Curr Cardiovasc Risk Rep (2012) 6:567–578
DOI 10.1007/s12170-012-0272-y

PEDIATRICS (SS GIDDING, SECTION EDITOR)

Behavioral Interventions and Cardiovascular Risk in Obese Youth: Current Findings and Future Directions

Anna Vannucci · Denise E. Wilfley

Published online: 22 September 2012
© Springer Science+Business Media, LLC 2012

Abstract The identification and early intervention of pediatric obesity is critical to reducing cardiovascular disease (CVD). Family-based behavioral interventions have consistently demonstrated efficacy in reducing adiposity and CVD risk factors (i.e., blood pressure, cholesterol, fasting glucose levels, insulin resistance, metabolic syndrome). Even modest weight loss in severely obese youth can lead to sustained improvement in CVD risk factors. However, weight regain following treatment cessation remains a challenge in the contemporary obesogenic environment. Intensive family-based interventions spanning socioenvironmental contexts (i.e., home, peer, community) show promise in sustaining weight loss in the long-term. Despite having effective treatments for pediatric obesity and CVD risk factors, families rarely have access to these programs and so increasing the role of healthcare providers in screening and referral efforts is imperative. Moving forward, it is also essential to establish communication and cooperative networks across sectors build sustainable prevention and intervention programs and to provide cohesive health messages.

Research support NIMH K24 070446 (D.E. Wilfley), NHLBI T32 5HL007456 (D.E. Wilfley), NICHD R01 HD036904 (D.E. Wilfley)

A. Vannucci
Department of Medical and Clinical Psychology,
Uniformed Services University of the Health Sciences,
4301 Jones Bridge Road,
Bethesda, MD 20814, USA
e-mail: anna.vannucci@usuhs.edu

D. E. Wilfley (✉)
Department of Psychiatry, Washington University
School of Medicine,
660 South Euclid,
St. Louis, MO 63110, USA
e-mail: wilfleyd@psychiatry.wustl.edu

Keywords Obesity · Cardiovascular disease · Prevention · Treatment · Family-based treatment · Predictors · Moderators · Children · Adolescents · Binge eating · Loss of control eating · Satiety responsiveness · Eating in the absence of hunger · Impulsivity · Food reinforcement · Appetitive traits · School · Primary care · Type 2 diabetes · Insulin resistance · Blood pressure · Cholesterol

Introduction

Cardiovascular disease (CVD) is currently the leading cause of death in the United States [1], which can—at least in part—be attributed to the epidemic increases in the prevalence of pediatric obesity. More than one third of children and adolescents in the United States are overweight (body mass index, BMI, ≥85th percentile for age and sex) or obese (BMI ≥95th percentile) [2]. Pediatric obesity not only is associated with CVD risk factors such as hypertension, dyslipidemia, carotid-artery atherosclerosis, insulin resistance, and type 2 diabetes [3–7], but it is also predictive of coronary artery disease and early death during adulthood [8, 9]. Children's risk for these health problems directly increases with their degree of overweight [7, 10], which is especially concerning in light of evidence that the rates of extreme obesity (BMI ≥99th percentile) are increasing disproportionately faster than the rates of moderate levels of obesity (BMI between the 95–98th percentiles) [11, 12].

Despite these sobering statistics, prospective data indicate that the deleterious medical sequelae associated with childhood obesity can be reversed. One study following individuals for 23 years found that obese children who developed into nonobese adults had a similar cardiovascular profile to adults who were never obese [13•]. The onset of endocrine dysfunction and CVD risk factors only persisted among those obese

youth who continued to gain excess weight and became obese adults [13•]. However, the reality is that pediatric obesity does not spontaneously resolve with age, as childhood overweight is a robust predictor of obesity during adolescence and young adulthood [14, 15]. This tendency for overweight and obesity to track across the lifespan starts as young as 6 months [16], which underscores the need for early identification and intervention of weight problems in youth.

Childhood is an ideal point of behavioral intervention for several reasons [17]. First, adult weight loss treatments have been met with limited long-term success [18]. Second, children's weight-related behaviors (i.e., eating behavior, physical activity) may be more amenable to change because these habits are not yet fully ingrained [17]. Third, natural increases in height during childhood create a circumstance where even small weight loss reductions or weight maintenance over time are sufficient for overweight and obese children to satisfy criteria for normal weight [19]. Fourth, traditional low-intensity universal prevention programs, psychoeducation, and usual care do not yield significant weight reductions or improvement in cardiovascular risk factors [20, 21]. Finally, early behavioral intervention has the potential to reduce the staggering healthcare costs resulting from obesity-related illness (e.g., CVD) [22, 23], which are estimated to be over $190 billion annually [24].

The purpose of this article is to: 1) discuss current treatment practices for pediatric obesity; 2) review the impact of family-based behavioral interventions on CVD risk factors; 3) describe treatment predictors and targeted interventions; 4) discuss family-based behavioral interventions that are implemented across socioenvironmental contexts; and 5) elucidate the role of coordinated and cost-efficient care in the future of pediatric obesity and CVD prevention.

Current Treatment Practices for Pediatric Obesity

The US Preventive Services Task Force [25] and the American Academy of Pediatrics [26] have published expert guidelines for the screening, prevention, and treatment of pediatric obesity. The importance of identifying at-risk youth as early as possible is stressed so that preventive options may be explored before more costly, intensive treatments are needed [26]. It is recommended that primary care providers routinely track BMI percentiles [25] and assess children's medical and behavioral risk factors for obesity [26]. The American Academy of Pediatrics guidelines encourage primary care providers to deliver obesity prevention messages to all youth (i.e., guidelines for fruit and vegetable intake and daily activity) and to provide specific behavior change targets for families with overweight and obese children [26]. Finally, primary care providers should establish procedures for making referrals to community resources that can provide the treatment appropriate for children's level of adiposity and risk factors [25, 26].

