Evidence-based management strategies for pediatric overweight that can be utilized in the primary care setting

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Dedication

I would like to thank my family for all the support and love they have given me over the years.

I would also like to thank my fiancé, William, for reminding that I chose this, and for always believing in me.

Lastly, I would like to thank my wonderful friends who have made PA school more than tolerable; they have made it fun.
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Introduction

Pediatric obesity and overweight is an undisputed health crisis. Labeled an epidemic in 1998 by the World Health Organization, it is imperative to intervene early, identifying at-risk patients and implementing treatment plans for those already overweight (Edmunds, Waters, & Elliot, 2001). Obese and overweight patients can present a difficult task for the primary care provider. There is an obligation to educate and promote preventive behaviors, but the audience can be unreceptive. As the nation’s adult population has increased in weight, a similar change is occurring in the nation’s youth (Inge et al., 2004). Insidious lifestyle changes that have plagued the adult population, such as decreased physical activity and increased consumption of calorie-dense, nutrient-deficient foods, have had similar effects on the pediatric population. In a promising light, it has been shown that overweight pediatric patients are more successful with weight loss and maintenance than their adult counterparts (Epstein, Myers, Raynor, & Saelens, 1998; Kitzman & Beech, 2006).

Pediatric weight trends have been tracked since the 1960’s by the National Health and Nutrition Examination Survey (NHANES). NHANES I (1963-1970), II (1976-1980), III (1988-1994), and IV (1999-2000) have been completed, showing a relatively stable prevalence of overweight among children from 1963-1980, ranging between 4%-6.5%. By 1988, the prevalence was 11.5%, and as of 2004, an estimated 17% of youth age 2-19 were overweight (Ogden et al., 2006).

Recent recommendations of the International Task Force on Obesity use the criteria of > 95th percentile of weight for age and gender to define pediatric overweight, using obese and overweight as interchangeable terms in the pediatric population. Since BMI is not a linear progression in childhood and is an imprecise measure of adiposity in children, percentiles, and
not absolute values, are used to track children’s weight changes (Kirk, Scott, & Daniels, 2005). Former guidelines stated that children > 85th percentile were considered overweight and >95th percentile considered obese. Currently, due to the difficulty in unanimous labeling, weights between the 85th and 95th percentile are considered “at risk for overweight” (Barlow & Dietz, 1998; Whitlock, Williams, Gold, Smith, & Shipman, 2005).

In spite of the wide variety of interventions available to treat obesity, it has been shown that prevention is the best way to avoid obesity, both in children and adults (Whitlock et al., 2005). Noller and Paulk (2005) reported that with long term follow-up, 80-90% of overweight children who have achieved weight loss will return to pre-intervention weights; yet, Epstein has reported 33% of one study cohort remaining at non-obese BMI percentiles in 10 years of follow-up (Epstein et al., 1998). Researchers also found that 25% to 41% of obese preschool-age children are likely to be obese as adults and 42% to 63% of obese school-age children will remain so into adulthood (Noller & Paulk). However, other studies have reported that overweight children less than 12 years old, including those above the 95th percentile, will not necessarily become obese adults (Whitlock et al.).

The recent surge in obesity in both adults and children has prompted studies examining the cause of the excess weight. The federal nutritional guidelines, published in the 1970’s, set the recommendations for dietary intake of carbohydrates (50%), protein (20%), and fat (30%) (Slyper, 2004). In studies done by Wright et al adolescent intake of fat was very close to the recommended intake, leading investigators to suspect increased refined carbohydrate intake to be a substantial contributor to the obesity epidemic (Bialostosky, Wright, Kennedy-Stephenson, McDowell, & Johnson, 2002; Plourde, 2006; Wright, Wang, Kennedy-Stephenson, & Ervin, 2003). Also, studies have found that calorie intake among children has been roughly the same
since the 1970’s, supporting the theory that a decrease in energy expenditure is a causative factor in the obesity epidemic (Noller & Paulk, 2005; Slyper). The combination of technologies that are very enticing for children (television, video games, computer) and a lack of safe outdoor areas to play maybe contributing to the decrease in energy expenditure (Noller & Paulk). The increases in BMI have been more pronounced in the upper ranges of BMI, meaning that those who were already overweight are increasing their BMIs more than those with a normal BMI (Whitlock et al., 2005). This phenomenon has led to the widely supported theory of “obesity susceptibility genes” that are being acted on and activated by environmental factors. It is suspected that approximately 50% of the population has these genes (Whitlock et al.).

