest) efficacy to date[7] and are currently recommended as part of the treatment for pediatric obesity.[8] Limited research, however, has examined clinical treatment programs targeting ethnic minority populations, who are disproportionately affected by obesity.[9]

Dietary intervention is an essential component of multidisciplinary treatment programs, as dietary intake significantly contributes to the energy imbalance leading to obesity. Dietary factors are also independently related to the development of many chronic diseases, including type 2 diabetes, certain cancers, and cardiovascular disease.[10] Thus, examining effective methods for promoting dietary change is essential for the treatment of pediatric obesity and the prevention of obesity-related comorbidities.

One major limitation of the extant literature examining interventions for pediatric obesity is that dietary intakes are rarely reported, making it difficult to determine the effectiveness of the interventions for eliciting dietary change.[11] It is well-known that dietary assessment in adolescents is challenging and often burdensome for both the researcher and the participant,[12] which may contribute to the paucity of assessing and reporting of dietary intake in pediatric obesity studies.[13–14] However, this information is critical to evaluate the effectiveness of interventions, and thus, guide the development of effective obesity interventions.

The current study

T.E.E.N.S. (Teaching, Exercise, Encouragement, Nutrition, Support) is an ongoing family-based, multidisciplinary treatment program for obese adolescents, at a university-based weight management clinic. The three main program components are nutrition, physical activity, and behavior support and modification; the program's duration is two years. We have previously reported cross-sectionally on the compromised psychosocial functioning of these adolescents; specifically their poor overall psychosocial functioning, which is negatively associated with their quality of life.[15] Further, T.E.E.N.S. participants, at six months, demonstrated significant improvements in cardiorespiratory fitness[16] as well as significant reductions in the many of the signs of metabolic syndrome, such as BMI z-score, total cholesterol and percent body fat.[17] The aims of this study were to describe the changes in dietary intake of participants after six months of participation in T.E.E.N.S. intervention. We also analyzed changes in lipid profiles and anthropometric measures within this specific cohort of participants (although lipid data was examined previously in a sample including some of these participants).[17] We hypothesized that participants would report significant improvements in their diets as measured by 24 hour dietary recalls.

Methods

Participants

Between December 2004 and October 2007, 187 participants enrolled in T.E.E.N.S. and completed baseline assessments. Participants were eligible if they: 1) were age 11–18 years, 2) had a BMI ≥ 95th percentile for age and gender,[1] 3) had a parent willing to participate, 4) had an identified primary care physician, and 5) had no underlying medical condition which would preclude weight loss through behavioral intervention. Participants were referred from pediatricians, family medicine physicians, school nurses, or self-referred. Study procedures were approved by the Institutional Review Board of Virginia Commonwealth University.

Parents provided written, informed consent and adolescents provided written assent prior to program participation.

Design and Procedures

Overview—At baseline, participants completed separate intake assessments with a behavior support specialist (psychology doctoral student under the supervision of a licensed clinical psychologist), a registered dietitian, and an exercise physiologist. Participants and their parents/caregivers completed psychosocial and behavioral measures, and parents provided demographic data. Participants underwent an initial examination by a program physician and a half-day visit to the General Clinical Research Center (GCRC) at Virginia Commonwealth University for standardized anthropometric measurements and metabolic testing. Once enrolled, participants and their parents attended alternating biweekly appointments with the dietitian and behavioral support specialist, and participants were expected to engage in physical activity at least three times per week (described below). After 12-weeks of program participation, families attended a tour of a local grocery store led by a dietitian and received a $100 gift card to the grocery store. Parents were expected to attend nutrition visits with their child, and participants were encouraged to maintain a program notebook to track goals and progress towards these goals. They were asked to bring this notebook to all nutrition and behavior support visits. Participants were allowed to continue in T.E.E.N.S. as long as they met the minimum requirement of 70% attendance for each program component (physical activity, nutrition, behavior support). All baseline measures were repeated at 6-months, at which point participants received an additional $100 grocery store gift card.