The US Preventive Services Task Force recommends that overweight and obese children receive specialty treatment of moderate to high intensity that incorporates behavioral counseling targeting diet and physical activity [25]. Lifestyle interventions are active treatments that modify overweight children's weight-related behaviors in a manner that is compatible with daily living and, therefore, more sustainable over time [17]. According to Task Force recommendations [25], parents are also expected to play a pivotal role in treatment. Indeed, the most efficacious lifestyle interventions for pediatric obesity incorporate the following components: dietary modification, changes in energy expenditure, behavior change techniques, and parental involvement (Table 1). Family-based behavioral weight loss treatments are currently considered the first line of treatment for pediatric overweight and obesity (see Wilfley and colleagues for comprehensive review; [17]), and there is increasing evidence that expanding these interventions to focus on the youth's socioenvironmental context are likely to be the most successful [27, 28••].

The use of pharmacotherapy or surgical options is recommended for older children and adolescents with extreme obesity and severe medical comorbidities [26]. Orlistat—a lipase inhibitor—is the only drug currently approved by the Food and Drug Administration for treating obesity in children (≥12 years old). A meta-analysis found that orlistat modestly reduced BMI (weight loss of 4–6 lbs) in severely obese adolescents, but was associated with a high prevalence of gastrointestinal side effects [29]. Although roux-en-y gastric bypass and laparoscopic adjustable gastric banding have demonstrated efficacy for the reduction of BMI and CVD risk factors in obese adolescents [30–33], there are high rates of surgical complications and cogent concerns about strict adherence to dietary recommendations and the continued cost of medical management. Notably, there are few studies evaluating the long-term outcomes and safety of pharmacological and surgical treatments for pediatric obesity. It must be emphasized that pharmacologic and surgical options should only be considered if good adherence to an intensive lifestyle intervention for three to six months was ineffective at reducing weight or improving medical comorbidities [26]. The implementation of intensive behavioral intervention is still indicated alongside the use of pharmacotherapy and surgical options.

Table 1 Efficacious components of lifestyle interventions for pediatric obesity

Intervention component	Intervention targets	Parental involvement
Dietary modification	*Induce overall caloric deficit*[a] *by:*	Provide and plan for healthy meals
	Increasing low energy density (LED) foods:	Involve child in preparing meals
	1. Fruits and vegetables (5 daily servings recommended)	Limit eating meals away from the kitchen and dining room
	2. "Good" fats (e.g., nuts, fish)	Serve fruits and vegetables for snacks
	3. High-fiber foods (e.g., raisins)	Limit access to HED foods in the home and trips for fast food
	Decreasing high energy density (HED) foods (no more than 15 servings per week):	Replace sugar-sweetened beverages with water or low-fat milk
	1. Sugar-sweetened beverages (i.e., soda, sugary fruit juice)	Serve appropriate portion sizes
	2. Snacking (e.g., foods that contain >5 g of fat, fast food, sugary cereal)	Model healthy eating behaviors
	3. Meals outside the home	
Energy expenditure modification	*Increase overall energy expenditure by:*	Make a weekly activity schedule
	Increasing daily activity:	Provide youth with proper clothing and equipment for physical activity
	1. 60 minutes of moderate- to vigorous-intensity physical activity every day	Plan family activities that are physically active (e.g., parks)
	2. Lifestyle activity (e.g., taking stairs instead of the elevator)	Monitor and limit youth's time spent in key sedentary activities
	Decreasing sedentary behavior (no more than 2 hours per day)	Provide encouragement for physical activity rather than sedentary activities
	1. Watching television/movies	Model an active lifestyle
	2. Playing videogames	
	3. Using the computer	
Behavior change techniques	Promote sustainable, healthful weight-related behaviors:	Review self-monitoring logs with child or adolescent
	1. Self-monitor goal achievement (e.g., log daily fruit and vegetable intake)	Help youth set appropriate goals
	2. Set eating and activity behavior goals	Model behavior change techniques
	3. Increase availability of healthful alternatives through stimulus control (e.g., limit access to HED foods, increase access to LED foods)	Hold family meetings
		Praise healthy behaviors and minimize attention unhealthy behaviors
	4. Implement a family-based reward system to encourage goal achievement	Solicit social support from friends and family to maximize prompts for healthy eating and activity

Note: Reprinted and adapted with permissions from Wilfley and colleagues [51]

[a]Setting calorie limits is often recommended and varies across individuals (i.e., age, sex, weight status), but general guidelines include: 1) weight loss=1,200–1,400 kcal/day; and 2) weight gain prevention=1,400–2,000 Calorie kcal/day

Impact of Behavioral Interventions on Cardiovascular Risk

Intensive multi-component lifestyle interventions are effective in inducing weight loss in children, which has the indirect effect of reducing the likelihood that these youths will develop CVD risk factors. Numerous randomized controlled trials and meta-analyses have demonstrated that active lifestyle interventions are superior to no-treatment control or education-only conditions for the treatment of pediatric obesity [34–39]. For example, one meta-analysis indicated that lifestyle interventions resulted in an average decrease in percent overweight of 8.9 %, as compared to education-only controls that resulted in an average increase of 2.7 % at follow-up [38]. Family-based behavioral interventions, in particular, have consistently demonstrated efficacy in reducing child BMI [40, 41]. It should be remembered that, in children, height increases and BMI norms change with age and pubertal status. Pediatric studies thus rely on change in BMI z –scores to assess outcomes.

In the first known study examining the impact of family-based behavioral interventions on CVD risk factors,

severely obese children were randomly assigned to a 20-week family-based behavioral intervention or a nutrition education condition [42••]. Youth in the family-based intervention exhibited modest weight loss (7.58 % decrease) at post-treatment, as compared to those in the usual care condition (0.66 % decrease). However, these differences were not sustained over time. Despite the lack of weight loss maintenance, youth enrolled in the family-based intervention had significantly lower systolic blood pressure, waist circumference, and overall fat mass than those in usual care at post-treatment and at 6-month follow-up. As compared to those randomized to usual care, significant decreases in BMI, fat mass, total cholesterol, and insulin resistance were found in obese children enrolled in a family-based intervention at 6- and 12-month follow-up time points [43]. No differences were found for blood pressure or triglycerides [43]. These preliminary data indicate that family-based behavioral interventions positively impact CVD risk.