Review Methodology

Studies have been identified from MEDLINE, PubMed, and CINAHL. Keywords and search terms include obesity, pediatric obesity, behavior modification, bariatric surgery, gastric bypass, non-prescription antiobesity agents, weight loss and motivation, antiobesity agents and weight loss motivation, and obesity interventions. The abstract or article will be assessed for compliance with the BMI percentile categories. Inclusion criteria includes: classifying children according to the CDC’s age- and gender-specific BMI percentiles, and age between 2 to 19 years. Exclusion criteria include classifying by triceps skinfold thickness or percent over ideal body weight without inclusion of a BMI measurement, and age < 2 years or > 19 years.
Comorbidities of Pediatric Overweight

Recent research has reported findings of obesity-related morbidities appearing in children that were previously seen only in adult populations, including cardiovascular conditions, sleep apnea, and orthopedic problems. The relationship between pediatric overweight and cardiovascular dysfunction is well-represented in the literature and includes hypertension, dyslipidemia, and insulin resistance and type II diabetes (Whitlock et al., 2005). The major concern regarding hypertension is its association with cardiovascular and renal disease (Mitsnefes, 2006). While still low, prevalence rates of pediatric hypertension have been increasing over the past decade, and it is recognized as an important health care issue. Essential hypertension is now the most common type of hypertension in children older than 10 years (Mitsnefes). Childhood hypertension is strongly correlated with adult hypertension and cardiovascular disease. Common cholesterol findings in obese children include elevated low-density lipoprotein (LDL) cholesterol, decreased high-density lipoprotein cholesterol (HDL), and elevated triglycerides. Central fat disposition is thought be an important causative factor in pediatric hyperlipidemia (Dietz, 1998). Diagnosis of type II diabetes in childhood raises concerns regarding earlier onset of advanced complications, including cardiovascular disease, renal failure and amputations (Must & Anderson, 2003). Basal insulin secretion, stimulated insulin secretion and insulin resistance are directly related to the amount of visceral fat present; however it is unclear whether visceral or total body fat plays a larger role in insulin and glucose metabolism (Dietz). There is also an increased risk of hepatic steatosis in overweight children, leading to liver dysfunction and elevated transaminase levels (Noller & Paulk, 2005).

Sleep apnea occurs in an estimate 7% of obese children and is an indication for aggressive obesity treatment (Dietz, 1998). A study by Silvesti et al found that children >200%
above ideal body weight had oxygen saturation below 90% for more than half the total sleep time (Must & Strauss, 1999). Also of concern are the neurocognitive defects and daytime sleepiness noted in children with obesity related sleep apnea (A. Must & Strauss, 1999). Obesity hypoventilation syndrome is a newer phenomenon, whose relationship with sleep apnea is unclear, but is also associated with high mortality and thus should be aggressively treated (Dietz, 1998). The long term health consequences of these morbidities are profound and cumulative. Early intervention is necessary to prevent severe future health problems and disability.

Also of concern in obese children is slipped capital femoral epiphysis (SCFE), which is one of the indications for immediate weight loss intervention. SCFE occurs when repetitive strain causes the femoral head to slip off the femoral neck at the epiphysis. This causes necrosis of the femoral head in 30% of affected children and is a surgical emergency (Noller & Paulk, 2005).

The rise in pediatric obesity has correlated with a rise in conditions known to cause dire long-term health consequences. Children and adolescents are more frequently being diagnosed with type II diabetes, sleep apnea and hypertension, conditions previously relegated to the adult population (Must & Anderson, 2003). To prevent future complications, it is imperative to address weight control early and promptly implement a weight loss plan.
Psychological Impact of Pediatric Overweight

Data collected on the psychological impact of obesity has shown obese children to also suffer from low self-esteem, depression, and anxiety. Social isolation, stigmatization and discrimination are also challenges facing the overweight child (Warschburger, 2005). Obesity onset in childhood is a major factor in the social effect of overweight, especially in middle childhood. Overweight at this stage of development leads to poor self-image and low self-esteem. Furthermore, the negative self-image and concern over body image are more likely to persist through adulthood, as compared to those who became obese in adulthood and suffer only minor disturbances in body image (Must & Strauss, 1999).

Although the prevalence of obesity has increased greatly and it is believed to be a tolerated condition, bias against obese children is actually greater now than 40 years ago (Warschburger, 2005). Overweight children are teased by peers three times as much as normal weight children, but weight-related comments were also reported from children of other ages, family members and even strangers (Warschburger). Rates of depression among overweight youth have been estimated as high as 43% and anxiety, especially social anxiety, is four times higher in obese youth than children with other chronic diseases (Warschburger). It has been shown that children who mature earlier (younger than 11 years old for girls and younger than 12 years old for boys) tend to have lower self-esteem than their peers; however this phenomenon has not been separated from concurrent overweight and early maturation (Dietz, 1998). Overweight children with low self-esteem are also more likely to smoke or use alcohol (Whitlock et al., 2005).