The Dietary Intervention—The dietitian followed a standardized lesson plan to provide nutrition education (see Table 1). In these 30 minute visits, the dietitian also discussed specific concerns and questions from the parent and participant and collaboratively set personalized goals at each biweekly visit. Goals were behavioral and focused on eating patterns and other behaviors associated with obesity, such as eating breakfast, switching to reduced fat dairy, increasing fruits and vegetables, reducing intake of sugar-sweetened beverages, and eating more meals at home as a family. A specific diet or caloric intake goal was not set. Progress on these goals and strategies to reach the goals were explored in the behavior support session (described below) and the dietitian also monitored progress on the goals in the subsequent nutrition visit. A reward for meeting each goal was collaboratively determined each week by the parent, participant, and dietitian. Participants were encouraged to self-monitor progress towards goals using logs provided in their T.E.E.N.S. notebook.

Behavior Support—On alternating weeks, participants met for 30 minutes with a behavioral support specialist, who monitored progress on nutrition and exercise goals, conducted psychoeducation about behavior change, and provided psychological support. These sessions varied based on the participants' needs, but generally followed a cognitive behavioral approach to behavior change. Sessions included psychoeducation about self-monitoring, problem solving, planning, and goal-setting strategies, explored benefits and barriers to changes, and conducted relapse prevention. The behavioral support specialist also explored psychological and psychosocial factors associated with obesity (e.g., body image disturbance, peer victimization, and depression). However, if participants presented with suicidal ideation or other serious psychopathology, outpatient psychotherapy referrals were made and participation in T.E.E.N.S. was contingent upon their involvement in psychotherapy. In this way, the behavior sessions could focus on T.E.E.N.S.-related issues and psychological concerns were appropriately addressed on an outpatient basis.

Physical Activity—The third program component was physical activity. Participants were required to attend the program gym at least once each week for supervised exercise sessions, and document two other occasions of exercise per week either at the T.E.E.N.S. gym or other location of their choosing. After attending the program gym four times, participants and their parents received a complimentary membership to their local YMCA. During supervised exercise sessions with a program exercise physiologist, participants engaged in 30 minutes of resistance training and 30 minutes of cardiorespiratory exercise. Participants routinely wore heart rate monitors (E600 Polar Electro, Inc) and were encouraged to maintain a heart rate above 150 beats per minute during the cardiorespiratory exercise session.

Measures

Dietary Data—Two multiple pass, consecutive, parent-assisted 24-hour dietary recalls were conducted in person with participants by a trained registered dietitian. Data were entered into Nutritionist Pro[18] for nutrition analysis, which contains an extensive database of ingredients and foods. The dietitian used 2 and 3-dimensional tools, including food models and empty food containers (e.g., potato chips, drinks, and other frequently-consumed items) to aid in portion estimates, and used memory prompts to assist with recall of frequently forgotten foods. An average of the 2-day intake of each nutrient or food group is reported. Analyses were conducted examining percent calories from macronutrients (protein, fat, and carbohydrates), total energy intake (kcals), and absolute intake of fat (g), saturated fat (g), dietary cholesterol (g), protein (g), carbohydrates (g), fiber (g), servings of fruits and vegetables (combined), sugar (g), sodium (mg), and calcium (mg). Nutrition Pro calculates serving sizes of fruits and vegetables based on the USDA Standard Reference Database. Dietary recalls are considered to be a particularly useful tool in culturally diverse samples, as they can accommodate a range of foods and impose a minimal response burden on participants.[19] Estimated energy requirements (or basal metabolic rate [BMR]) were calculated based on the Schofield equation.[20] The ratio of BMR to Energy Intake (EI) was then calculated.