Several non-controlled trials have investigated the impact of lifestyle interventions on CVD risk factors in obese youth. Obese children participating in a lifestyle intervention had a significant decrease in BMI-z scores and in metabolic syndrome prevalence (from 19 % to 9 %), as well as specific improvements in waist circumference, blood pressure, and fasting plasma glucose as compared to matched non-treated children [44]. Severely obese youth enrolled in a family-based intervention had significant reductions in body weight, systolic blood pressure, and insulin resistance as compared to non-treated lean youth that were maintained for 12 months following treatment cessation [45]. In a study comparing a family-based intervention, an intensive inpatient intervention and untreated obese children, all CVD risk factors improved among those youth receiving any intervention [46]. The inpatient intervention was associated with greater decreases in low-density lipoprotein (LDL) cholesterol, whereas the family-based intervention yielded greater improvements in insulin resistance, triglycerides, and high-density lipoprotein (HDL) cholesterol levels [46]. While these data show promise, it is imperative that randomized controlled trials testing pediatric obesity interventions begin to incorporate key measures of CVD risk factors more systematically.

Research has also examined the degree of weight loss needed to effect improvements in CVD risk. A BMI-z reduction of 0.5 or greater in obese children and adolescents participating in a lifestyle intervention program has been associated with improvements in all components of metabolic syndrome, including waist circumference, triglycerides, high-density lipoprotein (HDL) cholesterol, blood pressure, and fasting glucose[44, 47, 48]. One prospective study in obese adolescents found that improvements in insulin sensitivity, total and HDL cholesterol levels, and blood pressure were seen in youth achieving a BMI-z reduction of greater than or equal to 0.25 units [49]. Notably, this study found that a BMI-z reduction of at least 0.5 units was associated with additional improvements in waist circumference, triglycerides, LDL cholesterol levels, and plasma C-reactive protein [49]. Thus, it appears as though modest weight loss can induce improvements in CVD risk, even among those with severe obesity.

Overall, research supports the notion that family-based lifestyle interventions for pediatric obesity can make a notable impact on CVD risk factors. However, the impact of lifestyle interventions on CVD risk in a population with severe obesity-related medical comorbidities is unclear. In a recent randomized controlled trial in obese youths with recent-onset type 2 diabetes, those assigned to metformin plus rosiglitazone exhibited greater weight loss than those assigned to either metformin alone or metformin plus lifestyle intervention [50•]. However, youth in the metformin plus lifestyle intervention group gained less fat mass than those in the medication only groups; there were no treatment differences with regard to any other CVD risk factors [50•]. Overall, treatment failure rates in these youths were very high. It is possible that the impact of the lifestyle intervention would be enhanced with a more long-term, intensive adaptation than spans socioenvironmental contexts. Regardless, these sobering findings underscore the importance of prevention and early intervention of weight problems [51].

Outcome Predictors and Targeted Intervention Approaches

Family-based lifestyle interventions have demonstrated their efficacy for reducing BMI and CVD risk factors in the short- and long-term. These intensive multicomponent interventions are recommended over universal prevention programs, psychoeducation, and usual care, which have been consistently ineffective. Despite the success of family-based interventions, there is a sizable subset of youth who have difficulty making sustained behavior changes and do not achieve sufficient weight loss during treatment. Additionally, weight regain—and with it, the probable worsening of CVD risk factors— following treatment cessation is a common problem for a subset of children and adults [28••]. These challenges likely occur because factors in the individual, home, peer, and community contexts that set the occasion for obesity-promoting behaviors in this subset are not modified outside the clinic environment [28••]. To identify such vulnerable youth and their families, research has examined predictors across socioenvironmental contexts that reduce or potentiate the degree weight loss during lifestyle interventions and weight loss maintenance after treatment cessation (Table 2). While these predictors have only been linked to differential pediatric weight outcomes,

the strong connection between adiposity and CVD suggests that these predictors may similarly impact CVD risk.

Individual Context

Early Treatment Response At the individual level, early treatment response during family-based behavioral weight loss treatment is associated with short- and long-term weight outcomes. One study found that a reduction of 0.33 BMI-z units during the first three months of a family-based intervention was the most robust predictor of BMI-z reductions at 3 years following treatment cessation [52]. Another study found that overweight children who lost 4 to 8 % of their initial weight by week 8 of a family-based behavioral intervention had the greatest likelihood of maintaining successful weight loss outcomes (i.e., 5 % or 10 % BMI-z score reduction) post-treatment and at the 2-year follow-up [53]. Children's early treatment response was associated with early attendance [53], which likely contributed to a greater mastery of weight loss skills that promoted weight change. In addition, parent weight change by session 8 was also correlated with children's early treatment response [53],

Table 2 Targeted intervention strategies for specific predictors of treatment response

