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The Effect of Behavioral Interventions on Body Weight in Children: A Systematic Review and Meta-Analysis

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Abstract

Background: The Centers for Disease Control and Prevention has acknowledged the growing epidemic of childhood obesity and, with it, the likelihood of an increasing percentage of obese adults in the coming years. This problem raises alarm because more people will be susceptible to heart disease, type 2 diabetes and other weight-related illnesses. Thus far, effective interventions have proven elusive.

Methods: We conducted a meta-analysis of pediatric obesity behavioral interventions to examine the effect for improving weight/body composition. We reviewed 14 studies (total N = 3,363) that examined the effects of behavioral therapies on weight change (reduced weight gain while growing or reduced body fat percentage) in children. The studies included are randomized control trials (RCTs) from a prior systematic review that documented weight change as a primary or secondary outcome and were published between January 2007 and July 2009. Using standard meta-analytic methods, we quantified effects to determine whether behavioral therapies are effective in improving body weight/body composition in children.

Results: The overall standardized mean difference of -0.23 with a 95% Confidence Interval of -0.38 to -0.07 indicates that behavioral therapies do have a significant effect as an intervention for improving weight outcomes in children. There was significant heterogeneity present ($I^2 = 61\%$, $p = 0.0003$).

Conclusions: Behavioral interventions may be superior to other types of obesity interventions in children. Larger studies are warranted. These results may be utilized to treat patients, create policies and better inform the public. Future studies might increase intervention duration, which might improve maintenance of effects post-intervention.

Keywords: pediatric obesity, behavioral intervention, weight maintenance, meta-analysis

Introduction

Permanent weight loss is not an easy process. Most ongoing weight loss interventions are temporary and not effective. This is evident based on the growing obese population. The Centers for Disease Control and Prevention (CDC) states that childhood obesity has more than doubled in children in the last 30 years[1]. Childhood obesity increases the likelihood that a person will be obese later in life, thus contributing to growth of the obese population[2-4].

Obesity has become a major public health concern, and new studies are constantly being published about its prevention and treatment. The most common forms of treatment are diet, exercise, prescription drugs, surgery and behavioral therapies[2]. For this study, behavioral therapies are categorized as those that do not involve surgery or medication and utilize any form of a “lifestyle” education program, cognitive behavioral therapy, parent/guardian involvement, or

the creation of support systems. In children, behavioral therapies and lifestyle interventions have shown the best results for weight maintenance[3].

A number of studies have reported effects of behavioral therapies for weight maintenance in children, but there have been few meta-analyses quantifying the degree of effects compared to other therapies. After categorizing studies as behavioral, we attempted to analyze whether behavioral therapies have a significant effect on pediatric weight gain and to quantify the effects of this form of intervention versus other forms of treatment. All of the studies evaluated are randomized control trials, which can provide the best measurement of effectiveness of an intervention.

Methods

The initial step was to collect all the literature that reported behavioral therapy interventions for weight gain prevention in children. These were collected from a previous systematic review[5].

The following criteria were used in the present review: (1) the collected information was from a human study, (2) the study design used was a RCT, (3) sample sizes were at least 30 before randomization, (4) the intervention lasted 8 weeks or longer, (5) the primary or secondary outcome of the study was weight loss or prevention of weight gain, (6) the article could be acquired in English and (7) the study was published between January 1, 2007 and July 1, 2009. Additionally, studies included had to have utilized a behavioral therapy intervention. Of the 45 pediatric studies, 15 were categorized as behavioral therapy interventions, 3 of which did not contain the necessary data to be included in the meta-analysis. We attempted to contact the

authors for the 3 studies; two responses came after the allotted time, and were later added to the analysis. Of the 14[6-19] studies included, 5 of the studies had 2 intervention arms[11,12,14,20].

For all the studies the raw outcome data extracted was in one of three forms:

- Body Mass Index (BMI)
- Body Weight in kilograms
- z-BMI score (age- and sex-adjusted values of BMI)

To analyze the data, the mean weight or BMI change within all arms of each study was required, along with the standard deviation or standard error. The methods used were adopted from the Cochrane Collaboration Handbook[19]. The mean difference and standard deviation for each study were either calculated manually or using Review Manager (RevMan) Software, version 5.3, from the Cochrane Collaboration website[20]. The RevMan software was also then used to create a forest plot with the included study values. After the initial analysis of data, a subgroup analysis was used to further summarize the data based on three age range subgroups: prepubescent (<10 years), early puberty (10–12 years), and post-pubertal (>12 years). In addition, a funnel plot was generated to evaluate the presence of selective bias reporting among the studies (a bias towards studies showing a positive effect).

