Journal of Adolescent Health ■■ (2017) ■■–■■

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

Sex as a Moderator of Adolescents' Weight Loss Treatment Outcomes

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Article history: Received June 30, 2017; Accepted December 1, 2017
Keywords: Adolescent; Obesity; Weight loss; Peer influence; Physical activity; Cognitive behavior therapy

A B S T R A C T

Purpose: Weight loss treatments targeting adolescents often occur in mixed-sex contexts and produce variable outcomes. Sex considerations may be of particular importance, especially given differences in social relating. This study aggregated data from two randomized controlled trials of a peer-enhanced intervention compared with a standard cognitive-behavioral weight loss intervention to test the hypothesis that adolescent girls may demonstrate greater benefit than boys from a peer-enhanced weight loss intervention.
Methods: Participants were 193 adolescents with overweight/obesity (age $M = 14.4$ years, standard deviation = .99) from two randomized clinical trials comparing a peer-enhanced intervention with an active cognitive-behavioral weight loss intervention. Adolescents' percent over body mass index (percent greater than the 50th percentile for age and sex) was measured at baseline, end of treatment, and approximately 6 months post treatment. Multilevel modeling was used to test hypotheses.
Results: Findings suggested different weight change trajectories from baseline to end of treatment, and from end of treatment to follow-up. On average, all participants demonstrated weight loss from baseline to end of treatmentm and there was evidence that adolescent boys in the peer-enhanced condition may have benefited the most. On average, weight was maintained from end of treatment to follow-up.
Conclusion: Adolescent males may particularly benefit from weight loss interventions that incorporate a team component to supervised physical activity.

IMPLICATIONS AND CONTRIBUTION

Data aggregated from two randomized controlled weight loss intervention trials suggested that although all adolescents lost weight, males particularly benefited from the intervention including peer-based physical activity compared with standard exercise. Weight loss interventions primarily are delivered in mixed-sex group format; however, results from this study suggest important sex considerations.

More than 30% of youth in the United States meet criteria for overweight or obesity [1]. Adolescents with overweight/obesity experience short- and long-term medical complications [2] and psychosocial difficulties [3]. The extensive medical and psychosocial consequences of obesity underscore the importance of identifying factors that may amplify the effectiveness of youth weight loss interventions.

Relatively few cognitive-behavioral weight loss interventions that specifically target adolescents exist, and those that are focused on this age group produce variable outcomes [4,5]. One approach to improving the consistency of response to weight loss treatment among adolescents is to better match the goals of the intervention with the developmental context of youth. Given the increasingly important role of peers during adolescence [6], incorporating peers into interventions targeting adolescents may

Conflicts of Interest: The authors have no financial relationships or conflicts of interest relevant to this article to disclose.

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1054-139X/
https://doi.org/10.1016/j.jadohealth.2017.12.002

improve weight loss intervention response. Indeed, peers contribute to youths' adaptive physical activity and eating behaviors [7–9], suggesting the potential for peer relationships to be a mechanism of change in the context of weight loss interventions. Only two cognitive-behavioral weight loss interventions for adolescents leverage the peer context [10,11]; however, there is evidence to support peers having a central role in preventing eating disorders [12] and substance use [13] among adolescents, underscoring the potential positive impact of peers in interventions targeting healthy behaviors.

Empirically supported cognitive-behavioral weight loss interventions for adolescents with overweight/obesity predominantly are delivered in group format, providing opportunities to harness peer influence to impact adaptive health behaviors. Despite the potential to leverage group processes to achieve better treatment adherence and outcomes, few adolescent-focused cognitive-behavioral weight loss interventions are explicitly designed to use the group format to focus on improving peer relationships and generating positive peer influences. To date, only one research team has used in-person activities to broadly improve peer relationships as a means to increase self-efficacy related to physical activity and weight loss [11,14]. Primary analyses from two studies conducted by this team did not clearly support the peer-enhanced cognitive-behavioral weight loss intervention over standard cognitive-behavioral treatment. However, important moderating factors, such as sex, were not explored.