Predictor	Targeted intervention strategy
Children's early treatment response	• Encourage early weight loss (i.e., within first 8 weeks) and immediate engagement in making health behavior changes
	• Stress the importance of early attendance
Parental treatment response	• Promote parental behavior changes and weight loss
	• Discuss strategies for restructuring the home environmental to maximize healthful options
Parental psychopathology	• Assess for psychiatric comorbidity in both parents
	• Provide or refer for evidence-based treatments to address parental psychopathology (e.g., cognitive behavior therapy or interpersonal psychotherapy for depression)
	• Evaluate for attachment styles and, in families with children exhibiting insecure, ambivalent, or anxious/avoidant attachment, work with parents to modify how they respond to their child(s)
Poor social functioning	• Evaluate social skills and identify target areas (e.g., making friends, coping with teasing) for improvement
	• Encourage parents to set up healthy, active get-togethers with peers
High food reinforcement	• Identify alternative sources of reinforcement to replace food (e.g., physical activity, social activities)
	• Encourage parents to limit access to unhealthy foods and increase access to preferred non-food alternatives
Impulsivity	• Discuss the importance of delaying gratification for cravings and practice methods for overcoming impulsive food choices
	• Recommend that youth participate in executive control and working memory enhancement programs
	• Encourage parents to use stimulus control strategies (i.e., maximize access to healthy food, opportunities for physical activity, and items that provide cognitive stimulation)
Binge or loss of control eating	• Encourage parents to regulate eating patterns as well as to dentify and reduce triggers for binge eating
	• Identify ways to enhance supportive interpersonal relationships as alternatives to food
Poor satiety responsiveness	• Increase awareness of internal hunger and satiety cues
	• Teach methods to manage "tricky hungers" such as distraction, activity substitution, relaxation, mindful eating, and cost-benefit analyses
	• Work with parents to decrease external food cues in the home
Built environment	• Identify specific aspects of the built environment that may promote (e.g., parks, open spaces) or hinder (e.g., fast food restaurants) weight loss success
	• Determine how to capitalize on available resources or develop plans to increase access to healthful resources

Reprinted with permission from Wilfley DE, Vannucci A, & White EK. Early intervention of eating- and weight-related problems. J Clin Psychol Med S. 2010; 17(4).

which could reflect more healthful parental modeling or changes to the home environment and familial activity patterns. Overall, it is important to encourage families to engage in lifestyle changes at the outset of treatment to maximize the potential for long-term weight management.

Cognitive and Motivational Traits A subset of youth have traits affecting their cognitive resources to self-regulate eating behavior and intrinsic motivation for eating, which adversely affects the ease with which they can make sustained behavior changes. Overweight and obese children who reported that they find food more rewarding relative to non-food alternatives and those that reported they are likely to make more impulsive choices showed a blunted response to a family-based intervention [54, 55]. Further, findings suggest that an environment with an abundance of alternatives to unhealthy eating (e.g., healthy foods, recreational equipment) was associated with success during a family-based intervention, but only among children who did not find food highly reinforcing [54]. Impulsive youth may benefit from executive control and working memory training programs [56, 57], whereas it is important to identify reinforcing alternatives for unhealthy food in children who find food highly rewarding [58].

Binge and Loss of Control Eating Binge and loss of control eating is an appetitive trait defined as eating episodes during which youth report the subjective experience a loss of control over what or how much they are eating. Studies have found that severely obese children reporting binge eating experienced less weight loss during a family-based treatment program [59, 60], while other findings in overweight children are mixed [61, 62]. Preliminary data suggest that group interpersonal psychotherapy [63] and internet-based cognitive behavior therapy [64] are effective treatments for binge eating in adolescents, while appetite awareness training and food cue exposure treatment have shown reductions in binge eating among obese children [65].

Home Context

Parental Involvement The role of parents in lifestyle interventions is critical for successful child weight outcomes, as several studies indicate that a greater degree of parental involvement in behavioral weight loss treatment leads to greater child weight loss and maintenance outcomes [66–69]. Findings indicate that targeting both the parent and child directly is associated with more robust child weight loss outcomes than targeting the child alone [70–72] and, moreover, the degree of parental weight loss is positively correlated with child weight loss [39, 73, 74]. Social learning theory posits that these results are likely due to child observation and subsequent modeling of parental behaviors [75]. The inclusion of parents leads to modeling of healthy behaviors, familial social support for a healthy lifestyle, and stimulus control in the shared home environment, which may generalize to reducing obesity in at-risk siblings.

Parental Psychopathology Other familial characteristics have been shown to impact weight outcomes in family-based interventions. Specifically, self-reported family adversity, parental psychiatric symptoms, and attachment insecurity are associated with an weight regain following family-based treatments [76, 77]. Increases in parent self-reported confidence in their ability to refrain from overeating in high-risk dietary situations (e.g., parties where food is available) was positively associated with child and parent weight loss during a family-based intervention [78]. These findings highlight the potential utility of tailoring family-based interventions to target psychopathology and coping skills of parents, which may be critical for short- and long-term weight management in children.

Peer Context

Youth who experience social problems (e.g., loneliness, susceptibility to teasing) or peer rejection may be more likely to use food as a coping mechanism or less likely to engage in physical activity [19]. Heightened social problems in obese children predict greater weight regain following treatment cessation [27, 76]. Therefore, it is important to identify children with social deficits or who report interpersonal difficulties to help families develop social support systems that can facilitate sustained behavior change. Facilitating peer network support is critical because studies demonstrate that overweight children are more likely to make healthful eating choices when they are with peers making healthy choices [79] and engaging in social activities has been shown to be a viable alternative reinforcer for unhealthy foods[80].

Community Context

The built environment also appears to affect children's weight loss success in family-based behavioral treatment. Two-years following participation in a family-based treatment program, greater weight loss was predicted by children's access to parks and open spaces, whereas reduced access to parks and greater access to supermarkets and convenience stores predicted less weight loss in children [81]. Therefore, it is important to consider youth's built environment when identifying intervention goals and to

work with the family to determine how best to capitalize on available resources in the community.

Behavioral Interventions Spanning Socioenvironmental Contexts

Family-based behavioral interventions have demonstrated efficacy in the long-term, but their narrow focus on the home context may be insufficient to assist youth—especially genetically vulnerable ones—in sustaining resistance to the readily available obesity-promoting prompts. As such, children with negative prognostic indicators of short-term weight loss (e.g., limited parental involvement, appetitive traits) and long-term weight maintenance (e.g., late treatment response, poor social functioning, impoverished built environment) likely require more intensive interventions to elicit successful weight outcomes. To overcome the challenge of weight loss maintenance, the focus of behavior change within family-based interventions needs to extend beyond the individual and home to encompass peer and community contexts.