Finally, a Risk of Bias Assessment was tabulated to gauge different areas of potential bias in each study. The Risk of Bias Assessment was conducted by two authors (KTW and AC) for each individual study. The resulting information was discussed (with KAK) to reach a consensus, and the final results were then tabulated.

Results

The initial systematic review yielded 45 pediatric obesity studies; the selection process is shown in Figure 1. Among the included studies overall, there was a statistically significant effect for behavioral interventions on pediatric weight/body composition. The standardized mean difference (SMD) and confidence interval (CI) are highlighted in Figure 2. Three studies, of the 19 comparisons evaluated, showed results that favored the control versus the treatment arm, meaning there was a negative effect of treatment. The heterogeneity of outcomes among the included studies is significant, $p = 0.0003$ and $I^2 = 61\%$. Figure 2 also displays the SMD of each study and its weight on the overall outcome.

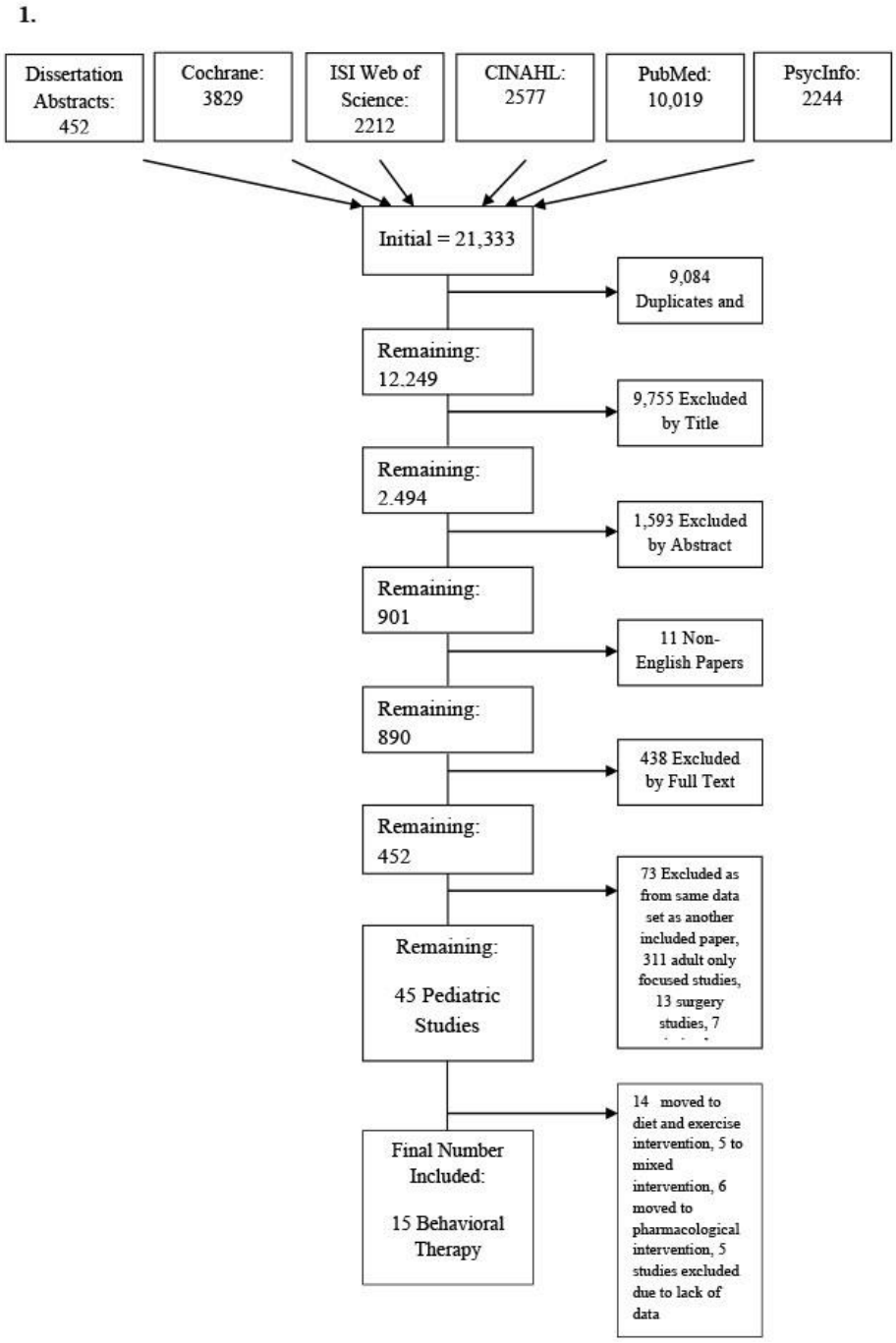


Figure 1 | PRISMA diagram of literature search and selection process

2.