Another study points out that psychological data are most often gathered in the populations of children presenting to a clinician for weight management help and are therefore
more likely to feel despair about their condition (Flodmark, 2005). In community samples studied, quality of life as rated by children, both overweight and normal weight, using the Self-perception Profile for children showed few significant differences. Overweight children rated athletic abilities and physical appearance as less important than normal weight peers, but showed no deficits in social or academic functioning (Flodmark). Flodmark also suggests that any functional deficits apparent in obese children might be ameliorated by increased social and familial support. Dietz reports that overweight children do not have low self-esteem, but a negative self-image develops in adolescence and is likely to persist into adulthood (Dietz, 1998). Children as young as six have been shown to be prejudiced against overweight children, rating them as undesirable friends, cheaters, lazy, and ugly (Dietz). The social stigma extends past childhood, as overweight adult women have been shown to complete fewer years of school, have a lower income and were less likely to marry (Dietz; Must & Strauss, 1999; Noller & Paulk, 2005). Other studies found overweight applicants to be less likely to be accepted to an elite college as other, normal weight applicants with similar qualifications (Dietz; Must & Strauss). These findings were not apparent among overweight young men.

Reports vary regarding whether overweight children suffer psychologically from the condition. It is reasonable to assume that strong familial or peer support can lessen any social or functional deficits perceived by the overweight child. However, a strong societal bias against the overweight may counteract personal support. As a clinician, the best option would be to advise family to provide strong support for the child in any measures that might improve self-esteem and especially health behaviors.
Assessment

It is vitally important for the primary care provider to routinely assess pediatric patients for weight gain. If a child is >95th percentile for height or >85th percentile with comorbidities, such as hypertension, musculoskeletal complaints, or hyperinsulinemia, an in-depth medical assessment should be performed (Barlow & Dietz, 1998). The assessment includes ruling out any exogenous causes of obesity, including genetic syndromes, endocrine syndromes, or psychological disorders. Secondly, any complications of obesity must be recognized and the effects treated or minimized. Common comorbidities are discussed below. Laboratory tests that ought to be performed include a lipoprotein profile, liver function tests (AST, ALT), glucose tolerance test and hemoglobin A1C if appropriate. A thorough history and physical exam should also be performed, looking specifically for any of the symptoms or physical findings associated with obesity related comorbidities: hip or knee pain or limited range of motion at hip, acanthosis nigricans, blurred optic disks, and tibia vara (Barlow & Dietz; Noller & Paulk, 2005). The clinician must also assess the parent and child’s acceptance of the condition and willingness to change behaviors and tailor education messages and suggestions to their motivation level (Young, 2005). Obesity must be treated as a chronic condition, with regular follow-up as appropriate. Also, due to the stigma associated with being obese, the clinician must approach the patient in a sensitive, non-judgmental, and caring manner (Barlow & Dietz). If the patient senses negativity or disgust from the clinician, therapy is much more likely to be unsuccessful (Barlow & Dietz).
Clinician Attitudes Toward Treatment of Pediatric Obesity

The primary care provider is obligated to address the issue of overweight with the child and parent. In a survey of New England area pediatricians (n = 1243), participants agreed the role of the clinician is to educate the patient and parent about the health consequences of excess weight, give advice and support on diet and exercise, and refer to a dietitian (Jelalian, Boergers, Alday, & Frank, 2003). However, the rates at which pediatric providers do so varies. With mildly overweight children (10%-19% over ideal body weight (IBW)), who may be in the easiest position to lose weight, providers discuss weight issues only 25% of the time. This percentage increases to roughly 60% for mildly obese patients (20%-30% over IBW), and more than 90% of visits with severely overweight patients (100% or more over IBW) (Jelalian et al.). This dearth of discussion concerning a major public health issue is due to three factors: lack of confidence in competency, lack of support staff, and lack of reimbursement. Three-quarters of the New England pediatricians surveyed labeled themselves as incompetent in terms of treating pediatric obesity. This perceived incompetence led to discomfort in addressing and treating pediatric overweight, and fewer recommended therapies (Jelalian et al.). Brief but consistent counseling has been shown effective with promoting adults to lose weight, and though similar studies have not been done in children, it is not unreasonable to assume the same would be true (Gilbert & Fleming, 2006). Also, pediatricians cited smoking, alcohol consumption, and sexual activity as more immediate concerns and thus education about these issues precede education about weight issues (Jelalian et al.). Given the limited amount of time allotted for a patient visit and the difficulty inherent in losing weight, it would benefit the patient and provider to be able to begin treatment with the most efficacious plan for long term adherence and benefit.
Intervention for Pediatric Overweight

The remainder of this literature review will include research on interventions for pediatric overweight from 1995 to the present. Four frequently implemented treatment plans for pediatric overweight will be discussed, 1) behavior modification, 2) prescription intervention, 3) over-the-counter medication intervention, and 4) bariatric surgery.

Therapies to be discussed in this paper include behavior modification, prescription therapy, over-the-counter interventions, and surgical interventions. Selecting a management plan for pediatric overweight must include consideration of maintaining the normal growth and development of the child (Kirk et al., 2005). In fact, for uncomplicated overweight, weight maintenance is the recommended first-line therapy. The goal is to maintain the child’s current weight, allowing for a reduction in BMI as the child grows taller (Barlow & Dietz, 1998; Ritchie, Crawford, Hoelscher, & Sothern, 2006). This strategy requires only modest alterations in diet and activity, making it a realistic option (Barlow & Dietz).