Anthropometric and Lipid Profile—Anthropometric measures and fasting blood samples were collected at the GCRC nearest 0.1 cm inch using a stadiometer (Holtain Limited by Crymmych Pembs, U.K.). Weight was measured in light clothing with shoes removed to the nearest 0.1 kg using an electric scale ("Health o meter" model 2500 KL, Serial # 971ow2407). These data were used to calculate BMI (kg/m^2). BMI *z*-scores and age and gender-specific BMI percentiles were determined using Epi Info software program (CDC, Version 3.3). Percent body fat (% body fat) was determined by bioelectric impedance analysis (Quantum II, RJL Systems). Total cholesterol (TC), triglycerides, and high-density lipoproteins (HDL) were measured using a Roche automated clinical chemistry analyzer. Low-density lipoprotein cholesterol (LDL-C) was calculated by the Friedewald equation (LDL = TC − HDL − [Triglycerides/5]). [21]

Data Analysis

Test for normality were examined, and one participant with extreme data was removed as his scores skewed the data (i.e., for this participant, total Calories = 4956 kcal, Total Fat = 234 g). Gender differences in baseline data were examined with independent samples t-tests and chi-square analyses. Point biserial correlations were used to explore differences in 6-month completers vs. non-completers on demographic and key study variables. Two linear models/GLM repeated measures multivariate analyses of variance (MANOVA), with time as the within-subjects variable, were used to examine baseline to 6-month changes in dietary variables and anthropometric and lipid variables. Wilks' was used in multivariate analyses as the omnibus test for the overall model. Repeated measures MANOVA is preferable to the inflated Type I error rate with multiple paired samples t-tests; however it does not preclude the risk of a Type II error, or missing a significant finding, with a smaller sample.[22] Data were then stratified by gender to examine gender differences in outcomes. To conservatively estimate if attrition biased the findings, intention-to-treat (ITT) analyses[23] were also conducted, bringing the baseline scores forward to 6-months for participants who dropped out prior to this point and running the above analyses with these imputed data. Of note, 11 participants were also enrolled in a small randomized trial with the T.E.E.N.S. program, investigating the effects of metformin versus placebo control on weight loss; when inclusion in this trial was added as a covariate, results did not meaningfully differ (i.e., all significance tests remained the same). Thus, these participants were included in the preceding analyses. PASW v18.0 (Chicago, IL) was used for all analyses, and all significance tests were 2-tailed.

Results

Sixty-six percent of participants were female, with a mean age of 13.7 years (range = 11.0–17.7 years). Most participants were African American (75.3%), with 22.0% Caucasian, and 2.7% other ethnicity. At baseline, parents reported annual household income (n = 166) and parent education (n = 168); 37.3% reported earning less than $30,000/year, 24.1% reported $30–50,000/year and 38.6% reported >$50,000/year. About 24% of parents completed high school or less, 36.9% completed some college, and 39.3% had at least a college degree. Mean adolescent BMI percentile was 99.1% (M BMI z-score = 2.5). Baseline gender differences were found in several study variables, thus main analyses were stratified and reported by gender. See Table 2 for baseline participant characteristics for the whole sample and by gender.

Of the 187 participants who consented, 27 (14.4%) completed baseline assessments only and did not begin T.E.E.N.S. program activities. At 6-months, 68 youth were still participating and had complete dietary data (68/160, 43%). These completers (n = 67, with outlier removed) were similar to non-completers on all but two study variables: non-completers were more likely to have lower HDL cholesterol and greater protein intakes (although no significant differences in % calories from protein) at baseline than completers ($P < 0.05$, data not shown).

Table 3 reports baseline and 6-month dietary intakes and results of multivariate analyses for total energy, macronutrients, and micronutrients, for the full sample of completers and stratified by gender. As shown, total energy intake decreased following 6 months of program participation, by a mean of 483 kcal/day ($P < .001$). Significant reductions were also reported in daily total fat, saturated fat, dietary cholesterol, total carbohydrates, sugar, and sodium intakes ($P < 0.05$). With respect to the macronutrient composition, percent calories from protein increased (14.9% at baseline to 17.9% at 6-months); however, no significant changes in percent calories from fat or carbohydrates were reported. Total servings per day of fruits and vegetables increased by 0.6 of a serving and fiber intake increased by 3 g ($P < 0.05$).