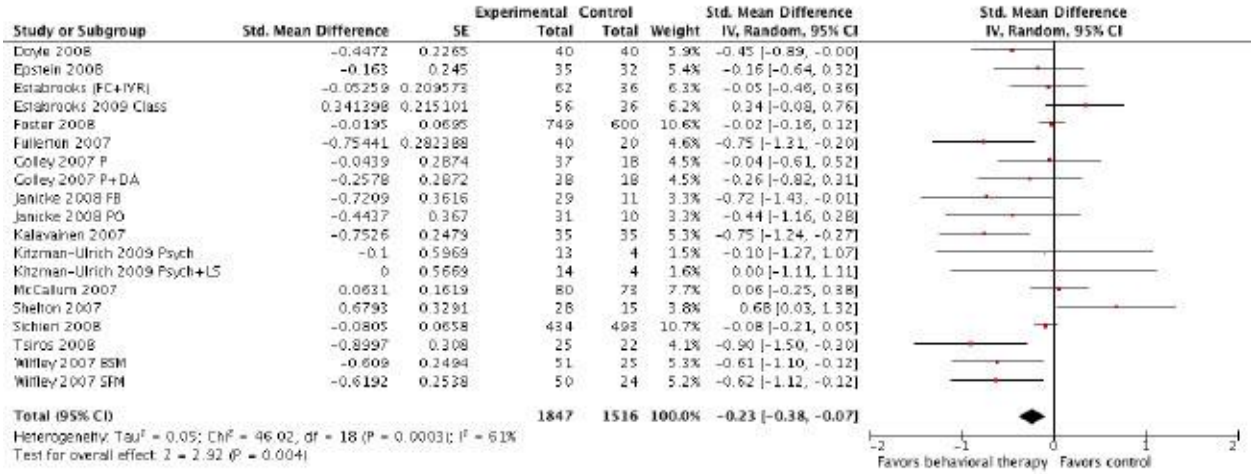


Figure 2 | Forest Plot of Behavioral Therapy Effects on Pediatric Obesity

As a post hoc data analysis, a subgroup comparison based on three age ranges was conducted: pre-pubescent (<10 years), early puberty (10–12 years), and post-pubertal (>12 years). For the pre-pubescent (n = 291) group of studies[8,10,12,15] the SMD was -0.05, 95% CI = -0.37 to 0.27; heterogeneity of 65%, p = 0.009. In the early puberty (n = 1,793) group, the SMD was -0.37, 95% CI = -0.65 to -0.08; heterogeneity of 69%, p = 0.003. For the post-pubertal (n = 1,049) group[7,13,16,17] SMD was -0.32, 95% CI of -0.67 to 0.03; heterogeneity = 55%, p = 0.07. The funnel plot in Figure 3 indicates that for the studies included in this meta-analysis, there was no evidence of reporting bias. The Risk of Bias Assessment pictured in Figure 4 evaluates potential sources of bias in individual studies as well as the potential risks of bias in the collective group of studies. The most common potential source of bias was the Lack of Attention Placebo in most of the included studies.

3.