Behavior Modification

The most extensively studied intervention in pediatric populations is behavior modification. Behavior modification is a series of comprehensive lifestyle changes with the goal of attainment of a healthy weight for the child. The targets of behavior modification include improved diet, increased physical activity with a decrease in sedentary behaviors, stimulus and impulse control, pre-planning, goal setting, self-monitoring, and reward. In implementing treatment, individual or multiple components can be targeted, depending on the motivation or expected adherence of the patient, realizing that modifying one behavior will be easier than modifying many.
Behavior modification can be implemented in a variety of settings; however a family-based therapy is generally more effective in younger children aged 5 to 12 years. School-based therapy can be effective in adolescents (Ritchie et al., 2006). It has been suggested that early adolescence coincides with a shift of locus of control over health issues for children, which means school-based therapies, with greater responsibility given to the adolescent, are more likely to succeed (Beckman, Hawley, & Bishop, 2006). Long-term follow-up of behavior modification studies have shown some promising results. In a ten-year follow-up of family-based behavioral treatment, (n = 42) targeting parent and child for weight loss showed greater maintenance of reduced weight compared to targeting the child alone (Epstein, Valoski, Wing, & McCurley, 1994). Perceived cost of implementing a lifestyle change (diet or exercise) can be a major impediment to successful, long-term adherence, especially if the change has other perceived negative qualities (burdensome, not enjoyable, poor taste, time-consuming, etc), and should be addressed by allowing the child some choice in behaviors targeted and reward options.

Behavior modification is based on a rewards system, learning to substitute non-food rewards as reinforcement of positive behavior and inducement to continue perceived negative changes. Small and large rewards, and the goal achievement they will correspond to, should be determined at the beginning of the program (Stewart, Houghton, Hughes, Pearson, & Reilly, 2005). As parental involvement has been shown to improve outcomes for pediatric weight loss, it is advantageous to include parents either as weight loss partners if both parent and child are overweight, or simply as providing positive reinforcement of goal achievement (Epstein et al., 1998; Epstein et al., 1994).
Diet modification is a major component of the therapy, which includes implementing a diet plan simple enough for the child to follow. The Traffic Light Diet, introduced by Epstein and colleagues, is a popular method. It categorizes foods into Green, Yellow, and Red foods, which correspond respectively to foods eaten freely, in moderation, and sparingly, with a calorie limit of 900-1200 kcal/d (Epstein et al., 1998). Interventions utilizing the Traffic Light Diet have been effective in decreasing children’s weight while also increasing consumption of required nutrients, such as calcium, protein, and vitamins (Epstein et al.). Other diets advised include the diabetic exchange diet, low-glycemic load diet, and the protein-sparing modified diet (PSMD). The diabetic exchange diet categorizes foods into groups based on similar nutrient densities. An individualized meal plan determines the number of exchanges of each category (Epstein et al.). The exchange system is easy to follow and exchange information is printed on most food labels, further simplifying choices. The low-glycemic load diet uses the concept of glycemic index (GI) to guide food choices. The diet is structured similarly to the federal guidelines, with 45%-50% carbohydrate, 15%-25% protein, and 30%-35% fat. This diet has been shown to reduce the postprandial increase in blood glucose and decrease hunger throughout the day in single-day studies of overweight children (Kirk et al., 2005). The glycemic load diet has also been shown to result in greater decreases in BMI and % body fat than a standard reduced-fat diet (Kirk et al.). A 2000 study evaluated 107 children randomized either to a reduced-fat, energy-restricted diet or a low-GI diet in which children were instructed to eat to satiety and snack when hungry. The low-GI group showed a mean BMI decrease of 1.15 kg/m² compared to no change in the reduced-fat group (Spieth et al., 2000). The PSMD focuses on protein intake, striving for 1.5-2.5g high-quality protein per kilogram body weight. This very restrictive diet allows 600-900 kcal/d and is reserved for severely obese, postpubertal
children and should be administered under close medical supervision. The goal of this diet is to achieve rapid weight loss while preserving lean muscle mass. One study showed a weight reduction of 11.5 kg over 10 weeks using the PSMD, however at 15 months, weight reduction was not different from less restrictive diet plans (Epstein et al.).

Behavior modification also includes education regarding increasing activity while reducing sedentary behaviors (Stewart et al., 2005). Participants are taught to keep logs of time spent in physical activities, including lifestyle activities, and sedentary behaviors. Epstein and colleagues (2004) found that decreasing sedentary behaviors results in weight loss equal to targeting an increase in physical activity, due to either a substitution of physical activities during time previously spent in sedentary activities or reduced energy intake. In another study by Epstein and colleagues, participants (n = 88) randomized to diet and exercise were markedly more successful with weight loss maintenance than the diet alone group at ten-year follow-up. Interestingly, the group who participated in lifestyle exercise was even more successful than the group that participated in aerobic exercise, as 64% of the lifestyle exercise group (n=42) were < 20% overweight at 10 year follow-up compared to 58% of the aerobic exercise group (n = 46). The weight loss maintenance in both groups was significantly greater than the calisthenics control group, but no between-groups analysis was available comparing aerobic to lifestyle exercise (Epstein et al., 1994).