This socioenvironmental treatment model—known as the Family-Based Behavioral Social Facilitation Treatment—builds upon the lifestyle change skills learned in family-based weight loss treatment programs by extending treatment duration and practicing new skills across contexts [28••]. Individual barriers to sustained self-regulation (e.g., appetitive traits) are identified and addressed with tailored evidence-based strategies (Table 2). Empowering families to build social support systems that promote healthy lifestyle choices is also a critical focus, as well as expanding the intervention scope to increase families' awareness of environmental cues and advocacy for making sustainable lifestyle changes. Examples of specific treatment strategies at individual, home, peer, and community contexts can be found in Fig. 1.

To develop the Family-Based Behavioral Social Facilitation Treatment, adaptations to existing interventions were made based on findings from the first randomized controlled trial on pediatric weight loss maintenance (see Wilfley and colleagues for review; [28••]). Specifically, a Social Facilitation Maintenance treatment—which focused on improving social skills and building social support networks—promoted greater long-term weight loss maintenance in obese children as compared with a Behavioral Skills Maintenance treatment—which emphasized individual self-regulatory behaviors and relapse prevention—and a no treatment control [27]. These data indicate that building healthful and supportive social networks is critical to maintaining weight loss. However, both Social Facilitation and Behavioral Skills Maintenance treatments were efficacious in the short-term as compared to the control condition [27]; this finding along with the emerging data on appetitive traits (described above) suggested that maintaining a focus on the individual context was important. The rationale for emphasizing the community context stemmed from contextual learning theory [82] and research on the substantial impact of the built environment on health behavior change [81]. While a randomized controlled trial is currently underway (Clinicaltrials.gov ID: NCT00759746), biosimulation modeling projects that Family-Based Behavioral Social Facilitation Treatment will elicit even more robust weight loss maintenance in the long-term than the original maintenance treatments [28••].

Although CVD risk factors are not explicitly addressed within Family-Based Behavioral Social Facilitation Treatment, this intervention could conceivably be adapted for the needs of obese youths with concurrent CVD risk factors. For example, the tracking of CVD risk factors could be implemented along with targeted behavioral strategies (e.g., setting an adherence goal and family-based reward system for medication administration in children with type 2 diabetes). It may also be beneficial for the family-based, socioenvironmental interventions to expand their treatment targets to health phenomena that increase CVD risk above and beyond the effects of weight status in obese youth (e.g., depressive symptoms [83], parental smoking [84]). Similar to pediatric obesity treatment, the sustained maintenance of CVD risk reduction in youth likely requires intensive behavioral interventions implemented across socioenvironmental contexts.

Coordinated Care for Pediatric Obesity: The Future of Cardiovascular Disease Prevention

Effective behavioral interventions have been established for reducing obesity and CVD risk factors in youth spanning all levels of adiposity. Yet, obese children and adolescents rarely have access to these programs for several reasons: 1) referrals to behavioral health specialists are not routinely made; 2) behavioral health professionals often lack adequate training and resources to deliver pediatric obesity interventions; 3) messages about weight-related behaviors and obesity treatment are inconsistent across sectors; and 4) insurance reimbursement for intensive, long-term interventions is difficult to obtain. Moving toward the future, sharing knowledge and the responsibility for the health of children across many sectors of society will increase access and reduce

Fig. 1 Sample recommendations across socioenvironmental contexts in family-based behavioral social facilitation treatment

burden while improving weight and CVD-related outcomes.

The primary care setting is ideal for the early identification of weight-related problems in youth because providers can screen for overweight, track CVD risk factors, and routinely meet with children and families to make referrals or deliver interventions [19]. Unfortunately, a significant proportion of primary care providers are either unaware of or do not regularly implement the expert guidelines that outline recommendations for pediatric obesity screening and treatment referrals [85, 86]. Many providers report concerns that they lack adequate skills to address weight problems with families [87] or that adequate treatment strategies do not exist [88], which could further impact screening and referral efforts. Primary care providers who report engaging families in discussions typically have only one brief counseling session about health behaviors and do not provide families with tools to implement changes [87], which has been shown to be ineffective at producing reductions in child BMI [21, 89]. Primary care-based motivational interviewing—a brief, patient-centered approach that explores ambivalence to behavior change and increases intrinsic motivation for healthful changes [90]—has also not been effective in reducing BMI or improving eating and activity patterns in obese children [91, 92]. However, one uncontrolled study found that motivational interviewing was associated improved dietary adherence and reduced cholesterol in children with elevated LDL cholesterol [93]. It may be beneficial for motivational interviewing interventions to focus on improving families' motivation for seeking intensive family-based programs known to be efficacious. Overall, participatory research, stemming from collaborative partnerships between obesity researchers and primary care providers, need to determine optimal methods for training providers in the implementation expert guidelines and for changing providers' obesity-related attitudes.

To further accelerate obesity and CVD prevention, the Institute of Medicine identified recommendations for changes in five critical areas [51], including physical activity environments, food and beverage availability, media messages about lifestyle behaviors and marketing toward children, health care and work environments, and schools. If implemented, these systemic changes would support the practice of healthy behaviors and the messages learned in socioenvironmental weight management programs, likely enhancing intervention outcomes. Schools may be especially compelling contexts to create "healthy eating and activity zones," since school is where children spend most of their time and consume the majority of their daily calories. Indeed, several multi-component school-based programs (e.g., consisting of physical education enhancements, farm-to-school-to-home programs, BMI and fitness reports, and heart health education) have demonstrated reductions in BMI-z scores, obesity prevalence, waist circumference, fasting insulin levels as well as improvements in cholesterol and triglyceride levels relative to controls [94–97]. While the effect sizes of these school programs are smaller than those associated with family-based behavioral interventions, the overall effects on weight and

CVD risk factors may be synergistic if implemented in communities concurrently.