In gender stratified models, few differences were noted. Only boys significantly reduced their percent calories from fat. This change resulted in boys' intakes changing from above to within the acceptable macronutrient distribution range set by the USDA (25–35% calories from fat for both genders, ages 4–18) [24]. The increase in fruit and vegetable intake was also only significant for boys; (however, boys' fruit and vegetable intake was significantly lower than girls' at baseline [1.9 vs 2.7 servings per day, $P < 0.05$]). Significant reductions in dietary cholesterol and sodium intakes were only significant for girls; there were no baseline gender differences in either variable.

Main effects over time for the anthropometric and lipid variables for the full sample and stratified by gender are presented in Table 4. As noted, significant decreases were found in absolute BMI, BMI z-score, BMI percentile, % body fat, total cholesterol, LDL, HDL, and triglycerides at 6 months ($P < 0.05$). BMI percentile decreased from just over the 99th to the 98.5th percentile ($P < 0.001$), corresponding to a BMI z-score decline from 2.4 to 2.3 ($P < 0.001$). Gender stratified models were similar, with the exception that HDL significantly decreased for boys only, and the decreases in triglycerides and percent body fat were significant for girls only (although trends were consistent in both genders).

Intent to Treat

ITT analyses for the dietary, lipid and anthropometric variables, bringing the baseline scores forward for participants who did not complete the 6 month evaluation, were similar to the completer analyses described above for the total sample model (N = 187) and the gender stratified models (all previously significant findings remained significant, in the same direction). In gender stratified models, % body fat became significant for boys (mean decrease from 29.5% to 28.9%, $P < 0.01$), likely due to the increased power of the model.

Discussion

The primary aim of this study was to investigate the impact of participation in an outpatient, multidisciplinary weight management program on changes in dietary intakes in obese adolescents. Significant improvements in many areas of participants' diets were found after 6-months of participation in T.E.E.N.S. Data suggest that, overall, the T.E.E.N.S. intervention led to significant reductions in total energy intake, while still maintaining appropriate macronutrient compositions (i.e., % calories from protein fat and carbohydrates were all within the acceptable macronutrient distribution range according to the Dietary Reference Intakes [DRI] for adolescents).[24] Reductions in total fat, saturated fat, and dietary cholesterol are also noteworthy and correspond to the reductions in blood lipid parameters found at 6-months.[16–17] Other positive improvements found were increased fiber and fruit and vegetable intake, a 41 g/day reduction in sugar intake and a 604 mg/day reduction in sodium intake, suggesting that participants made significant changes to their diets while participating in T.E.E.N.S.

While the focus of this investigation was on dietary changes, biochemical and anthropometric data were analyzed and presented to provide objective indicators supportive of dietary changes in this cohort of participants. Specifically, the significant reductions in BMI z-score are consistent with the reduction in energy intake (although likely are also influenced by increased physical activity, reported elsewhere).[16] Further, improvements in blood lipid parameters are consistent with the reductions in total fat, saturated fat, and dietary cholesterol described above. Although mean BMI was still >95th percentile at 6-months, data are suggestive of improved health status in participants. The significant reductions in BMI and improvements in body composition are notable when compared to data suggesting that children at the 95th percentile of body weight who are not in treatment will gain 5–7 kg annually, which is similar to what has been found in 8–16 year old obese children in a control group receiving standard of care (traditional weight management counseling every 6 months) in the Bright Bodies Program.[25] Although dietary intake was not reported in Bright Bodies, this comparison with their control group and national growth statistics increases support for the positive effects of T.E.E.N.S. on objectively-measured physiological health indicators.

