Review of Pediatric Obesity Interventions

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Abstract
Obesity in children and adolescents has become a global epidemic, and for the first time in 200 years may result in a decrease in life expectancy. Strategies for weight loss and subsequent maintenance include dietary therapy, physical activity, behavioral therapy, combined therapy, pharmacotherapy, and weight loss surgery. The purpose of the present paper was to review pediatric obesity treatments that could be considered ESTs; with the objective of determining which treatments are effective and the direction that future research could take. Twenty studies met the criteria for this review, which followed those guidelines congruent with ESTs. Of these twenty studies ten were categorized as using psychotherapy as the primary intervention in decreasing weight. Eight of the ten studies showed significant effects for the treatment conditions. Two of the studies used diet changes as the primary intervention, and both showed significant treatment effects. Three of the studies used physical activity as the primary intervention, of which two showed significant treatment effects. Six of the studies reviewed used pharmacotherapy as their primary intervention and all were found to have significant treatment effects. Metformin, Orlistat, and Sibutramine were the drugs used in these studies to treat youth obesity, and from this review it would appear that all are effective treatments. Overall psychotherapy, diet, physical activity, and pharmacotherapy are all effective interventions in treating youth obesity, when evaluated using established criteria for empirically supported treatments.

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REVIEW OF PEDIATRIC OBESITY INTERVENTIONS

A THESIS

SUBMITTED TO THE FACULTY OF

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SHELLIE M. JERVIS

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Abstract

Obesity in children and adolescents has become a global epidemic, and for the first time in 200 years may result in a decrease in life expectancy. Strategies for weight loss and subsequent maintenance include dietary therapy, physical activity, behavioral therapy, combined therapy, pharmacotherapy, and weight loss surgery. The purpose of the present paper was to review pediatric obesity treatments that could be considered ESTs; with the objective of determining which treatments are effective and the direction that future research could take. Twenty studies met the criteria for this review, which followed those guidelines congruent with ESTs. Of these twenty studies ten were categorized as using psychotherapy as the primary intervention in decreasing weight. Eight of the ten studies showed significant effects for the treatment conditions. Two of the studies used diet changes as the primary intervention, and both showed significant treatment effects. Three of the studies used physical activity as the primary intervention, of which two showed significant treatment effects. Six of the studies reviewed used pharmacotherapy as their primary intervention and all were found to have significant treatment effects. Metformin, Orlistat, and Sibutramine were the drugs used in these studies to treat youth obesity, and from this review it would appear that all are effective treatments. Overall psychotherapy, diet, physical activity, and pharmacotherapy are all effective interventions in treating youth obesity, when evaluated using established criteria for empirically supported treatments.

Keywords: Childhood obesity, obesity treatments, adolescent obesity, review of obesity treatments, behavioral therapy
Introduction

Obesity in children and adolescents has become a global epidemic, and for the first time in 200 years may result in a decrease in life expectancy (Kohn et al., 2006). Prevalence rates of pediatric obesity and weight problems in children have tripled among school age children since 1980 (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Child obesity is defined by using body mass index (BMI); a measure of weight in relation to height, used to determine weight status. Overweight is defined as having a BMI at or above the 85th percentile but below the 95th percentile. Obese is defined as having a BMI at or above the 95th percentile (Center for Disease Control and Prevention, 2011). In 2007 – 2008, among children and adolescents aged 2 to 19 years old, 11.9% were at or above the 97th percentile, and 16.9% were at or above the 95th percentile, and 31.7% were at or above the 85th percentile for age and weight (Ogden et al., 2010).

This continued increase in prevalence rates, will have tangible and negative affects on the health of our youth. Obese children and adolescents are at higher risk for health problems, and are more likely to later become obese adults. Additionally, a child/adolescent who is obese possesses increased risk factors associated with cardiovascular disease such as high blood pressure, high cholesterol, and Type II diabetes than their non-obese counterparts (Center for Disease Control and Prevention, 2011). Other health concerns linked to obesity in youth include dyslipidemia, metabolic syndrome, fatty liver, sleep apnea, and other significant co-morbidities (Williams, Strobin, & Brotanek, 2007).

The rise in youth obesity prevalence rates is a serious public health concern, and in addition to health related consequences the economic costs associated with obesity are burdensome. Overall estimates show that the annual medical cost of obesity has risen to
nearly 10 percent of all medical spending. In 2008, the estimated cost of obesity in the US was $147 billion per year (Finkelstein, Trogdon, Cohen, & Dietz, 2009). In 2006, obese Americans cost nearly $1,429 more in medical related dues than their normal weight counterparts (Center for Disease Control and Prevention, 2009). Since there is such a high cost related with obesity in Americans, the need for effective and cost-efficient therapies to treat this epidemic are imperative.

Treating obesity is a two-step process, which consists of assessment followed by treatment management as defined by the NIH’s clinical guidelines (NHLBI Obesity Education Initiative Expert Panel, 1998). Strategies for weight loss and subsequent maintenance include dietary therapy, physical activity, behavioral therapy, combined therapy, pharmacotherapy, and weight loss surgery. In considering using any of these multiple interventions either alone or in combination, obese youth should not be offered pharmacotherapy or surgical treatments before more conservative treatments are fully utilized.

**Literature Review**

**Psychotherapy Treatment Overview**

The most studied intervention in pediatric obesity is behavioral therapy (BT). There are several derivations of BT used in weight loss and maintenance including: goal setting, self-monitoring, stimulus control, mastery, contingent reinforcement, problem solving, and group interventions. Yet, ultimately behavioral therapy is often used in conjunction with other treatments making it difficult to parse out the effects due to BT alone (Latzer, 2008). Combined interventions of behavior therapy, low calorie diets, and increased physical activity provide the most successful treatment for weight loss and maintenance. This
Behavior therapies, especially comprehensive behavioral treatment which focus on targeting eating, and physical activity have been shown to be superior to wait-list control or nutrition alone for short and longer-term weight loss in children (Jelalian & Saelens, 1999). Additionally, behavior therapy in these instances is more effective when it uses such components as: stimulus control, self-monitoring, reinforcement of behavior change, and modeling of healthy eating behaviors (Herrera, Johnston, & Steele, 2004). Thus, it appears that current pediatric obesity suggests family-based behavioral therapy as the most efficacious method for weight loss in both the long and short term.

