



Evaluation of BMI in obese adolescents at weight-loss camp with the Boy Scouts of America

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Abstract

Background: Summertime is particularly problematic for obese youth, as this unstructured time typically shows accelerated weight gain. We hypothesized that obese adolescents participating in a pilot summer camp program, developed in partnership with the Boy Scouts of America, would demonstrate significant weight loss and improvement of metabolic parameters.

Methods: Obese and overweight adolescent males between ages 13 and 18 were eligible for enrollment. BMI (kg/m^2) and additional anthropometric and metabolic measurements were measured at the start and end of the 4 week camp.

Results: Thirteen participants enrolled and ten participants with the mean age of 16.1 years finished camp. Among these ten participants, BMI decreased by 9.1% ($40.2 \pm 13.0 \text{ kg}/\text{m}^2$ vs. $36.5 \pm 12.0 \text{ kg}/\text{m}^2$; $p < 0.001$). Waist circumference decreased by 7.4% ($48.4 \pm 9.6 \text{ cm}$ vs. $44.9 \pm 9.4 \text{ cm}$; $p < 0.001$), and fasting glucose levels decreased by 23.1% ($84 \text{ mg}/\text{dL}$ vs. $62 \text{ mg}/\text{dL}$; $p = 0.001$).

Conclusions: BMI and metabolic parameters significantly improved after 4 weeks of camp. Partnering with the Boy Scouts of America is an innovative approach to creating a summer weight management camp for adolescents.

Keywords: Childhood obesity, weight loss treatment, blood pressure, hyperlipidemia

Introduction

Obesity is a global epidemic [1] and a public health crisis [2,3]. For overweight children, BMI increases more rapidly in summertime compared to the school year [4,5].

The Penn State Hershey Children's Hospital in Hershey, Pennsylvania (USA) partnered with the Boys Scouts of America (BSA) to create an evidence-based weight-loss camp. The BSA organization promotes responsible citizenship through outdoor and educational activities. We hypothesized that adolescents participating in this pilot summer camp program would demonstrate significant weight loss and improvement of metabolic parameters.

Methods

Program overview

Penn State Hershey Children's Hospital partnered with the Hidden Valley Boy Scout Reservation in Loysville, Pennsylvania.

Camp staff consisted of two physicians, two BSA leaders, two dietitians, a psychologist, an exercise physiologist, one fitness leader, one cook, counselors and volunteers. A private donation and two grants funded all camp costs.

Participants

Obese ($\text{BMI} \geq 95\text{th}\%$) adolescent males ages 13 to 18 seen within 4 months before camp at the Hershey Medical Center's Divisions of Pediatric Endocrinology and Pediatric Weight Management were eligible for enrollment. Exclusion criteria included uncontrolled mental health. No eligible participants were excluded.

Parents and campers consented to research with prior approval from the Penn State Hershey Medical Center IRB.

Intervention

Participants spent 4 uninterrupted weeks attending camp in

July, 2008. Healthier options were added to the Boy Scout menu by the dietitians at 1800kcal/day.

Dietitians created an educational nutrition curriculum and held daily group sessions to discuss healthy eating habits and menu planning. Activity (1-3 hours a day) was led by a fitness leader and exercise physiologist and included swimming, team sports, hiking, canoeing, and archery. A psychologist ran weekly group meetings focused on behavior modification using cognitive behavior therapy.

The physicians and BSA leaders created the program and functioned to oversee the camper's safety. A physician recorded measurements of height, weight, resting pulse and BP weekly. Fasting insulin, glucose and lipid profiles were obtained <1 month prior to camp start and the last day of camp.

Statistical analysis

Categorical variables were summarized with percentages while continuous variables were summarized with means and standard deviations (Table 1). After checking the distributions of outcome variables, a linear mixed effects model for repeated measures analyzed the mean change in outcome variables from the start to the end of camp (Tables 2 and 3). This model allows data for all subjects to be used regardless of complete data. Model assumptions were determined to hold true by plotting the studentized residuals versus the predicted values as well as by using a normal QQ plot of

Table 1. Baseline characteristics of study sample (N=11).

Characteristic	Mean±SD or N (%)
Age (years), Mean±SD	16.1±1.0
Weight start (lbs), Mean±SD	260.7±78.4
BMI start (kg/m ²), Mean±SD	40.2±13.0
Ethnicity, %	
African American/Black	5 (45.5)
Asian	1 (9.0)
Caucasian	4 (36.5)
Hispanic/Latino	1 (9.0)
Residential category (based on RUC zip code), %	--
Urban	11 (100)
Health insurance, %	
Government	6 (55.5)
Non-government (Private)	5 (45.5)
Boy Scout Member	1 (9.0)

the studentized residuals. Statistical significance was set at p<0.05. Statistical analyses used SAS software version 9.3 (SAS Institute, Cary, NC).

Results

Thirteen participants enrolled. Two campers left the first day, and one was dismissed after 2 weeks for behavior concerns.

Table 2. Comparisons of biometrics between start and end.