Behavior modification is probably the most accepted form of weight loss intervention for the pediatric population. However, the combination of diet changes, incorporating exercise and lifestyle modifications have been found to be difficult to achieve in adult populations and could be more difficult with a pediatric population (Barnett et al., 2005). The tenets of behavior modification will, however, lead to a lifetime of improved health, if consistently
applied, and therefore are a worthwhile endeavor for the PCP and parents to pursue with the child or adolescent.

Prescription Interventions

Prescription drugs for weight management that have been approved for use in adult populations are being prescribed to pediatric patients, although the indications do not include children and there is limited testing on the safety and efficacy of these drugs in children. However, orlistat and sibutramine have been approved for use in adolescents greater than 16 years of age (Epstein et al., 1998).

Sibutramine (Meridia™) is an antiobesity agent designed to inhibit the reuptake of norepinephrine and serotonin thereby acting as an appetite suppressant (Berkowitz et al., 2006; Epstein et al., 1998). Sibutramine has been tested in adolescent (>16 years) populations alone (n =60) and as an adjuvant to behavioral therapy (n = 498). In both instances, sibutramine significantly increased the mean weight reduction. As compared to the behavior therapy with placebo group, sibutramine plus behavior therapy had greater reduction in BMI (-9.4 kg/m² vs -1.2 kg/m²) at the end of the 12 month study (Berkowitz et al.; Epstein et al.). Berkowitz et al (2006) also found significant improvements in secondary outcomes such as decreased waist circumference, triglyceride levels, and improved HDL, insulin levels, and insulin sensitivity.

The adverse effects of most concern with sibutramine, as with other norepinephrine modulators, are cardiac effects. In a meta-analysis of adult trials of sibutramine, increases in blood pressure were dependent on initial body weight and age, being more pronounced in those > 92 kg and < 44 years old. In a study (n = 361) done by Berkowitz et al (2006), 5 subjects in the sibutramine group discontinued therapy due to hypertension compared to none in the
placebo group. Withdrawal due to tachycardia (defined as heart rate >110 beats per minute or an increase of >20 bpm) was similar for both groups. The incidence of other reported adverse events was similar for both groups. Only tachycardia was significantly more frequent in the sibutramine group. However, another study of 52 subjects found no differences in cardiovascular measures, comparing sibutramine to placebo in adolescent populations (Godoy-Matos et al., 2005). Also, in the study by Godoy-Matos et al., echocardiograms were performed on participants (n = 52) to investigate a suspected adverse effect of sibutramine on cardiac valves, with no adverse effects found. A study by Zannad and colleagues in adult subjects (n = 184) showed no changes in cardiac valves during sibutramine treatment and found no increase in blood pressure, but a significant increase in pulse rate in the sibutramine-treated group (Zannad et al., 2002). Gaciong et al (2005) found a significant decreases in blood pressure and pulse rate in a 3 month trial of sibutramine (n = 2,225). It is also demonstrated that sibutramine may prolong the QT interval, and case reports suggest this may cause serious arrhythmias in some patients, specifically those with long QT syndrome or taking other medications known to prolong the QT interval (Harrison-Woolrych, Clark, Hill, Rees, & Skinner, 2006). Overall, sibutramine is acknowledged as a safe and effective drug, yet it is recognized by the FDA as a potential danger to patients, and therefore close monitoring and follow-up of any patient taking sibutramine is advised (Wirth & Krause, 2001).

Orlistat (Xenical™ ) is a gastrointestinal lipase inhibitor, which acts by decreasing absorption of fats, thereby promoting their excretion in stool (Krempf et al., 2003). This mechanism of action is meant to act as a catalyst to change eating behaviors, teaching patients to reduce and avoid high-fat foods. In a 2 year study of adults (n = 411), orlistat was shown to be effective in weight loss and maintenance over the 2 year period. Side effects reported by
adult patients were minimal, with gastrointestinal events being the most common (Krempf et al.). In 2003, a pilot study with eleven children ages 8 to 12 investigated whether weight reduction could be achieved and if children could alter their diets to avoid the adverse effects of a high-fat diet (Norgren, Danielsson, Jurold, Lotborn, & Marcus, 2003). While no formal behavioral therapy component was assessed in the pilot study, participants and guardians were given information about dietary fat sources and intake guidelines before treatment began. Receiving the adult dose of orlistat (120mg at each eating session), participants completed a 12 week pre-treatment screen and a 12 week treatment program. Median weight reduction during the 12 week treatment program was 4 kg with excellent treatment compliance, in comparison to a 2.6 kg weight gain during the 12 week screening session (Norgren et al.). There is limited information reported about adverse effects; it was reported that 2 children prematurely withdrew from the study due to excessive diarrhea, suggesting failure to reduce fat consumption as recommended. Vitamin A deficiency was the only biochemical parameter that showed significant (p=0.028) decline over the 12 week period, and should be a focus of study in longer-term trials (Norgren et al.). A study (n =539 ) by Chanoine et al (2005) found orlistat to be only moderately more effective than placebo over a 2 year period, with both groups participating in an exercise and hypocaloric diet program. The orlistat-treated group, after an initial decline in BMI, experienced a stabilization of BMI, while the placebo group had a slight, steady increase in BMI through the rest of the study period.