In 1999, Jelalian and Saelens reviewed the efficacy of existing interventions for pediatric obesity. In this review they found certain treatment conditions, which demonstrated superior outcomes, were those that included children targeted for loss with their parents, and diet combined with lifestyle or aerobic activity. Particularly interesting was that children whose parents were also targeted for weight loss demonstrated a significantly greater decrease in weight at five-year follow and additional reduction in weight at ten years. Jelalian and Saelens (1999) concluded that it could be critical within parental involvement to have parents serve as a model for their children in activity and diet parameters in these weight loss programs. Regardless of the exact nature of parental involvement according to this review family based weight loss strategies are superior to child only weight loss treatments.

**Dietary Therapy Overview**
Dietary therapy implies a structured planned change in one’s established meal pattern, which include specific guidelines for nutrient and energy intake (Latzer, 2008). Conventional diet standards usually include a low-fat diet regimen, yet considering the increasing prevalence rates in youth obesity new dietary approaches should be considered for this population as well. For instance, low-carbohydrate, high protein, and low glycemic load diets, which have been used successfully (Latzer, 2008). Among these three diets no one has been found to be superior over another, in short term.

**Physical Activity Overview**

Simply put obesity results from an energy imbalance, that is, energy intake exceeds expenditure, but the truth is there is no simple answer to treating obesity in our youth. High levels of physical activity could compensate for children’s excessive caloric or fat intake, but research has shown there has been a marked reduction in levels of physical activity in children and adolescents (Davison & Birch, 2001). Furthermore, lower levels of physical activity and habitual exercise among children are associated with higher BMI’s. In opposition physical activity and regular exercise has also been shown to decrease BMI in children and adolescents, and of those studies reviewed by Davison and Birch (2001) only 2 failed to find this association.

Davison and Birch (2001) reviewed the complex factors involved in placing children at risk for increases in weight status. They view these complex set of factors from an Ecological Systems theory perspective, which looks at their family, school, and social contexts including community and society at large. From this perspective child activity patterns are not only impacted by the child’s characteristics, but a combination of parent and peer activity levels, socioeconomic status, availability and accessibility of recreational
facilities, and school physical education programs. Parent activity levels have been positively associated with in activity levels among children and adolescents. Thus this pattern may reflect the importance of parents as social models for children’s preferences in leisure activities. Additionally, changes in the school have negatively impacted activities levels in children; due to school budget cuts many schools no longer offer physical education classes during the school day.

Sedentary behaviors also play a major role in the increased prevalence rates of overweight in obesity in children and adolescents. Research has shown that decreases in sedentary behaviors, were associated with decreases in BMI (Davison & Birch, 2001). Although, in reference to TV viewing, influence is not solely the displacement of physical activity, but is in part a combination between the sedentary nature of this activity as well as food requests made to parents in reaction to food commercials and subsequent energy intake. In fact TV viewing of more than 1 hour per day has been correlated with a high consumption of fast foods, sweets, chips, and pizza with a lower consumption of fruits and vegetables (Davison & Birch 2001).

In sum, these behavioral patterns including low levels of physical activity, high levels of sedentary behaviors, and preferences for high fat-high, and sugar foods together put children and adolescents at risk for overweight and obesity problems (Davison & Birch, 2001). In treating youth for obesity an increase in physical activity, decrease in sedentary behaviors; while including the child’s parents, school, and community make the most effective intervention plan. Parent and family involvement is especially important, and research has shown that programs that include multiple family members have greater long-term success rates (Davison & Birch, 2001). An overweight child cannot be treated effectively in isolation
of any one of these areas, but with a combination of them, and especially parent and family involvement.

**Pharmacotherapy Overview**

Pharmacotherapy as stated earlier should only be implemented after other more conservative treatments have been fully explored, and still should be used in conjunction with lifestyle, behavioral, and family based interventions (NHLBI Obesity Education Initiative Expert Panel, 1998). Pharmacotherapy methods are usually designed to do one of three things, increase energy expenditure (stimulants), suppress appetite (anorectic agents), and/or limit nutrient absorption (Latzer, 2008).

Stimulants such as amphetamines, thyroid hormones, and Ephedra have drawn criticism due to risks associated with addiction, and the possibility of severe and life threatening medical and psychiatric complications (Latzer, 2008). These medications are considered potentially effective in reducing weight but are contraindicated in children/adolescents. Presently, Sibutramine is the only anorectic agent that has been approved for use with adolescents by the Food and Drug Administration. Sibutramine is a nonselective inhibitor of neuronal reuptake of serotonin, norepinephrine, and dopamine, which promotes satiety. Drugs that limit nutrient absorption, in addition with Sibutramine, are the only drugs approved for use in children and adolescents in treating obesity. Orlistat is one such drug, and inhibits pancreatic lipase and thereby increases fecal losses of triglycerides, which aids in decreasing body weight and total and low-density lipoprotein cholesterol levels (Latzer, 2008). One additional drug that is currently being investigated is Metformin, which is an insulin-sensitizing and antihyperglycemic agent used in the treatment of non-insulin dependent diabetes. The premise behind the use of Metformin is that it demonstrates reduced
food intake and weight loss with reduction in fasting plasma glucose, cholesterol, and insulin concentrations (Kay et al., 2001).

**Surgical Treatment Overview**

Bariatric surgery refers to surgical procedures performed with the intent of weight loss. Overall in these surgeries the size of the stomach is reduced either with the implantation of a gastric band, removal of a portion of the stomach, or by restricting and re-routing the small intestines to a small stomach pouch. Severely obese adolescents, ranging from 12 to less than 18 years of age, are considered eligible for bariatric surgery according to the National Institutes of Health adult criteria. Severe obesity is increasing rapidly in adolescents and is associated with significant comorbidity and social stigmatization. Bariatric surgery in adolescents has been found to be safe and is associated with significant weight loss, correction of obesity comorbidities, and improved self-image and socialization (Sugerman et al., 2003). However, very little information has been published on the subject of obesity surgery in adolescents, but has been increasing over the past decade. As the prevalence rates of youth obesity related diseases increase, bariatric surgery may be considered as an acceptable treatment option for those who are most severely ill.