Although these statistically significant findings are encouraging, the clinical significance of these dietary changes should also be considered and compared to the DRI for adolescents.[24] For example, 6-month fruit and vegetable intake (M = 3.0 servings per day) represented an increase from baseline; however this falls short of the recommended 5–9 servings per day. Similarly, fiber intake is well-below the recommended intake for males (15 g vs. 38 g recommended) and females (16 g vs. 29 g recommended). Girls' calcium requirements are particularly important due to increased risk of osteoporosis;[26] however girls' 6-month calcium levels (700 mg) were lower than boys' (938 mg), and both were well below the recommended 1300 mg/day for this age group. These data suggest that modifications to the intervention's nutrition lessons and individual goals to specifically promote these deficient nutrients might be warranted. In addition, more than 6- months of intervention may be needed to achieve greater dietary improvements.

Comparison with other studies is limited by the paucity of reporting of dietary intake in obesity treatment programs, particularly among this underserved population.[11] Further investigation about the effectiveness of the T.E.E.N.S. behavioral dietary approach compared to other strategies is also needed. There is some evidence that providing a structured meal plan is less effective and less attractive to participants of this age and ethnic group, than is an approach similar to T.E.E.N.S., which focuses on improving food choices and portion sizes.[25,27] Indeed, in a multidisciplinary weight management program targeting obese inner city minority youth ages 8–16 years, the structured meal plan treatment arm was discontinued due to high (82%) attrition, with the majority of drop-outs stating it was too difficult to adhere to the meal plan.[25] Other dietetic approaches have been examined by Epstein and colleagues[28] with overweight and obese, primarily Caucasian children ages 8–12 years, based on the Stoplight Diet, which identifies high calorie foods ("red"), moderate-calorie foods ("yellow"), and low calorie, healthy options, such as vegetables ("green"). Within the context of a reduced-calorie Stoplight Diet, the authors found that promoting an increase in healthy food consumption (i.e., "green foods") was more effective in reducing consumption of unhealthy foods (i.e., "red foods") than directly targeting reducing consumption of high energy-dense foods. The "increase healthy foods" group also had greater reductions in BMI z-score and BMI percentile. The authors concluded that increasing healthy eating (as opposed to focusing on reducing intake of less healthy foods) may be an important target of pediatric obesity interventions. These different strategies for dietetic intervention with obese adolescents warrant further investigation.

Limitations of this study should be noted. Data are from the initial cohorts of an ongoing weight management program. Because this was a community-based pilot, no control group was enrolled to compare the magnitude of the findings, presenting threats to internal validity including regression to the mean, history, and maturation. The dietary recall method used also has limitations. Specifically, while collecting dietary recall data on three random, nonconsecutive days is preferable, we used the two previous consecutive days of intake due to study limitations (i.e., scheduling and personnel availability). Limitations of recall include underreporting of energy intake, which may be a particular problem with this sample (mean BMI in the 99^{th} percentile), as underreporting of energy intake has been found to be positively correlated with increased body weight.[29] However it is unlikely that there is differential bias at baseline versus six months. Twenty-four hour recalls are considered a highly valid and reliable method for obtaining dietary intake data,[19] and recalls have been demonstrated to result in accurate energy intake estimates for youth ages 15–18 years.[14] To estimate the potential under-reporting of energy intake, we calculated the ratio of reported EI to BMR using the Schofield Equation.[20] Mean EI to BMR ratio was 1.02 (2090:2034) at baseline, suggesting participants' energy requirements were lower than their intake (as expected), thus underreporting was not likely a significant factor. At six months, this ratio declined to 0.80 (1607:2014), which we would anticipate as participants were still actively involved in T.E.E.N.S. Furthermore, the improvements in objectively-measured biochemical and anthropometric data (specifically total cholesterol, triglycerides, LDL, and BMI z-scores) over the intervention period increase confidence in the dietary changes reported.