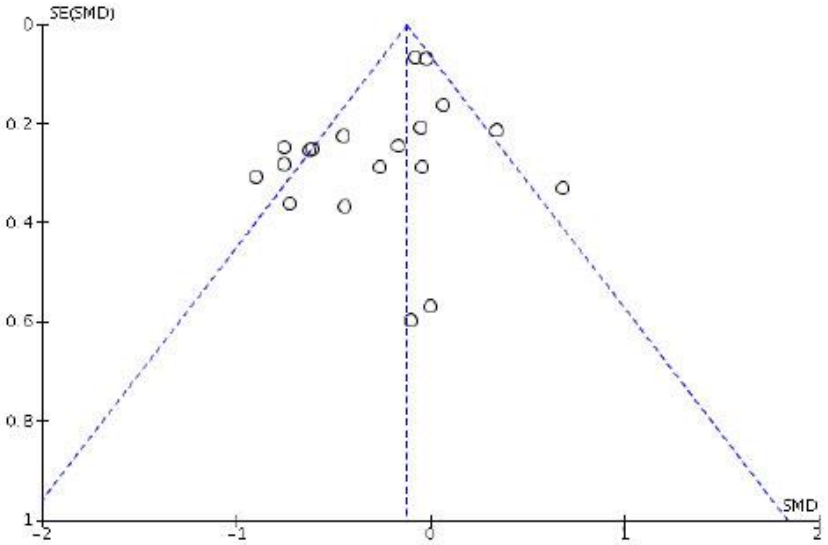
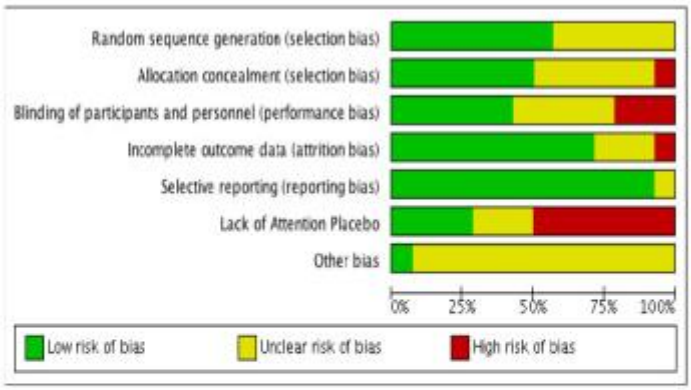


Figure 3 | Funnel Plot Summary of Reporting Bias

4A.



4B.

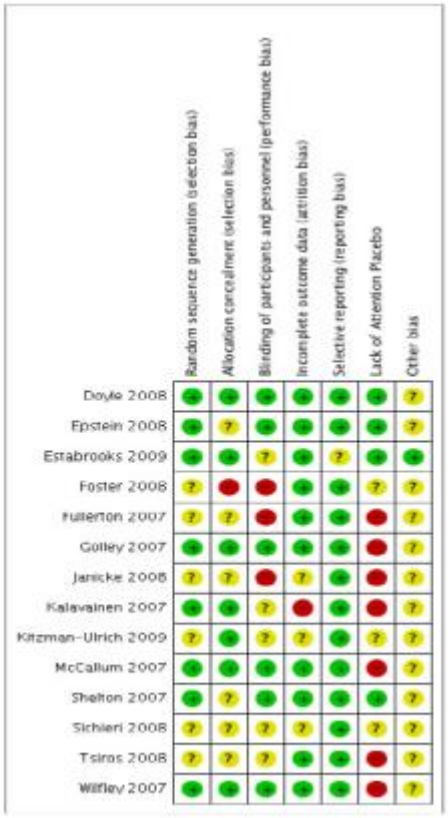


Figure 4 | Study-level Risk of Bias (top) and Risk of Bias of all included studies (bottom)

Discussion

Our results indicate that behavioral therapies generally have significantly favorable effects on body weight in children. In the post hoc subgroup analysis, by age range/pubertal status, the effect of behavioral therapies on body weight was not significant for the pre-pubescent and post-pubertal age groups. For the early puberty age group, the effect of behavioral therapies did have a significant effect. For the three subgroups, the SMD of effects appear largest in the early puberty age group (10–12 years).

This meta-analysis contained 14 recently published studies ranging in intervention duration from three months to two years. All included studies were randomized control trials, which help to minimize confounding effects. However, this meta-analysis was limited by the small number of studies and the high heterogeneity of observed effects. Future studies should include attention to placebo in their study designs to further minimize the potential for confounds. Additionally, given that other evaluations have indicated that lifestyle interventions are the best intervention for long-term weight maintenance in children[6], a standardized definition of behavioral therapy is desirable because it would allow better classification and comparison of studies.

In light of the continuing increase of pediatric obesity, the results of this study could be used in support of policies geared toward behavioral therapy-based interventions. However, studies have noted the complexity of designing lifestyle change programs for children because their environments are not isolated[19]. The best option for implementing such programs is to include parents in creating goals for their children and incorporating professionals from nutrition,

health, and psychological backgrounds in the treatment team[19]. The more educated the population becomes on ways to reduce weight gain or elicit weight loss in children, the more effective interventions can become in the future.

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