**Efficacious Treatment Defined**

The APA Clinical Psychology Division 12 Task Force has established a set of parameters by which treatment interventions are determined effective, and considered empirically supported treatments (ESTs). First, treatment efficacy must be demonstrated in controlled research where it is reasonable to conclude that benefits observed are in fact a result of the treatment being used and not outside or confounding factors (Chambless & Hollon, 1998). Also, efficacy is best demonstrated in randomized controlled clinical trials (RCTs), which
use group designs where participants are randomly assigned either to the treatment or comparison conditions (Chambless & Hollon, 1998). This comparison group can be either a control condition, other treatment condition, or wait list condition. Replication of the studies and findings are also of particular importance (Chambless & Hollon, 1998). Treatment is found to be efficacious only when two independent investigators have replicated it, so as to protect against experimenter biases and drawing invalid conclusions from one atypical finding. In addition, if a treatment has been replicated by only one study, or one team has conducted all research, then the treatment is considered probably efficacious. Methods used to conduct the treatment must be sufficiently sound, in order to justify reasonable confidence in the data. Lastly, the treatment results must be of clinical significance, that is, the treatment condition must produce significantly greater effects than the comparison condition achieves (Chambless & Hollon, 1998). EST guidelines and best practices have been established for treating pediatric obesity (Barlow & Dietz, 1998). ESTs for treating pediatric obesity include nutritional education, increase in physical activity or decrease in sedentary behaviors, and support which involves both children and parents participating in group therapy (Herrera, Johnston, & Steele, 2004).

The purpose of the present paper is to review pediatric obesity treatments that could be considered ESTs; with the objective of determining which treatments are effective and the direction that future research could take. Studies are grouped into sections based upon their primary intervention, and all types of treatment methods are included in this review including psychotherapy, dietary, physical activity, and pharmacotherapy. Surgical interventions were also included for consideration but due to lack of ability to randomly assign participants and have a comparison group they were eliminated from the main portion of this review.
Methods

Study selection

All studies published between 2000 and 2009 were considered for inclusion in the review. An initial search was conducted using Psychinfo, Medline, and Google Scholar using such keywords as “pediatric,” “childhood,” “adolescent,” crossed with “obesity treatment.” Additional articles were located by examining the reference sections from articles and reviews found in this manner. The initial search yielded 220 articles. This number was further narrowed down to 65 studies, by eliminating articles outside of the U.S. and Canada, not using BMI as an outcome measure, dissertations, and secondary analysis of studies that were already present. Another 45 articles were eliminated due to randomization procedures, absence of a control condition, or because the study targeted a specific population. The final yield was twenty randomized controlled trials that were included in this review.

Exclusion criteria were based on the Division 12 parameters for treatment efficacy. As a starting point the task force stated that the efficacy of treatment must be demonstrated in controlled research, where it is plausible to be able to conclude observable benefits due to the treatment and not confounding factors (Chambless & Hollon, 1998). Thus, according to the Division 12 task force, efficacy is best demonstrated in randomized clinical trials (RCT's), where participants are randomly assigned to a group. Another criteria to prove effectiveness of a treatment set forth by the task force, is that the treatment group be compared with a no treatment group (control), other treatment group, or placebo (Chambless & Hollon, 1998). Thus, studies included in this review met these criteria for inclusion.
Studies were only included that targeted overweight or obese children and adolescents and used interventions to aid them in losing weight. Additionally, all articles selected for inclusion in this review were required to report outcomes on at least one weight or adiposity related variable, such as BMI, weight, or percentage body fat. Studies that used interventions relevant to weight loss, such as increased consumption of fruits and vegetables, were eliminated due to the fact that it is impossible to evaluate the significance of such programs for decreasing weight. Lastly, studies were eliminated if the population targeted was a specific group (i.e., only African Americans, Hispanics, etc.), because the outcomes in these studies lack generalizability to the larger U. S. population.

Results

Psychotherapy

Nine of the 20 studies identified used psychotherapy as the main intervention in treating obesity. Doyle et al. (2008), randomized eighty adolescents aged 12 to 17 who were above the 85th percentile for BMI, to either the usual care or Student Bodies 2 (SB2) group. Usual care participants received handouts containing basic info on nutrition and physical activity. The SB2 group was administered a 16 week Internet delivered program using cognitive behavioral therapy to increase body image, basic health education, and guided behavioral modification. Participants were instructed to spend 1 to 2 hours per week on this Internet program, and adiposity measurements were taken at baseline, post intervention, and a 4-month follow up. The usual care group’s mean baseline BMI was 33.86, a .21 increase post intervention, and another .27 mean BMI increase at the 4-month follow up. The SB2 group had a mean base BMI of 34.64, at post intervention there was a .74 mean BMI decrease, and at the 4-month
follow up there was only a .27 mean decrease from baseline BMI. BMI was significantly ($p < .027$) reduced in the SB2 group in comparison to the control group from baseline to post treatment. Although the SB2 group maintained reductions in BMI at the 4-month follow-up, significant differences were not observed due to improvements in the usual care group when compared.