Biometric	Start (N=11)	End (N=10)	Δ	%Δ	P-value*
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	
Weight (lbs)	260.7 (208.0, 313.4)	238.0 (189.7, 286.3)	-22.7 (-27.8, -17.7)	-8.7 (-9.6, -7.8)	<0.001
BMI (kg/m ²)	40.2 (31.4, 48.9)	36.5 (28.5, 44.6)	-3.6 (-4.4, -2.9)	-9.1 (-10.2, -8.1)	<0.001
Waist circumference (cm)	48.4 (41.9, 54.8)	44.9 (38.5, 51.2)	-3.5 (-4.2, -2.9)	-7.4 (-8.7, -6.1)	<0.001
Waist/Hip Ratio	1.01 (0.97, 1.04)	0.96 (0.93, 0.99)	-0.05 (-0.07, -0.02)	-4.7 (-6.9, -2.6)	0.001
Resting pulse (bpm)	100.9 (89.0, 112.9)	79.6 (72.3, 87.0)	-21.3 (-36.5, -6.0)	-18.6 (-31.7, -5.5)	0.011
Systolic blood pressure (mmHg)	133.2 (122.8, 143.5)	124.1 (116.6, 131.6)	-9.1 (-21.2, -3.0)	-5.9 (-14.3, 2.6)	0.125
Diastolic blood pressure (mmHg)	74.4 (66.3, 82.4)	69.1 (62.1, 76.1)	-5.3 (-13.5, 3.0)	-5.6 (-17.4, 6.3)	0.186

*P-value from linear mixed effects model for comparing the start to end means and the change (Δ) between them.

Table 3. Comparisons of fasting metabolic parameters between start and end.

Outcome	Start (N=11)	End (N=10)	Δ	% Δ	P-value*
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	
Insulin (μIU/mL)	24.0 (15.0, 33.0)	7.0 (4.7, 9.3)	-17.0 (-26.9, -7.1)	-60.7 (-80.3, -41.2)	0.003
Glucose (mg/dL)	83.6 (75.5, 91.7)	62.4 (57.6, 67.1)	-21.3 (-31.5, -11.0)	-23.1 (-36.7, -9.5)	0.001
Total cholesterol (mg/dL)	167.8 (139.8, 195.9)	130.2 (105.6, 154.7)	-37.6 (-47.0, -28.2)	-22.5 (-27.1, -18.0)	<0.001
LDL cholesterol (mg/dL)	100.2 (77.8, 122.5)	74.0 (54.1, 93.9)	-26.2 (-35.5, -16.9)	-26.3 (-35.0, -17.7)	<0.001
HDL cholesterol (mg/dL)	44.6 (37.7, 51.5)	40.9 (32.0, 49.8)	-3.7 (-10.5, 3.1)	-8.4 (-24.5, 7.7)	0.250
Triglyceride (mg/dL)	117.3 (77.9, 156.6)	75.3 (47.3, 103.2)	-42.0 (-74.8, -9.2)	-31.1 (-59.9, -10.3)	0.017

* P-value from linear mixed effects model for comparing the start to end means and the change (Δ) between them.

Ten participants (mean age of 16.1) finished camp (Table 1). Medical problems included elevated blood pressure (6), hyperlipidemia (4), and hyperinsulinemia (6).

Among the eleven participants, the mean±SD pre-camp weight was 260.7±78.4 lbs., compared with the mean post-camp weight of 237.9±71.9 lbs., a 8.7% reduction ($p<0.001$) (Table 2). The mean±SD pre-camp BMI was 40.2±13.0 kg/m² compared with the mean post-camp BMI of 36.5±12.0 kg/m², a 9.1% reduction ($p<0.001$).

Systolic and diastolic blood pressures, waist circumference, waist-to-hip ratio and resting pulse significantly decreased (Table 2). Waist circumference decreased 7.4% (48.4±9.6 cm vs. 44.9±9.4 cm; $p<0.001$).

Insulin, glucose, total cholesterol, LDL cholesterol and triglycerides significantly decreased (Table 3). Fasting glucose decreased 23.1% (84 mg/dL vs. 62 mg/dL; $p=0.001$). At camp's end, 66% (4/6) with elevated blood pressure, 75% (3/4) with hyperlipidemia, and all with hyperinsulinemia (6/6) normalized.

Discussion

Summertime is problematic for obese youth, as this unstructured time typically shows accelerated weight gain. This pilot study demonstrates that collaboration with the BSA is an effective strategy for implementing summertime weight loss for adolescents.

Our findings of reduced weight, BMI [6-8] and blood pressure [9] are consistent with other previously published reports.

To our knowledge, this is the first published report of improved waist circumference, waist-to-hip ratio, insulin and hyperlipidemia, suggesting a unique contribution to the literature.

Previous studies show sustainable weight loss is possible after camp; [10-12] however, further study is needed regarding long-term health outcomes and the feasibility of wide scale implementation. Major limitations of this study include a small sample size with lack of control group and follow-up after camp.

Conclusion

Physicians should consider networking with community organizations, like the BSA, to create desired summer weight-loss programs.

List of abbreviations

BSA: Boy Scouts of America
BMI: Body mass index
BP: Blood pressure
HDL: High density lipoprotein
LDL: Low density lipoprotein

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Authors' contributions	MBN	EL	RJW
Research concept and design	✓	--	✓
Collection and/or assembly of data	✓	--	✓
Data analysis and interpretation	✓	✓	✓
Writing the article	✓	✓	✓
Critical revision of the article	✓	✓	✓
Final approval of article	✓	✓	✓
Statistical analysis	✓	✓	✓

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