The social and psychological implications were not found in the literature, especially the effect on personal responsibility felt for weight management and rebound weight gain. This would be an interesting area for future research.
Over-the-counter supplementation

Self-medicating is an option many overweight patients attempt as a seemingly easy alternative compared to the long, difficult, and often fraught with failure attempts to lose weight by conventional methods. Few randomized, double-blinded studies concerning weight loss supplements are in the literature. However, there are case reports and level II evidence (non-biased investigational studies lacking randomization and placebo control) available to educate the public.

Since the ban of ephedra, a sympathomimetic stimulant, in 2004 by the FDA, consumers have been looking for a product that delivers similar results. The new ephedra-free supplements contain compounds that have a pharmacokinetic action similar to ephedra, and similar adverse effects are being seen. Bitter orange (*Citrus aurantium*, the dried peel of bitter orange) is Chinese herbal remedy and a popular ephedra substitute. Available literature suggests that bitter orange supplements may cause adverse cardiac events (Haller, Benowitz, & Jacob, 2005); case reports of stroke, variant angina, QT prolongation, and possible myocardial infarction in which bitter orange containing supplements are suspected of being the causative factor were found in the literature (Gange, Madias, Felix-Getzik, Weintraub, & Estes, 2006).

Guar gum and psyllium, both sources of soluble fiber, are supplements purported to increase satiety by absorbing water in the digestive tract. No good-quality studies support either method as a means for weight loss (Saper, Eisenberg, & Phillips, 2004). Chitosan, derived from chitin in crustacean shells, is a positively charged polymer which allegedly prevents fat absorption by binding to the negatively charged fat molecules. Several placebo-controlled studies of chitosan have been performed, with contradictory results. Some have shown no significant difference between chitosan groups and placebo (Mhurchu, Dunshea-Mooji, Bennet, & Rodgers, 2005a;
Shields, Smock, McQueen, & Bryant, 2003), while others have shown at least a slight significant increase in weight loss in the chitosan group (Mhurchu et al., 2005a; Mhurchu, Dunshea-Mooji, Bennet, & Rodgers, 2005b). Chromium, an essential micronutrient, may have a role in carbohydrate metabolism and a deficiency of chromium has been linked to hyperinsulinemia, hyperglycemia, and hypertriglyceridemia (Saper et al., 2004). Therefore chromium supplementation has been proposed to promote carbohydrate digestion and control weight gain, however, randomized controlled trials do not support the link (Egger, Cameron-Smith, & Stanton, 1999; Saper et al.).

Based on self-report surveys, 79% of adolescents have used some form of alternative medicine in their lifetime, the most popular choices being vitamins, herbal teas. Most common herbal choices are ginseng, zinc, Echinacea, and the above mentioned weight loss supplements. (Wilson et al., 2006). Overall, 46% of adolescents reported using a dietary supplement. Girls are more likely to use supplements than boys (49% v 42%), and use is most prevalent in the 16-17 year-old cohort (Wilson et al.). Side effects and drug interactions vary widely with the supplements taken, and with the high prevalence of alternative medicine use among youth, a careful history is essential to prevent dangerous interactions.

Recently, the FDA has approved an over-the-counter version of orlistat, called Alli. This is the first medication approved for weight loss available over-the-counter (Myers, 2007). It has been approved for use in people 18 years or older. Alli will be sold as a 60 mg dose, whereas the prescription Xenical is 120mg. However, studies show that the 60mg dose provides 85% of the weight loss benefit seen with the prescriptive dose of 120mg. The safety profile for orlistat in general is fairly good. Very little of the drug is absorbed systemically, limiting its drug-drug interactions and side effects. Common side effects with Alli are similar
to Xenical and include gastrointestinal discomfort and loose stool due to an increase in excreted fat (Myers). It remains to be seen whether the abuse potential will increase with an over-the-counter version.

Bariatric surgery

While not a management plan for the primary care office, bariatric surgery is being considered increasingly in the adolescent population. Gastric bypass surgery for morbidly overweight adolescents has been practiced since the 1970’s and still randomized, placebo-controlled studies of efficacy and associated benefits (e.g., comorbidity resolution) are lacking. The bariatric inclusion criteria for adolescents are more stringent than those for adults and allow for consideration of effects on growth and development (Inge et al., 2004). Adults must have a BMI > 40 or BMI > 35 with severe obesity-related comorbidities to be considered for bariatric surgery (Inge et al.). Adolescents must have a BMI > 40 with severe comorbidities (e.g., type II diabetes, obstructive sleep apnea, metabolic syndrome) or a BMI > 50 with less severe comorbidities and at least a 6 month history of failed medically-supervised weight loss attempts (Inge et al.). With a mature patient willing to adhere to the post-surgery lifestyle, gastric bypass can be as effective in adolescence as in adult populations, without seriously interfering with growth and development (Lawson et al., 2006).