Attrition was high, although comparable to (and lower than) that reported in similar weight management programs targeting predominately African American participants of relatively low socioeconomic status.[30] Attrition can be a particular problem in this population,[31] as there are numerous strains on families making compliance with a rigorous weight management program like T.E.E.N.S. difficult, including transportation challenges, single-parent homes, and having limited resources; thus, continued strategies to reduce attrition are needed. The similarity of the intent to treat analyses to the completer analyses lends increased confidence that these findings are not significantly biased by attrition. Moreover, the current sample of primarily African American families from lower socioeconomic status is a strength of this study, as it is one that is disproportionately affected by pediatric obesity and understudied in this context. Thus major strengths of this study are that we examined comprehensive dietary, anthropometric and lipid data in a predominately African American sample after participation in a highly intensive weight management intervention.

In summary, this study provides support for multiple positive dietary and physiological changes after 6 months of participation in a multidisciplinary weight management treatment program focusing on helping participants make behaviorally-based dietary changes. It also highlights areas in participants' diets that remain deficient and in need of improvement, thus guiding intervention modifications and future research and suggesting that additional dietary intervention is needed. As this is one of only a handful of studies reporting dietary intakes in the context of pediatric obesity interventions, these data are important to help inform behavioral weight management strategies targeting dietary changes in this population at high risk for chronic disease.

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Table 1

Outline of T.E.E.N.S. Nutrition Education Topics

Session/Week Number	Topic
Orientation- Week 1	Overview of behavioral approach to dietary change
1- Week 2	Food Guide Pyramid; Reading Labels
2- Week 4	Hunger Cues; Smart Snacking
3- Week 6	Food Portions I
4- Week 8	Food Portions II
5- Week 10	Energy Balance
6- Week 12	Fruits and Vegetables-5-9 per day
7- Week 14	Eating on the Run/Dining Out
8- Week 16	Shopping Solutions for Healthy Eating
9- Week 18	Take Control of your Environment
10- Week 20	Dealing with Cravings
11- Week 22	Carbohydrates, Proteins, and Fats
12- Week 24	Vitamins, Minerals, Antioxidants

Note: Participants met with the Registered Dietitian every other week for 6 months. Participants met with the behavioral support specialist on alternating weeks.

Table 2

Baseline anthropometric, metabolic, and dietary intake characteristics for T.E.E.N.S. participants: full sample and stratified by gender.

Variable	Total (N = 186)	Males (n = 63)	Females (n = 123)
%Female	66.1%	--	--
%African American [a]	75.3%	63.5%*	81.3%
Age	13.7 ± 1.8	13.6 ± 1.7	13.8 ± 1.8
Total Energy (kcal)	2146 ± 654	2232 ± 681	2102 ± 638
%Calories from Fat	34.9 ± 7.1	35.3 ± 6.2	34.6 ± 7.5
Total Fat (g)	83 ± 30	88 ± 32	81 ± 29
Saturated Fat (g)	28 ± 12	30 ± 13†	27 ± 10
Dietary Cholesterol (g)	280 ± 158	264 ± 148	288 ± 162
%Calories from Protein	15.3 ± 3.5	16.0 ± 3.9††	14.9 ± 3.32
Protein (g)	81 ± 28	88 ± 30*	78 ± 26
% Calories from Carbohydrates	49.4 ± 9.0	48.4 ± 8.2	50.0 ± 9.3
Total Carbohydrate (g)	272 ± 95	276 ± 99	269 ± 93
Fiber (g)	13 ± 6	13 ± 7	13 ± 6
Sugar (g)	124 ± 64	127 ± 75	123 ± 58
Fruit and Vegetable servings (servings/day)	2.2 ± 2.0	1.8 ± 1.5*	2.4 ± 2.2
Sodium (mg)	3530 ± 1247	3687 ± 1286	3451 ± 1225
Calcium (mg)	803 ± 433	932 ± 533**	738 ± 357
BMI absolute (kg/m^2)	38.0 ± 6.9	36.9± 6.0	38.5 ± 7.3
BMI percentile (%)	99.1 ± 0.8	99.1 ± 1.1	99.1 ± 0.6
BMI *z*-score (SD)	2.5 ± 0.3	2.5 ± 0.3	2.4 ± 0.2
Percent Body Fat (%) [b]	44.1 ± 11.9	29.5 ± 4.2***	51.6 ± 6.1
Triglycerides (mg/dL)	97.9 ± 54.6	102.1 ± 60.0	95.8 ± 51.8
LDL Cholesterol (mg/dL)	100.2 ± 23.6	107.7 ± 24.8**	96.4 ± 22.1
HDL Cholesterol (mg/dL)	43.1 ± 9.9	42.2 ± 10.1	43.6 ± 9.9
Total Cholesterol (mg/dL)	162.9 ± 28.4	170.3 ± 30.5**	159.2 ± 26.7