Epstein, Paluch, Gordy, Saelens, and Ernst (2000), randomly assigned sixty-two children with a mean age of 10 and 20 percent or more overweight to one of three groups. All participants received 6 months of family based behavioral therapy, which included workbooks with information on the traffic light diet, a 1,200-calorie diet, lifestyle physical activity, and behavioral change techniques. There were 16 weekly sessions and 2 meetings at 12 and 24-month follow ups. The standard treatment group the family based behavioral treatment only. The remaining two groups received problem solving training, which was integrated into content in both groups and individual sessions. Problem solving which was used in order to help participants overcome barriers to their weight loss goals was taught through therapists and group leaders in response to questions asked. In one of these groups both the parent and the child received problem solving training, and in the other group only the child received this training. The standard treatment group had a mean base standard BMI of 2.7 and at 2-year follow there was a 1.1 decrease in the mean standard score. In the parent plus child group the mean standard BMI was 2.8, with a .5 decrease at 2 year follow up. Lastly, the child only group’s mean standard BMI at baseline was 2.6, which decreased by .9 at the 2-year follow up. The standard treatment group showed significantly ($p < .02$) larger BMI decreases than the parent plus child group and child only group through 2 years.
Estabrooks et al. (2009), randomized two-hundred and twenty children aged 8 to 12, with
a BMI greater than or equal to 85th percentile, to one of three family connections (FC)
interventions, FC-workbook, FC-group, or FC-interactive voice response. All three
interventions were intended to support parents in aiding their children in weight loss, used
parents only as the agent of change. The FC-workbook group was given a 61 page manual
promoting increased physical activity, decreased sugar consumption, and parents were
encouraged to complete 5 days a week of the intervention. In the FC-group participants
attended 2 small group sessions which were 2 hours each and one week apart, where they
learned behavioral health skills, parental limit setting, effective communication, and strategy
development for an at home plan. The FC-interactive voice response group, completed the
FC-group sessions, and was then provided 10 follow-up sessions through an interactive voice
response program over the telephone. Depending upon the responses given by the parent as to
the goals and barriers of their children, they were then given tips and help to meet these goals
and overcome stated barriers. Children were monitored over the course of a year, and had
follow-up sessions at 6 and 12 months. The FC-workbook group had a mean standard
baseline BMI of 2.04, with a .05 decrease at six months, and a .06 decrease at 12 months from
baseline. The FC-group’s mean standard baseline BMI was 2.06, with a .03 decrease at six
months, and a .02 decrease at 12 months from baseline. Lastly, the FC-interactive voice
response had a mean standard base BMI of 2.03 with a .07 decrease at six months and a .08
decrease at 12 months from baseline. Participants in the FC-interactive voice response
condition significantly ($p < .05$) decreased their BMI-Z scores from base to 6 months and base
to 12 months, while the FC-workbook group significantly ($p < .05$) decreased from base to 12
months, the FC group significantly ($p < .05$) decreased BMI from base to 6 months but did not
sustain the decrease to month 12. There was no significant difference observed among groups.

Janicke et al. (2008), randomly assigned seventy-one participants aged 8 to 12 who had a BMI above the 85th to one of three groups; behavioral family group, behavioral parent only group, or the wait-list control group. The wait-list control group completed assessments and follow-ups on the same schedule as the other two groups. Both of the behavioral intervention groups attended weekly group sessions for 8 weeks, then biweekly session for the following 8 weeks, which lasted 90 minutes, and were encouraged to monitor food intake and physical activity. In the family based group parents and children participated in concurrent but separate group sessions, where they learned behavioral methods of decreasing weight and overcoming barriers. In the parent only group parents were the only individuals attending group meetings. The behavioral family group had a mean standard baseline BMI of 2.16, with a .078 decrease at four months, and a .115 decrease at 10 months from baseline. The behavioral parent only group had a mean base standard BMI of 2.015, a .139 decrease at six months, and a .091 decrease at 10 months from baseline. The waitlist control group had a baseline mean standard BMI of 2.133, with a .012 decrease at month six, and a .022 increase at month 10 from baseline. At month 4 children in the parent only group demonstrated significantly ($p = .02$) greater decrease in mean standard BMI than did the control condition. Additionally at the 10-month follow-up children in the parent only and family based behavioral groups demonstrated significantly ($p = .04$) greater great decreases from baseline than did the control group. No significant differences were found between the two treatment groups at the 4 or 10-month follow-ups.
Kalarchian et al. (2009) looked at family based behavioral treatment in severe pediatric obesity, using 192 children aged 8 to 12, whose BMI were above the 97\textsuperscript{th} percentile. Out of those 192 children 55.67 percent were female, 1.03 percent native Asian, 24.74 percent African American, and 74.23 percent were Caucasian. Participants were randomized to one of two groups, either usual care of family based behavioral therapy. The family based group attended 20, 60 minute group sessions over the course of 6 months. The same participants then received 6 booster sessions between 6 and 12 months, but there as no contact between months 12 and 18. The behavioral intervention included a nutrition component, and behavioral strategies to help increase physical activity. In the usual care group participants were offered 2 nutrition consultation sessions, but there was no further contact beyond these two sessions. Mean baseline BMI for the control group was 32.54, with a .54 increase at 6 months, and a 1.7 increase from baseline at 18 months. The family based group had a mean baseline BMI of 31.71, a .68 mean decrease at 6 months, and a 1.5 increase form baseline at 18 months. The intervention group was associated with significant decreases in BMI relative to usual care at 6 months. There were no significant differences between groups at months 12 and 18.

Kitzman-Ulrich et al. (2009) randomized forty-two families, with female children aged 12 to 15 who had a BMI above the 95\textsuperscript{th} percentile to one of three groups; the control group, multifamily therapy group with psychoeducation or the psychoeducation group only. All three groups participated in the study for 16 weeks. The psychoeducation group only included behavioral and psychosocial skills building strategies and encouraging healthy eating. The multifamily group, in addition to the psychoeducation curriculum also attended weekly 45-minute group sessions, where topics from the psychoeducational curriculum were discussed.
The control group did not participate in any intervention during the 4-month period. The psychoeducation group only had a mean base standardized BMI of 2.2, with a .1 decrease post treatment. Mean baseline standard BMI scores for the multifamily therapy group with psychoeducation was 2.2 with no change in scores at post treatment, and the control group had a base standard BMI of 2.3 with again no change at the end of the 4 month intervention. No significant effects were found for change in BMI between the groups.

Melnyk et al. (2007), randomly assigned twelve teenagers aged 15 to 18, who had a BMI greater than or equal to 25 to either the control group or the creating opportunities for personal empowerment (COPE) and thinking, emotions, exercise, and nutrition (TEEN) group. The COPE, TEEN group received 15 sessions of cognitive behavioral skills building program which included physical activity. The control group received an adapted version of the Red Cross Safety Program, simply to meet the same amount of attention as the experimental group. The control group had a mean baseline BMI of 30.72 and a post intervention increase of 2.35. The COPE group had a mean base BMI of 33.31 and a 3.97 mean BMI decrease post intervention. The COPE group experienced significantly ($p < .05$) greater reduction in BMI than did the control group, who actually gained weight over time.