In addition to early identification and widespread efforts for the prevention of pediatric obesity, there is a critical need for cost-efficient healthcare to increase the feasibility of implementing and obtaining coverage for evidence-based interventions. Efficiency can be achieved through matching interventions of appropriate content, breadth, and dose to youth based on their severity of obesity and co-occurrence of CVD risk factors. For example, excess weight gain prevention in healthy children at-risk for overweight may be achieved through targeted, low intensity interventions such as internet-based programs focused on healthy eating [21, 89] or TV allowance devices that limit access to screen time [64]. At the other end of the spectrum, severely obese adolescents with multiple CVD risk factors would require intensive family-based behavioral interventions that span across socioenvironmental contexts, as well as a consideration of pharmacological or surgical treatments. Family-based interventions may also serve as a platform for preventing obesity across multiple generations, which could enhance their cost-effectiveness. Furthermore, the dose of family-based interventions could potentially be scaled based on the presence of negative prognostic indicators and familial risk factors. Research evaluating stepped-care treatment algorithms and treatment-matching options would greatly improve access to evidence-based healthcare, thereby reducing obesity and CVD risk.

Conclusions

The reduction of CVD is paramount to improving health outcomes and health-related economic costs in the United States. The prevention and early intervention of pediatric obesity has the potential for the greatest impact on CVD. Effective treatments for pediatric obesity and CVD risk factors (e.g., intensive family-based behavioral interventions) have been identified, but families rarely have access to these evidence-based programs. Pediatric obesity is a complex, multiply determined problem that requires bold and comprehensive action [84]. Primary care providers are essential for the early identification of weight problems and referral to appropriate community resources. With an increased focus on early intervention and stepped-care approaches, cost-efficient and individualized treatment has the potential to become a reality. Finally, establishing communication and cooperative networks among families, health care professionals, schools, community organizations, and policy makers will facilitate the dissemination of cohesive health messages and the sustained implementation of best practices. Future research must evaluate more integrated, systematic approaches to refine the course of action for prevention obesity and CVD.

Acknowledgements We greatly appreciate the efforts of Heather Waldron and Brendan Finton for their invaluable assistance in the preparation of this article.

Disclosure A. Vannucci: none; D.E. Wilfley: Consultancy for Jenny Craig/Nestle

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Miniño AM, Murphy SL, Xu J, Kochanek KD. Deaths: final data for 2008. Natl Vital Stat Rep. 2011;59.
2. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. JAMA. 2012;307:483–90.
3. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. Risk factors and adult body mass index among overweight children: the Bogalusa Heart Study. Pediatrics. 2009;123:750–7.
4. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. Pediatrics. 2001;108:712–8.
5. Jones A, Charakida M, Falaschetti E, Hingorani AD, Finer N, Masi S, et al. Adipose and height growth through childhood and blood pressure status in a large prospective cohort study. Hypertension. 2012;59:919–25.
6. Rosenbloom AL, Joe JR, Young RS, Winter NE. Emerging epidemic of type 2 diabetes in youth. Diabetes Care. 1999;22:345–54.
7. Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, et al. Obesity and the metabolic syndrome in children and adolescents. N Engl J Med. 2004;350:2362–74.
8. Baker JL, Olsen LW, Sorensen TIA. Childhood body-mass index and the risk of coronary heart disease in adulthood. N Engl J Med. 2007;257:2329–37.
9. Franks PW, Hanson RL, Knowler WC, Sievers ML, Bennett PH, Looker HC. Childhood obesity, other cardiovascular risk factors, and premature death. N Engl J Med. 2010;362:485–93.
10. August GP, Caprio S, Fennoy I, Freemark M, Kaufman FR, Lustig RH, et al. Prevention and treatment of pediatric obesity: an endocrine society clinical practice guideline based on expert opinion. J Clin Endocrinol Metab. 2008;93:4576–99.
11. Freedman DS, Kettel Khan L, Serdula MK, Ogden CL, Dietz WH. Racial and ethnic differences in secular trends for childhood BMI, weight, and height. Obesity. 2006;14:301–8.
12. Koebnick C, Smith N, Coleman KJ, Getahun D, Reynolds K, Quinn VP, et al. Prevalence of extreme obesity in a multiethnic cohort of children and adolescents. J Pediatr. 2010;157:1–6.
13. • Juonala M, Magnussen CG, Berenson GS, Venn A, Burns TL, Sabin MA, et al. Childhood adiposity, adult adiposity, and cardiovascular risk factors. N Engl J Med. 2011;365:1876–85. *This large-scale prospective study followed children for 23 years into adulthood and track the cardiovascular outcomes associated with*