Sex considerations may be of particular importance to adolescent group-based cognitive-behavioral weight loss interventions. Not only do physical sex differences become prominent during puberty [15], but social differences between adolescent males' and females' experiences of weight-related concerns and behaviors emerge [16,17]. Research suggests that adolescent females engage in more weight-related discussions than males [18], which may lead to adolescent females feeling more comfortable talking about eating, weight, and shape in a group context. Further, developmental psychology research suggests that females tend to be more relationally oriented [19], suggesting that females may particularly benefit from a peer-enhanced weight loss intervention.

In light of the National Institutes of Health's encouragement to combine data across treatment trials to increase precision of effect size estimates, this research aggregated data from two randomized controlled trials of a peer-enhanced cognitive-behavioral weight loss intervention compared with a standard cognitive-behavioral weight loss intervention [11,14]. To our knowledge, these two clinical trials represent all work focused on enhancing face-to-face peer interactions in the context of a cognitive-behavioral weight loss intervention. Using these combined data, we aimed to evaluate the hypothesis that a peer-enhanced cognitive-behavioral weight loss intervention would be particularly impactful for adolescent females. Specifically, it was hypothesized that adolescent girls would demonstrate greater weight loss than boys randomized to the peer-enhanced treatment, and adolescents randomized to the peer-enhanced condition would demonstrate greater weight loss compared with adolescents receiving standard cognitive-behavioral weight loss treatment.

Methods

Participants were a combined 194 (study 1 n = 76; study 2 n = 118) adolescents with overweight/obesity randomized to one of two active, weekly, mixed-sex, group-based behavioral weight loss interventions: (1) cognitive-behavioral therapy plus supervised aerobic activity (CBT + EXER) or (2) CBT with peer-enhanced adventure therapy (CBT + PEAT) across two studies [11,20]. The sample was primarily female (n = 133, 69%) with a mean age of 14.4 years (standard deviation = .99). All participants were between 20% and 90% overweight as defined with reference to median body mass index (BMI) for age and sex (percent over BMI). The racial/ethnic composition of the participants was white (n = 141, 73%), African-American (n = 23, 12%), and other ethnic background (n = 15, 8%). Fourteen (7%) reported Hispanic heritage. There were no significant differences in baseline percent over BMI or age, or distribution of sex or racial/ethnic composition between studies.

Eligibility requirements were the same across both studies: (1) adolescent between 13 and 16 years; (2) adolescent greater than the 85th BMI percentile; (3) one parent able to participate in the study with the adolescents; and (4) English speaking. Potential participants were excluded if they met criteria for a major psychiatric disorder at the time of evaluation, were taking medications that might impact weight loss, had medical comorbidities that would impact participation in the diet and physical activity prescriptions, or were already enrolled in counseling or a weight loss program.

Recruitment strategies and study design were also similar across both studies. Participants who met eligibility for either study were scheduled for an assessment, after which they completed a 2-week (study 1) or 1-week (study 2) diet record as part of a "run-in" period before the intervention. An urn randomization procedure [21] with percent over BMI (dichotomized as high versus low) and sex (male vs. female) included as covariates was used to assign adolescents to treatment condition across both studies. Randomization occurred after participants had completed their initial baseline assessment. Both studies were approved by the hospital institutional review board. Parents of all participants provided written informed consent, and adolescents provided assent. No adverse events or untoward side effects occurred in either study in either treatment condition during the intervention. Specifics about recruitment, randomization, response rates, and participant compensation can be found in the original study outcomes papers [11,14].

Across the two studies, a total of 194 participants (study 1 n = 76; 39.2%) were randomized to either CBT + EXER or CBT + PEAT. One participant from study 1 did not have data for baseline BMI and therefore was dropped from the current analyses, leaving a total of 193 adolescents. Assessments were obtained at baseline, at the end of the 16-week intervention (i.e., end of treatment), and approximately 6 months post-treatment (i.e., follow-up; study 1: 6 months; study 2: 8 months).

Procedure

Common treatment components. Both the CBT + EXER and the CBT + PEAT treatment conditions included 16 consecutive weeks of active treatment during which adolescents and their parent/caregiver attended separate concurrent weekly 1-hour meetings (sessions 1–16). Treatment groups consisted of didactic material and educational activities illustrating a range of behavioral topics (e.g., self-monitoring, motivation for weight loss, goal setting, stimulus control, and relapse prevention). Treatment groups were led by master- and doctoral-level psychologists with experience in adolescent weight management and a registered