Saelens et al. (2002) randomized forty-four adolescents aged 12 to 16, with a BMI between 20 and 100 percent over the median for sex and age to either typical care or healthy habits groups, for 4 months. The healthy habits group first took a computerized test, which assessed their current eating, physical activity, and sedentary behavior, and generated an individual plan to achieve their goals based on this information. Then utilized computer, telephone, and mail based behavioral interventions to maintain plan directives. The typical care group met with a pediatrician for a single session, to receive physical weight counseling.
The typical care group had a mean baseline BMI of 30.7, and at post intervention a 1.1 increase, and at follow-up (about 7 months) a 1.4 increase from baseline. The healthy habits group had a mean base BMI of 31, at post intervention a .1 decrease, and at follow-up a .1 increase in mean BMI from baseline. Mean standard BMI scores were significantly ($p < .04$) reduced in the healthy habits group when compared with the typical care group at post treatment. BMI from baseline to follow-up between the two groups only approached significance ($p = .07$) in favor of the healthy habits group.

Savoye et al. (2007) randomly assigned one hundred and eighteen children aged 8 to 16, with a BMI greater than or equal to the 95th percentile to either the control group or the Bright Bodies group for 12 months. The control group attended a pediatric obesity clinic once every 6 months, where they received diet and exercise counseling and were instructed to decrease sedentary behavior. The Bright Bodies group attended the program twice a week for 6-months, and then biweekly for an additional 6-months. During the program the first 6 months the program consisted of exercise for 50 minutes twice a week, and behavioral modification for 40 minutes one a week. During the last 6-months exercise consisted of 100 minutes twice per month. Children and caregivers attended separate but concurrent meetings, and using cognitive behavioral therapy were taught coping skills, and parents were stressed the importance of modeling healthy behaviors for their children. The control group had a mean base BMI of 36.3, at 6-months had a 1.1 increase, and at 12-months there was a 1.6 increase in BMI from baseline. The Bright Bodies group had a mean baseline BMI of 35.8, at 6-months there was a 2.1 decrease, and at 12-months a 1.7 decrease in BMI from baseline. Six-month improvements in BMI were sustained at 12 months in the Bright Bodies group versus
the control group, and these differences between the groups after 12 months was significantly ($p < .001$) different.

**Dietary**

Two studies of the 20 studies identified used changes in diet and/or nutrition as the primary intervention in targeting obesity in children and adolescents. Sondike, Copperman, and Jacobson (2002) randomized thirty adolescents aged 12 to 18 with a BMI greater than the 95th percentile to either the low carbohydrate or low fat group (control) for 12 weeks. In the low carbohydrate group participants were prescribed by the group instructor to consume less than 20 grams of carbohydrates per day for two weeks, and then less than 40 grams for the remaining 10 weeks. In the low fat group the instructor prescribed participants to consume less than 30 percent of their energy intake from fat. The low carbohydrate group started with a base BMI of 35.4 and at the end of 12 weeks had a BMI mean decrease of 3.3. For the low fat group base BMI was 35.6 with a decrease of 1.5 in BMI at the end of the twelve-week intervention. Average BMI improvements noted at the end of the 12-week trial were significantly ($p < .05$) greater in the low carbohydrate group in comparison with the low fat group.

Williams, Strobin, and Brotnanek (2007) randomized thirty-two children aged 11 to 15 with a BMI greater than the 95th percentile to one of two dietary interventions in a 12-week controlled clinical trial. The Free Snack group was assigned a 1500k-calorie per day diet, and participants in this group were allowed to choose any 150-calorie snack item as of their 2 snacks for the day. This “free snack” did not have to be listed on the predetermined healthy snack list, and included being able to choose regular soda. In Restricted Snack group
participants were also assigned a 1500k calorie per day diet, with both snacks restricted to those listed on the healthy snack list, and only being able to choose diet soda. Participants from both groups received behavioral counseling, and specific physical activity goals. Group 1’s base BMI was 31.7 and at the end of 12 weeks the BMI mean decrease was 1.0. Group 2 participants’ base BMI was 33.2 and after the 12-week intervention the BMI mean decrease was 1.05. Significant decreases in BMI were observed in both the Free Snack group ($p < .05$) and the Restricted Snack group ($p < .02$), but no significant differences were found between the two groups in reference to BMI changes.

**Physical Activity**

Four of the 20 studies identified used physical activity as the primary mode of intervention to treat obesity in children and adolescents. Carrel et al. (2005), randomized fifty children aged 12 to 13, who had a BMI over the 95th percentile to either the control or fitness group in this school based exercise program for 9 months. Control group participants received traditional physical education classes. The school fitness group participated in 5, 45-minute classes every two weeks. These lifestyle focused fitness oriented gym classes, where class size was limited to 14, and children were encouraged to make fitness and nutrition fun. Mean baseline BMI for the control group was 30 and post intervention BMI remained the same. For the intervention group mean base BMI was 32 and at the end of the 9-month intervention there was a mean increase of 1. BMI changes between the two groups were not statistically significant.

Faith et al. (2001) randomized ten children aged 8 to 12 with a BMI greater than the 85th percentile to either the control group or experimental group in this 12-week physical activity
program. The experimental group’s TV watching time was contingent on the amount of time they spent cycling on their stationary bicycles, where they earned 2 minutes of TV for every 1 minute of cycling time. The control group’s TV watching was not contingent upon time spent cycling. In the control group mean baseline BMI was 26, and at post intervention had increased by 1. In the experimental group baseline BMI was 30.2, and at the end of 12 weeks there a .3 mean BMI decrease. The experimental group demonstrated significantly ($p < .05$), greater BMI changes than the control group.