A comprehensive weight management center (Health Works!, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH), which has been performing gastric bypass on adolescents since 2001, reports that 1-3 months after surgery, 19% of excess weight was lost, 33% by 3-6 months, and on average 53% of excess weight was lost at the 2 year point. A retrospective study of 34 bariatric surgery patients, who were adolescents at the time of
surgery, report average weight loss of 45-90 kg, with a reduction in BMI from an average of 47 to an average of 32 (Rand & MacGregor, 1994). Most patients remain overweight after surgery, but the weight loss achieved is sufficient to alleviate many of the co-morbid conditions present prior to surgery (Barnett et al., 2005; Rand & MacGregor).

A meta-analysis of adult bariatric surgery patients shows resolution or improvement of many obesity-related conditions, including hypertension, type II diabetes, hyperlipidemia, and obstructive sleep apnea (Barnett et al., 2005). Though information regarding improved health among adolescent patients is sparse, the limited information available suggests that these benefits extend to the adolescent population as well. In a retrospective study 6 years after surgery, adolescent patients (n =14) report discontinuation of hypertension medication and resolution of musculoskeletal pain and obstructive sleep apnea (Barnett et al.).

Part of the concern in allowing adolescents to undergo bariatric surgery is the radical lifestyle changes that must be adhered to after surgery, such as greatly reduced food intake, vitamin supplementation, and regular follow-up appointments with medical staff. Rand and McGregor, in their retrospective study, found only 15% of adolescents were compliant with the post-operative regimen (Rand & MacGregor, 1994). However, Lawson et al (2006) state that adolescent compliance is no worse than adult compliance with post-operative regimens, which suggests that more post-operative support should be offered to any patient undergoing bariatric surgery.

The primary care provider functions as a sort of liaison for bariatric surgery patients. The primary care provider should recognize potential candidates for surgery, begin the education process, and refer patients to an appropriate surgical site (Presutti, Gorman, & Swain, 2004). Primary care providers must be familiar with the various methods of gastric surgery and
the potential complications. As resolution of comorbidities is common after gastric bypass, the primary care physician should be aware of changing medication needs. Also, nutritional deficiencies, specifically B\textsubscript{12} and iron, should be monitored periodically by the primary care provider. The primary care provider should also be aware of the high percentage of patients, especially adolescents, who do not comply with post-surgical regimens, and thus, can provide continued education and encouragement (Presutti et al.).

Bariatric surgery is a major decision for any patient choosing this option. For the pediatric patient, there are the added issues of maturity and ability to comply with necessary lifestyle changes, future weight and health issues and appropriateness of surgery for adolescents. By stringently adhering to the criteria set for adolescent bariatric surgery, clinicians can offer a chance at weight loss to patients who might otherwise face a lifetime of serious morbidity from obesity.
Discussion

It is readily apparent that pediatric overweight is a national crisis, with psychosocial and medical consequences that extend far into adulthood. Given how difficult it has been shown to be for adults to fully combat their obesity, it is not surprising that no successful, widely utilized management strategy has been found for pediatric patients who, in addition to attempting to correct their weight, are facing the normal trials of growing up, may be lacking the cognitive tools to fully appreciate their health status, and require even more social & familial support than adult obese patients. While even primary care providers fare poorly at detecting overweight in their patients, only about half of obese children are diagnosed as obese by their provider, the primary care provider may be in the best position to address this issue early for the greatest likelihood at achieving a positive outcome (Plourde, 2006). Pediatric providers must be trained in diagnosing and treating pediatric overweight, as lack of specific training has been cited as a substantial barrier to initiating treatment (Jelalian et al., 2003). A supportive and persistent primary care provider can help the pediatric patient—educating on healthful diet choices, increasing activity & decreasing sedentary behaviors, referring to nutritionist, referring for surgery, and involving the entire family for support and role-modeling behaviors, especially concerning diet and exercise.

Parents are key participants in the treatment of pediatric overweight and their support and cooperation is needed for any weight loss endeavor. It has been shown that programs that involve the family are more successful than interventions targeting the child alone (Barlow & Dietz, 1998; Epstein et al., 1998; Flynn et al., 2006). Parents have so much control over their child’s environment that studies have found that targeting the parent as the agent of change has better outcomes than targeting the child (Flynn et al.). Educating families about the
implications and the long-term complications of overweight is the first step in assessing readiness of the family to initiate a weight-loss intervention. If the family is in denial about the seriousness of overweight or the possibility of weight loss, any attempt to initiate behavior change will most likely fail (Barlow & Dietz). The Expert Committee on the evaluation and treatment of pediatric obesity recommend either delaying the initiation of treatment or referring the family to a counselor who can address motivation, misconceptions and denial of the condition. The family must be educated about how to encourage physical activity and discourage sedentary behaviors and well as about making healthy food choices. By having the parent in control of the environment, while maintaining the child’s sense of choice, a balance can be achieved that results in prolonged behavior changes (Barlow & Dietz; Epstein et al.). Ensuring strong family support of pediatric weight loss is the first crucial component necessary to implement a successful program, which should be discussed and decided upon by the clinician, parents and child (Barlow & Dietz).