weight loss, weight gain, and weight maintenance in obese and normal weight individuals.
14. Nader PR, O'Brien M, Houts R, Bradley R, Belsky J, Crosnoe R, et al. Identifying risk for obesity in early childhood. Pediatrics. 2006;118:594–601.
15. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med. 1997;337:869–73.
16. Taveras EM, Rifas-Shiman SL, Belfort MB, Kleinman KP, Oken E, Gillman MW. Weight status in the first 6 months of life and obesity at 3 years of age. Pediatrics. 2009;123:1177–83.
17. Wilfley DE, Vannucci A, White EK. Family-based behavioral interventions. In: Freemark M, editor. Pediatric obesity: etiology, pathogenesis, and treatment. New York: Humana Press; 2010.
18. Perri MG. The maintenance of treatment effects in the long-term management of obesity. Clin Psychol. 1998;5:526–43.
19. Wilfley DE, Kass AE, Kolko RP. Counseling and behavior change in pediatric obesity. Pediatr Clin N Am. 2011;58:1403–24.
20. Haynos AF, O'Donohue WT. Universal childhood and adolescent obesity prevention programs: review and critical analysis. Clin Psychol. 2011;32:383–99.
21. Wake M, Baur LA, Gerner B, Gibbons K, Gold L, Gunn J, et al. Outcomes and costs of primary care surveillance and intervention for overweight or obese children: the LEAP 2 randomised controlled trial. BMJ. 2009;339.
22. Hollingworth W, Hawkins J, Lawlor DA, Brown M, Marsh T, Kipping RR. Economic evaluation of lifestyle interventions to treat overweight or obesity in children. Int J Obes. 2012;36:559–66.
23. Ma S, Frick KD. A simulation of affordability and effectiveness of childhood obesity interventions. Acad Pediatr. 2011; 11:342–50.
24. O'Grady MJ, Capretta JC, Assessing the economics of obesity and obesity interventions. Campaign to End Obesity; 2012. pp. 3–39.
25. Barton M. Screening for obesity in children and adolescents: US Preventive Services Task Force recommendation statement. Pediatrics. 2010;125:361–7.
26. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics. 2007;120: S164–92.
27. Wilfley DE, Stein RI, Saelens BE, Mockus DS, Matt GE, Hayden-Wade HA, et al. Efficacy of maintenance treatment approaches for childhood overweight: a randomized controlled trial. JAMA. 2007;298:1661–73.
28. •• Wilfley DE, Van Buren DJ, Theim KR, Stein RI, Saelens BE, Ezzet F, et al. The use of biosimulation in the design of a novel multilevel weight loss maintenance program for overweight children. Obesity 2010;18(Suppl 1):S91–98. *This paper reviews the theoretical rationale for Family-based Behavioral Social Facilitation Treatment, and employs biosimulation modelling to estimate effects of the proposed intervention.*
29. Viner RM, Hsia Y, Tomsic T, Wong IC. Efficacy and safety of anti-obesity drugs in children and adolescents: systematic review and meta-analysis. Obes Rev. 2010;11:593–602.
30. de la Cruz-Muñoz N, Messiah SE, Cabrera JC, Torres C, Cuesta M, Lopez-Mitnik G, et al. Four-year weight outcomes of laparoscopic gastric bypass surgery and adjustable gastric banding among multiethnic adolescents. Surg Obes Relat Dis. 2010;6:542–7.
31. O'Brien PE, Sawyer SM, Laurie C, Brown WA, Skinner S, Veit F, et al. Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial. JAMA. 2010;303:519–26.
32. Silva GM, Osório A, Pereira F, Monteiro P, Ubierna BB, Enes C, et al. Effect of laparoscopic adjustable gastric banding on modifiable cardiovascular risk factors in extremely obese adolescents. Obes Surg. 2012;22:991–4.
33. Widhalm K, Fritsch M, Widhalm H, Silberhumer G, Dietrich S, Helk O, et al. Bariatric surgery in morbidly obese adolescents: Long-term follow-up. Int J Pediatr Obes. 2011;6:65–9.
34. American Dietetic Association (ADA). Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. J Am Diet Assoc. 2006;106:925–45.
35. McGovern L, Johnson JN, Paulo R, Hettinger A, Singhal V, Kamath C, et al. Clinical review: treatment of pediatric obesity: a systematic review and meta-analysis of randomized trials. J Clin Endocrinol Metab. 2008;93:4600–5.
36. Snethen JA, Broome ME, Cashin SE. Effective weight loss for overweight children: a meta-analysis of intervention studies. J Pediatr Nurs. 2006;21:45–56.
37. Tsiros MD, Sinn N, Coates AM, Howe PR, Buckley JD. Treatment of adolescent overweight and obesity. Eur J Pediatr. 2008;167:9–16.
38. Wilfley DE, Tibbs TL, Van Buren DJ, Reach KP, Walker MS, Epstein LH. Lifestyle interventions in the treatment of childhood overweight: a meta-analytic review of randomized controlled trials. Health Psychol. 2007;26:521–32.
39. Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. Parent weight change as a predictor of child weight change in family-based behavioral obesity treatment. Arch Pediatr Adolesc Med. 2004;158.
40. Epstein LH, Paluch RA, Roemmich JN, Beecher MD. Family-based obesity treatment, then and now: twenty-five years of pediatric obesity treatment. Health Psychol. 2007;26:381–91.
41. Epstein LH, Valoski A, Wing RR, McCurley J. Ten-year follow-up of behavioral, family-based treatment for obese children. JAMA. 1990;264:2519–23.
42. •• Kalarchian MA, Levine MD, Arslanian SA, Ewing LJ, Houck PR, Cheng Y, et al. Family-based treatment of severe pediatric obesity: randomized, controlled trial. Pediatrics. 2009;124:1060–8. *This study is the first large-scale randomized controlled trial that examines the impact of family-based behavioral interventions on cardiovascular risk factors in severely obese children.*
43. Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, et al. Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial. JAMA. 2007;297:2697–704.
44. Reinehr T, Kleber M, Toschke AM. Lifestyle intervention in obese children is associated with a decrease of the metabolic syndrome prevalence. Atherosclerosis. 2009;207:174–80.
45. Roemmich JN, Liu EY, Rogol AD, Epstein LH, Quattrin T. Diminished insulin resistance with weight loss in severely overweight youth. Metab Syndr Relat Disord. 2004;2:160–8.
46. Reinehr T, de Sousa G, Wabitsch M. Changes of cardiovascular risk factors in obese children effects of inpatient and outpatient interventions. J Pediatr Gastroenterol Nutr. 2006;43:506–11.
47. Reinehr T, Andler W. Changes in the atherogenic risk factor profile according to degree of weight loss. Arch Dis Child. 2004;89:419–22.
48. Reinehr T, Kiess W, Kapellen T, Andler W. Insulin sensitivity among obese children and adolescents, according to degree of weight loss. Pediatrics. 2004;114:1569–73.
49. Ford AL, Hunt LP, Cooper A, Shield JP. What reduction in BMI SDS is required in obese adolescents to improve body composition and cardiometabolic health? Arch Dis Child. 2010;95:256–61.
50. • TODAY Study Group. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Engl J Med. 2012;366:2247–56. *This multi-site randomized controlled trial in obese children and adolescents with recent-onset type 2 diabetes found that lifestyle intervention was not associated with improved outcome, underscoring the improtance of early intervention.*
51. Insitute of Medicine (IOM). Accelerating progress in obesity prevention: solving the weight of the nation. Washington, DC: Institute of Medicine of the National Academies; 2012.