Goldfield et al. (2006) randomly assigned thirty children aged 8 to 12, whose BMI were above the 85\textsuperscript{th} percentile for age and to either open loop feedback only or open loop feedback plus reinforcement. Open-loop feedback systems require a person to do physical activity in order to gain access to high-rate sedentary activities, and require an external method of accurately measuring the physical activity one is attaining, as well as having an individual (in this case their parent) to evaluate the level of activity in order to deliver the subsequent reinforcement (TV watching). Individuals had to have a BMI above the 85\textsuperscript{th} percentile, and watch at least 15 hours of TV per week. In the open loop feedback plus reinforcement group participants were provided feedback on physical activity by wearing a monitor, and were rewarded with 1 hour of TV for every 400 counts on pedometer. In the open loop feedback group only access to the TV was independent of physical activity completed. The intervention lasted 8 weeks and participants attended biweekly meetings to download results on the monitors, and were given 10 dollars for baseline data collection, each biweekly meeting, and 20 dollars for attending the follow-up session. The open loop only group had a mean baseline BMI of 28.2 and a .3 increase at follow-up. The open loop plus reinforcement group had a mean base BMI of 28.9 and a .6 decrease at follow-up. Open loop feedback plus
reinforcement demonstrated significantly ($p < .05$), greater BMI changes than the control group.

**Pharmacological**

Six studies of the 21 were identified using pharmacological means as the primary intervention when targeting obesity in children and adolescents. Berkowitz et al. (2006) randomized four hundred and ninety-eight children aged 12 to 16, who were 2 units above the 95th BMI percentile to either a placebo or Sibutramine group. Sibutramine is a serotonin and norepinephrine reuptake inhibitor, which works as an appetite suppressant. This double blind intervention lasted 12 months, and those in the Sibutramine group took 10mg of Sibutramine a day, and those who had not lost 10% of their BMI at 6 months had their dose increased to 15mg per day. The placebo group was given a sugar pill that appeared to look the same as the Sibutramine. Both groups received behavior therapy, nutritional counseling, and were instructed to consume a 500-calorie deficit diet. Baseline mean BMI for the placebo group was 35.9 and at 12 month follow-up had a mean decrease in BMI of 1.2. The Sibutramine group had a mean base BMI of 36.1 and at the 12 month follow had a mean BMI decrease of 9.4. Mean BMI changes from baseline to 12 months favored the Sibutramine group, and showed statistically significant differences between treatment groups ($p < .001$).

Berkowitz, Wadden, Tershakovec, and Cronquist (2003) randomized eighty-two adolescents aged 13 to 17 who had a BMI between 32 and 44 to either the Sibutramine or placebo group. In this 6 month double blind study, both the Sibutramine and placebo groups received family based behavioral group therapy, which consisted of 13 weekly, 6 biweekly, and 2 monthly sessions. Parents and children attended separate but concurrent group
meetings. Both groups received the placebo during the first week, and then during week 2 the Sibutramine group received 5mg of Sibutramine a day, which was increased to 10mg at week 3, and to 15mg at week 7. Mean base BMI for the placebo group was 38, and post intervention mean BMI decrease was 4. In the Sibutramine group mean base BMI was 37.5, and at post intervention mean BMI decrease was 8.5. The addition of Sibutramine to a comprehensive behavioral program induced significantly ($p < .001$) greater BMI reduction than behavioral therapy plus a placebo.

Burgert et al. (2008) randomized twenty-eight adolescents aged 13 to 18 to either the placebo or Metformin group in their 4-month double blind study. Metformin is an insulin sensitizing and antihyperglycemic agent used in the treatment of non-insulin dependent diabetes mellitus, which has show to aid in weight loss. All individuals were seen monthly for lifestyle counseling, which included nutritional education and exercise recommendations. The Metformin group had a slow increase in dosage to one 500mg tablet in the morning and 2 at night. Mean base BMI for the placebo group was 40 and mean BMI change after the month intervention was a 1.1 increase. In the Metformin group the mean base BMI was 41, with a .9 mean BMI decrease post intervention. BMI changes among groups were statistically significant ($p = 0.02$), with the Metformin group being superior to a placebo.

Chanoine, Hampl, Jensen, Boldrin, and Hauptman (2005), randomized five hundred and thirty nine adolescents aged 12 to 16 who had a BMI above the 95th percentile to either the placebo or Orlistat group in this 54 week double blind study. Orlistat is a gastrointestinal tract lipase inhibitor, which works to decrease the amount of intestinal fat absorption by up to 30 percent. In the medication group participants took 120mg of Orlistat three times a day. Both groups were encouraged to follow a mild hypocaloric diet, exercise, and received behavioral
therapy. Behavioral therapy consisted of a behavioral modification program with a study-specific manual that mainly involved recording food intake and activity, limiting high-calorie and high-fat foods, and encouraging participants to understand their cues for overeating. At baseline the mean BMI for the placebo group was 35.4 and at the 1-year follow mean BMI change increased by .31. In the Orlistat group mean BMI at baseline was 35.7 and at follow-up there was a .55 decrease. In combination with diet, exercise, and behavioral modification the Orlistat group significantly ($p = .001$) improved weight management in obese adolescents when compared with a placebo.

Kay et al. (2001) randomized twenty four adolescents, who had a BMI greater than 30 into either the placebo or Metformin group. In this double blind controlled trial, all subjects were on a low calorie, which consisted of between 1500, and 1800 calories. After the first week of the intervention one group began taking Metformin at a dose of 850mg two times per day for 8 weeks, while the other group received a placebo. The placebo group had a mean baseline weight of 113kg, with a decrease of 3.2kg post intervention. The Metformin group had a mean baseline weight of 116kg with a mean weight decrease of 6.1kg after the 8-week intervention. Compared with the low calorie diet alone the Metformin plus low calorie group had a significantly ($p < .01$) greater effect on BMI change.

Maahs et al. (2005) randomized forty adolescents aged 14 to 18, who had a BMI greater than 40 in either the placebo or Orlistat group. In this double blind study that lasted 6 months, both groups received lifestyle recommendations to aid in decreasing weight. The Orlistat group received 120mg of Orlistat three times a day. The placebo group had a mean baseline BMI of 41.7 and at post-intervention a mean decrease of .8. The Orlistat group had a mean baseline BMI of 39.2 and mean decrease of 1.3. No statistically significant differences were
observed between the two groups for decrease in BMI from baseline to 6 months. The decrease in BMI within the Orlistat group ($p < .04$) and within a placebo group ($p < .02$) showed statistically significant effects.