Variable	Total (N = 186)	Males (n = 63)	Females (n = 123)
Total/HDL (mg/dL)	3.95 ± 1.04	4.23 ± 1.21 *	3.80 ± 0.91

Note: Data are mean ± standard deviation unless otherwise indicated. Nutrient data represent average of two 24-hour recalls; Abbreviations: kcal=kilocalories, BMI=body mass index, LDL=low-density lipoproteins, HDL=high-density lipoproteins.

[a]For analyses, data recoded into African American and White/Other;

[b]Determined by bioelectrical impedance analysis.

†$P = 0.056$,

††$P = 0.059$,

*$P < 0.05$,

**$P < 0.01$,

***$P < 0.001$, indicating baseline gender differences

Table 3

Dietary intakes at baseline and after 6-months of T.E.E.N.S. participation: whole sample and by gender.

Variable	Total (n = 67)			Boys (n = 22)			Girls (n = 45)		
	Baseline	**6-month**	***P***	**Baseline**	**6-month**	***P***	**Baseline**	**6-month**	***P***
Total energy (kcal)	2090 ± 80	1607 ± 52	**<0.001**	2230 ± 156	1654 ± 99	**<0.01**	2021 ± 92	1584 ± 60	**<0.001**
% Calories Fat	34.9 ± 0.9	32.4 ± 1.0	0.09	37.2 ± 1.4	31.1 ± 1.7	**<0.05**	33.7 ± 1.1	33.0 ± 1.3	0.69
Total Fat (g)	80 ± 3.3	56 ± 2.5	**<0.001**	90 ± 6.2	57 ± 5.2	**<0.001**	75 ± 3.8	56 ± 2.8	**<0.001**
Saturated Fat (g)	27 ± 1.3	18 ± 0.9	**<0.001**	31 ± 2.7	19 ± 1.9	**<0.01**	25 ± 1.3	18 ± 1.1	**<0.001**
Dietary Cholesterol (mg)	281 ± 20.4	199 ± 15.2	**<0.01**	283 ± 33.6	212 ± 21.3	0.10	280 ± 25.8	193 ± 20.1	**<0.01**
% Calories Protein	14.9 ± 0.5	17.9 ± 0.5	**<0.001**	15.5 ± 0.8	18.8 ± 0.8	**<0.05**	14.6 ± 0.6	17.5 ± 0.6	**<0.001**
Protein (g)	76 ± 2.7	72 ± 2.6	0.30	84 ± 5.0	76 ± 3.9	0.25	71 ± 3.2	69 ± 3.4	0.66
% Calories Carbohydrates	49.3 ± 1.2	55.4 ± 5.8	0.31	47.2 ± 1.7	50.2 ± 1.9	0.32	50.3 ± 1.6	58.0 ± 8.7	0.40
Total Carbohydrates (g)	267 ± 12.1	208 ± 7.3	**<0.001**	277 ± 25.4	212 ± 12.7	**<0.05**	262 ± 13.3	206 ± 9.23	**<0.001**
Fiber (g)	13 ± 0.7	16 ± 1.1	**<0.01**	12 ± 1.0	15 ± 1.2	**<0.05**	13 ± 0.9	16 ± 1.5	0.054
Sugar (g)	126 ± 8.9	85 ± 4.5	**<0.001**	135 ± 20.1	90 ± 7.3	**<0.05**	122 ± 9.0	83 ± 5.7	**<0.001**
Fruit/Veg[c]	2.4 ± 0.2	3.0 ± 0.2	**<0.05**	1.9 ± 0.2	3.0 ± 0.4	**<0.05**	2.7 ± 0.3	3.1 ± 0.3	0.37
Sodium (mg)	3438 ± 141	2834 ± 103	**<0.001**	3561 ± 267	3231 ± 220	0.30	3377 ± 166	2640 ± 98.0	**<0.001**
Calcium (mg)	727 ± 41.3	778 ± 45.1	0.34	826 ± 81.8	938 ± 95.5	0.32	678 ± 45.5	700 ± 44.7	0.71