School is another arena in which to focus on pediatric overweight. Both primary (targeting all children) and secondary (targeting children at-risk for overweight) interventions have been studied in the school environment. The consensus of the American Dietetic Association is that school based programs should be multifaceted, including physical activity and nutrition education (Ritchie et al., 2006). It is important to avoid a stigmatization of children participating in secondary prevention programs. Initiating secondary prevention programs as part of a primary prevention program may be the best way to avoid stigmatization and embarrassment (Ritchie et al., 2006).

Behavioral therapy is the recommended first-line therapy for treating overweight pediatric patients, and is the most accepted in terms of treatment administration to growing
children. However, treatment interventions shown to achieve long-term results are very intensive programs, requiring specially trained personnel and many hours per patient. These interventions may not be feasible to implement in the primary care setting, depending on the level of attention the patient requires. Referral to obesity clinics might best serve the patient’s needs; however, if possible, management in the primary care office, through advice, education and other treatment plans deemed necessary might be less stigmatizing for the child and more cost-effective for the family, if the clinician is comfortable with treating the level of overweight and comorbidities. Continual reinforcement of the importance of healthy weight attainment can increase the likelihood that the patient will undertake a weight loss program and simply advising weight loss along with basic education about food choices and exercise can result in moderate weight loss in a motivated patient (Saelens et al., 2002).

Bariatric surgery in the adolescent is limited to a very specific subset of the obese adolescent population. It is, however, the only therapy shown to achieve consistent, long-term weight loss (Brolin, 2005). Complications of therapy can be severe, and it is imperative to ensure that both patient and parent fully understand the risks involved. Adolescent bariatric surgery is best performed at a multidisciplinary center, where specialists are available to address each component of pre- and post-operative regimens.

Use of prescription weight-loss medications in adolescents is rapidly becoming a legitimate option in the treatment of adolescent overweight. It remains to be seen if mainstream use of antiobesity agents in adolescents will result in apathy and lack of responsibility felt for weight loss. However, for those whom tenacious weight loss efforts have failed, sibutramine and orlistat offer another opportunity to achieve their goal. Interestingly, since studies have found that many adolescents’ intake of dietary fat is close to recommended
guidelines, it may be that orlistat is ineffectual in that population. However, it is noted in the literature that the majority of preferred snacks in obese population samples are high-fat foods (Epstein et al., 1998). The conflicting results of sibutramine trials regarding the effect on heart valves and hemodynamic measures create another obstacle to mainstream use of this drug for adolescents. However, when designing any weight loss plan for a patient, it bears mentioning simply to remind practitioners that each patient profile for weight loss will be different, and that the approach must be individualized to address the specific patient’s weight issues.

It is unlikely that obesity in the adult or pediatric population will ever be “cured” by a return to ideal body weight (Noller & Paulk, 2005; Whitlock et al., 2005), but without persistent clinician intercession, few patients will achieve any sort of improvement and the majority will struggle with a lifetime of weight-related disease (Barlow & Dietz, 1998; Moran, 1999).
References


Appendix: Key Points for Clinicians

- Address weight issues in a timely manner with parents and child; do not wait until health concerns arise to begin education and intervention.
- Be direct. Address weight issues openly and in plain language.
- Be familiar with height/weight standards and track both in all pediatric patients.
- Inquire about and offer exercise and diet education to all patients, regardless of weight status.
- Be persistent. Weight loss will be a long-term commitment and the family will need continued support and encouragement.
- Have educational reading material available for families, reiterating diet changes and exercise suggestions.
Abstract

**Objective.** This paper examines the current epidemic of pediatric overweight with regard to assessment, clinician perspective and treatment options. Pediatric overweight increases the risk of obesity in adulthood with increased risk of chronic diseases. **Methods.** The literature was searched for studies, meta-analyses, and systematic reviews relating to pediatric overweight: causes, appropriate assessment, interventions and clinician perception of pediatric overweight. **Results.** Topics with sufficient support in the literature include weight maintenance, behavior modification, bariatric surgery, and prescription weight loss drugs, which were reviewed for indications for use and efficacy. Over the counter weight loss supplements were included as a reference for clinicians. **Conclusion.** The intervention of choice for uncomplicated pediatric overweight is weight maintenance. Behavior modification is preferred for complicated or morbid obesity; however prescription drugs and bariatric surgery are gaining support as treatment options for older children with complicated overweight.