**Conclusion/Discussion**

Youth obesity has become a global epidemic, and it is an increasingly concerning issue because of the long-term effects of this chronic disease (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Obese children are more likely to become obese adults and thus more likely to have health risks associated with obesity beginning in their youth and continuing on into their adulthood (Center for Disease Control and Prevention, 2011). Life expectancy trends of humans during the past thousand years have been characterized by a slow, steady increase (Olshansky et al., 2005). Yet, for the first time our children, grandchildren, and young adults may have a shorter life expectancy than those adults today, reducing the length of life of severely obese by an estimated 5 to 20 years (Olshansky et al., 2005). There has been an increase in the prevalence rate of type II diabetes in children, which is a disease with complications that are both life threatening and life shortening by approximately 13 years (Olshansky et al., 2005).

The purpose of the current study was to explore and review the current state of pediatric obesity treatments that meet the guidelines for an empirically supported treatment (Chambless & Hollon, 1998). Twenty studies met the criteria for this review, which followed those guidelines congruent with ESTs. Of these twenty studies ten were categorized as using psychotherapy as the primary intervention in decreasing weight. Eight of the ten studies showed significant effects for the treatment conditions. Those two studies that failed to show a significant effect, used interventions lasting 16 weeks, and had the least comprehensive methods. Those studies that did
show significant effects used a combination of methodologies, for example CBT plus physical activity and/or diet. Thus these results imply that more comprehensive and environmentally inclusive behavioral/psychological treatments seem to be effective in weight reduction in children.

Two of the 20 studies used diet changes as the primary intervention, and both showed significant treatment effects. Both studies restricted the diets of participants in some way either by designating the amount of fat or carbohydrates consumed per day, or by the amount of calories and types of snacks that were consumed. It seems from these results that portion control, and restricting the nature of the calories consumed are effective treatments in treating pediatric obesity.

Three of the 20 studies used physical activity as the primary intervention, of which two showed significant treatment effects. The study that failed to show significant treatment effects only prescribed physical activity changes within an already required school fitness class. Thus no more physical activity was added to the participants’ days than they had previous to the start of the intervention. The other two studies showing significant effects used accrued physical activity time to be redeemed for television viewing privileges, used as an incentive. These interventions were also based in the home, and thoroughly involved parents in the treatments. Thus, these results imply that a reward system based in the home and involving parents may be the best approach in using physical activity as an effective obesity treatment.

Six of the studies reviewed used pharmacotherapy as their primary intervention and all were found to have significant treatment effects. Metformin, Orlistat, and Sibutramine were the drugs used in these studies to treat youth obesity, and from this review it would appear that all
are effective treatments. Among the three pharmacological therapies, it appears that Sibutramine had more significant treatment effects than Metformin and Orlistat. Although these pharmacological treatments are extremely effective in reducing weight they are not without side effects. In those studies reviewed side effects due to taking these medications ranged from dry mouth, gastrointestinal related symptoms, and nausea to a few more severe symptoms such as excessive vomiting and tachycardia (Berkowitz, Wadden, Tershakovec, & Cronquist, 2003; Maahs et al., 2005; Kay et al., 2001). In lieu of these potential side effects, pharmacotherapy should only be used on those children or adolescents who have fully exhausted less evasive interventions as psychotherapy, diet, and physical activity treatments.

Overall psychotherapy, diet, physical activity, and pharmacotherapy are all effective interventions in treating youth obesity, when evaluated using established criteria for empirically supported treatments (Chambless & Holland, 1998). Yet, it is difficult to say that any one of these treatments is effective alone, as most of these interventions used some combination of the four interventions in their methodologies in order to treat participants. Even within the psychotherapy studies reviewed here, those interventions that were less integrative in using two or more of these methods were unsuccessful in establishing significant treatment effects.

Current EST guidelines support behavioral therapy, with parents, and other family members as best practices in treating childhood and adolescent obesity (Herra, Johnston, & Steele, 2004). This review supports this area of research. Also more comprehensive treatments with longer-term follow-ups seemed to work best as previous research has stated. Yet, the current study does not establish which treatment modality works better over another. That is, it does not answer the question of whether psychotherapy, diet, physical activity, or
pharmacotherapy is more effective than the other in treating pediatric obesity. Thus future research should focus on clarifying the issue of which treatment modality is most effective.

Alternatively, the criteria set may have been too stringent. This included only published studies, and only those who met the EST criteria set forth by the Division 12 task force (Chambless & Hollon, 1998). The primary limitation of this study could be the criteria set for study inclusion. Initially 65 studies were identified that were suitable for review, but 45 of those were eliminated due to EST criteria. The subsequent results of this review may have been quite different had these studies been included.

Another weakness associated with the present study was a lack of diversity among the subjects used in the reviewed studies. In all of these studies the percentage of Caucasian subjects were 70 percent or higher, with only a few small percentages of minorities represented in some of these studies but not all. Also, among these twenty studies reviewed several did not explicitly list the racial makeup of those subjects who participated, which limit the subsequent knowledge as to generalizability. Additionally, of those minorities represented in the general US population only a few were represented in the samples of these studies (Table 1). In those 65 studies, which were seriously considered for review in this study four targeted Hispanic/Mexican American only populations, and 6 African American only populations. Yet, these studies were eliminated due to the EST criteria mentioned above. Conversely, the prevalence rates of children and adolescent obese minority populations, especially Hispanics and African Americans, are disproportionately higher than that of Caucasians, yet Caucasians are the most studied population (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Lastly, most of these studies precluded subjects with other major mental health comorbidities, when in real life obese individuals often report multiple comorbidities such as depression and other psychological issues (Dehghan, Akhtar-
Danesh, & Merchant, 2005). Wallace et al. (1993) found 32% of obese children had depression, and Sheslow et al. (1993) reported that 50% of obese children and adolescents had depression. Additionally, Epstein et al. (1996, p. 65) found that “58% of boys and 44% of girls met criteria on at least one Child Behavior Checklist/4–18 (CBCL) behavioral problem scale.” ESTs require that accepted interventions be based on research that has been conducted in accordance with very strict randomized controlled trial guidelines, but these studies preclude any kind of substantial variability among subjects, in order to ensure the control of outside variables. Yet, this has left us with very limited and narrowly based data about those interventions we hold as the gold standard.