Note: Data reported are means ± s.e.m. Total refers to participants who completed 6-months in T.E.E.N.S.; Wilks' Lambda used for multivariate tests; Nutrient data represent the average of two 24-hour recalls; Abbreviation: kcal=kilocalories,

[c] Fruit/Veg=combined fruit and vegetable servings per day.

Table 4

Baseline to 6-Month changes in body mass index, percent body fat, and lipid parameters for the whole sample and by gender.

Variable	Total (n = 65)[d]			Boys (n = 22)			Girls (n = 43)		
	Baseline	**6-month**	***P***	**Baseline**	**6-month**	***P***	**Baseline**	**6-month**	***P***
BMI absolute (kg/m^2)	36.8 ± 0.66	35.5 ± 0.70	<0.001	35.8 ± 1.31	34.3 ± 1.34	<0.01	37.3 ± 0.73	36.1 ± 0.80	<0.01
BMI z-score (SD)	2.4 ± 0.03	2.3 ± 0.04	<0.001	2.5 ± 0.07	2.3 ± 0.09	<0.01	2.4 ± 0.03	2.3 ± 0.05	<0.001
BMI percentile (%)	99.1± 0.10	98.5 ± 0.21	<0.001	99.0 ± 0.24	98.3 ± 0.46	<0.05	99.1 ± 0.08	98.6 ± 0.21	<0.01
% Body Fat[b]	43.3 ± 1.46	42.1 ± 1.47	<0.01	28.2 ± 0.93	27.2 ± 0.93	0.055	51.0 ± 0.70	49.8 ± 0.84	<0.05
LDL Chol (mg/dL)	101.3 ± 3.01	94.5 ± .53	<0.01	105.7 ± 5.30	96.5 ± 4.19	<0.05	99.1 ± 3.64	93.5 ± 3.19	<0.05
HDL Chol (mg/dL)	45.0 ± 1.20	43.2 ± 1.17	<0.01	46.1 ± 2.19	42.5 ± 1.61	<0.05	44.5 ± 1.45	43.5 ± 1.58	0.197
Total Chol (mg/dL)	165.8 ± 3.52	153.5 ± 3.41	<0.001	169.3 ± 6.48	153.7 ± 5.48	<0.01	163.9 ± 4.20	153.4 ± 4.37	<0.01
LDL/Total Chol (mg/dL)	3.82 ± 0.12	3.67 ± 0.11	< 0.05	3.82 ± 0.22	3.71 ± 0.18	<0.05	3.82 ± 0.15	3.66 ± 0.14	<0.05
Triglycerides (mg/dL)	96.7 ± 6.88	80.9 ± 5.91	<0.01	87.7 ± 8.08	73.6 ± 8.51	0.09	101.3 ± 9.54	84.7 ± 7.81	<0.05

Note: Data are reported as means ± s.e.m. Wilks' Lambda used for multivariate test; Total refers to participants who completed 6-months in T.E.E.N.S. Abbreviations: BMI=body mass index, Chol=cholesterol, LDL=low-density lipoproteins, HDL=high-density lipoproteins;

[b]Determined by bioelectrical impedance analysis,

[d]N differs from that used in dietary analyses as a result of 2 participants who did not complete 6-month testing.