The findings of this review again support more integrative and comprehensive interventions to treat childhood obesity. Thus, future research should focus on using these approaches and defining specifically which combination of interventions is most effective and cost efficient. For instance, Goldsfield, Epstein, Kilanowski, Paluch, and Kogut-Bossler (2001) compared the cost-effectiveness of two protocols for the delivery of family based behavioral therapy. Results showed that adding individual therapy to group based family behavioral therapy for the treatment of childhood obesity did not increase the effectiveness of treatment. Thus, group behavioral therapy was more cost efficient than group plus individual. Studies looking at the most cost efficient and effective treatments are few, so in future research finding those combinations that are both effective and cost efficient would be greatly beneficial.

Many public health researchers and clinicians seem to agree that prevention could be the key strategy for controlling the obesity epidemic. From this standpoint it is believed that children should be the primary focus of prevention strategies due to the difficulty involved in losing weight in adulthood (Dehghan, Akhtar-Danesh, & Merchant, 2005). Prevention studies
that focus on reducing sedentary behavior and encouraging free play have shown to be most effective. Additionally, health report cards have been introduced in the school setting, in order to inform parents of their child’s weight problems. This effort caused those parents informed to be over twice as likely to plan weight control activities for their overweight children (Dehghan, Akhtar-Danesh, & Merchant, 2005). Thus, prevention may be a more practical and efficient intervention in controlling the obesity epidemic, but more research needs to be conducted comparing the effectiveness and cost efficiency of treatment versus prevention strategies.
References


Center for Disease Control and Prevention. (2009). Study estimates medical cost of obesity may be as high as $147 billion annually: *New community recommendations show ways to reduce burden*. http://www.cdc.gov/media/pressrel/2009/r090727.htm
http://www.cdc.gov/obesity/childhood/index.html

http://www.cdc.gov/obesity/childhood/defining.html


Appendix A: Demographic Information for Studies
### Table 1

**Demographic Information for Studies**

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample Size</th>
<th>Gender</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalarchian et al., 2009</td>
<td>192</td>
<td>55.67% F</td>
<td>1.03% Native Asian, 24.74% African American, 74.23% Caucasian</td>
</tr>
<tr>
<td>Kitzman-Ulrich et al., 2009</td>
<td>42</td>
<td>42 F</td>
<td>N/A</td>
</tr>
<tr>
<td>Melnyk et al., 2007</td>
<td>12</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Saelens et al., 2002</td>
<td>44</td>
<td>18 F</td>
<td>70.5% Caucasian, 15.9% Hispanic, 4.5% African American, 2.3% Asian, 6.8% multi-ethnic</td>
</tr>
<tr>
<td>Sondike, Copperman, &amp; Jacobson, 2002</td>
<td>30</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Williams, Strobin, &amp; Brotanek, 2007</td>
<td>32</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Berkowitz et al., 2006</td>
<td>498</td>
<td>322 F</td>
<td>282 Caucasian, 105 African</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>Sex</td>
<td>Race/Origin</td>
</tr>
<tr>
<td>------------------------------</td>
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</tr>
<tr>
<td>Berkowitz, Wadden, Tershakovec, &amp; Cronquist, 2003</td>
<td>82</td>
<td>55 F</td>
<td>Caucasian, 34 African American, 3 other</td>
</tr>
<tr>
<td>Burgert et al., 2008</td>
<td>28</td>
<td>19 F</td>
<td>Caucasian, 7 African American, 5 Hispanic</td>
</tr>
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<td>Chanoine, Hampl, Jensen, Boldrin, &amp; Hauptman, 2005</td>
<td>539</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Kay et al., 2001</td>
<td>24</td>
<td>15 F</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Maahs et al., 2005</td>
<td>40</td>
<td>27 F</td>
<td>Hispanic, 15 Caucasian</td>
</tr>
<tr>
<td>Balagopal et al., 2003</td>
<td>15</td>
<td>11 F</td>
<td>N/A</td>
</tr>
<tr>
<td>Carrel et al., 2005</td>
<td>50</td>
<td>24 F</td>
<td>N/A</td>
</tr>
<tr>
<td>Faith et al., 2001</td>
<td>10</td>
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<td>N/A</td>
</tr>
<tr>
<td>Goldfield et al., 2006</td>
<td>30</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Doyle et al., 2008</td>
<td>80</td>
<td>50 F</td>
<td>Caucasian, 21 African</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>Gender</td>
<td>Ethnicity</td>
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<td>------------------------------</td>
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<td>----------------------------------------</td>
</tr>
<tr>
<td>Epstein, Paluch, Gordy,</td>
<td>62</td>
<td>F</td>
<td>American, 10 Hispanic, 9 other</td>
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<td>Saelens, &amp; Ernst, 2000</td>
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<tr>
<td>Estabrooks et al., 2009</td>
<td>220</td>
<td>46 F</td>
<td>63% Caucasian, 26% Hispanic</td>
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<tr>
<td>Janicke et al., 2008</td>
<td>71</td>
<td>43 F</td>
<td>76.13% Caucasian, 10.2% African American, 8.4% Hispanic, 5.2% biracial</td>
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<tr>
<td>Savoye et al., 2007</td>
<td>118</td>
<td>69 F</td>
<td>41 Caucasian, 43 African American, 34 Hispanic</td>
</tr>
</tbody>
</table>
Appendix B: Flow Chart of inclusion of studies into the review

Figure 1. Flow chart of inclusion of studies into the review

Initial search of Psychinfo, Medline, Google Scholar, and reference sections from relevant articles, yielded 220 studies from searches for: Pediatric or child or adolescent AND Obesity or overweight AND treatment or intervention studies between 2000 and 2009

Narrowed further down to 65 studies. Studies were excluded studies outside of the U.S. and Canada, not using BMI as an outcome measure, dissertations, and secondary analysis based on a study already included.

45 studies eliminated from the review due to no randomization or control group, targeting specific populations, and case studies.

20 studies included in the review