52. Reinehr T, Temmesfeld M, Kersting M, de Sousa G, Toschke AM. Four-year follow-up of children and adolescents participating in an obesity intervention program. Int J Obes. 2007;31:1074–7.
53. Goldschmidt AB, Stein RI, Saelens BE, Theim KR, Epstein LH, Wilfley DE. Importance of early weight change in a pediatric weight management trial. Pediatrics. 2011;128:e33–9.
54. Best JR, Theim KR, Gredysa DM, Stein RI, Welch RR, Saelens BE, et al. Behavioral economic predictors of overweight children's weight loss. J Consult Clin Psychol. doi:10.1037/a0029827.
55. Nederkoorn C, Jansen E, Mulkkens S, Jansen A. Impulsivity predicts treatment outcome in obese children. Behav Res Ther. 2007;45:1071–5.
56. Bryck RL, Fisher PA. Training the brain: practical applications of neural plasticity from the intersection of cognitive neuroscience, developmental psychology, and prevention science. Am Psychol. 2012;67:87–100.
57. Diamond A, Lee K. Interventions shown to aid executive function development in children 4 to 12 years old. Science. 2011;333:959–64.
58. Epstein LH, Salvy SJ, Carr KA, Dearing KK, Bickel WK. Food reinforcement, delay discounting, and obesity. Phys Behav. 2010;100:438–45.
59. Ranzenhofer LM, Tanofsky-Kraff M, McDuffie JR, Checchi JM, Salaita C, Yanoff LB, et al. The impact of disordered eating pathology, depression, and anxiety on weight cutcomes of overweight adolescents following weight loss treatment Eating Disorders Research Society Annual Meeting, 2008.
60. Wildes JE, Marcus MD, Kalarchian MA, Levine MD, Houck PR, Cheng Y. Self-reported binge eating in severe pediatric obesity: impact on weight change in a randomized controlled trial of family-based treatment. Int J Obes. 2010;34:1143–8.
61. Goossens L, Braet C, van Vlierberghe L, Mels S. Weight parameters and pathological eating as predictors of obesity treatmen toutcome in children and adolescents. Eat Behav. 2009;10:71–3.
62. Levine MD, Ringham RM, Kalarchian MA, Wisniewski L, Marcus MD. Overeating among seriously overweight children seeking treatment: results of the children's eating disorder examination. Int J Eat Disord. 2006;39:135–40.
63. Tanofsky-Kraff M, Wilfley DE, Young JF, Mufson L, Yanovski SZ, Glasofer DR, et al. A pilot study of interpersonal psychotherapy for preventing excess weight gain in adolescent girls at-risk for obesity. Int J Eat Disord. 2010;43:701–6.
64. Jones M, Luce KH, Osborne MI, Taylor K, Cunning D, Doyle AC, et al. Randomized, controlled trial of an internet-facilitated intervention for reducing binge eating and overweight in adolescents. Pediatrics. 2008;121:453–62.
65. Boutelle KN, Zucker NL, Peterson CB, Rydell SA, Cafri G, Harnack L. Two novel treatments to reduce overeating in overweight children: a randomized controlled trial. J Consult Clin Psychol. 2011;79:759–71.
66. Heinberg LJ, Kutchman EM, Berger NA, Lawhun SA, Cuttler L, Seabrook RC, et al. Parent involvement is associated with early success in obesity treatment. Clin Pediatr. 2010;49:457–65.
67. Israel AC, Stolmaker L, Sharp JP, Silverman WK, Simon LG. An evaluation of two methods of parental involvement in treating obese children. Behav Ther. 1984;15:266–72.
68. Kirschenbaum DS, Harris ES, Tomarken AJ. Effects of parental involvement in behavioral weight-loss therapy for preadolescents. Behav Ther. 1984;15:485–500.
69. Wadden TA, Butryn M, Byrne K. Efficacy of lifestyle modifcation for long-term weight control. Obes Res. 2004;12:151–162S.
70. Epstein LH, Wing RR, Koeske R, Andrasik F, Ossip DJ. Child and parent weight loss in family-based behavior modificatin programs. J Consult Clin Psychol. 1981;49:672–85.
71. Golan M, Crow S. Parents as key players in the prevention and treatment of weight-related problems. Nutr Rev. 2004;62:39–50.
72. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: long-term results. Obes Rev. 2004;12:357–61.
73. Boutelle KN, Cafri G, Crow SJ. Parent predictors of child weight change in family based behavioral obesity treatment. Obesity. 2012;20:1539–43.
74. Wrotniak BH, Epstein LH, Roemmich JN, Paluch RA, Pak Y. The relationship between parent weight change and child weight change from 6 months to 10 years in family-based behavioral weight control treatment. Obes Res. 2005;13:1089–96.
75. Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs: Prentice-Hall; 1986.
76. Epstein LH, Wisniewski L, Weng R. Child and parent psychological problems influence child weight control. Obes Res. 1994;2:509–15.
77. Fröhlich G, Pott W, Albayrak Ö, Hebebrand J, Pauli-Pott U. Conditions of long-term success in a lifestyle intervention for overweight and obese youths. Pediatrics. 2011;128:e779–85.
78. Theim KR, Sinton MM, Stein RI, Saelens BE, Thekkedam SC, Welch RR, et al. Preadolescents' and parents' dietary coping efficacy during behavioral family-based weight control treatment. J Youth Adolesc. 2012;41:86–97.
79. Salvy SJ, Coelho JS, Kieffer E, Epstein LH. Effects of social contexts on overweight and normal-weight children's food intake. Phys Behav. 2007;92:840–6.
80. Romero ND, Epstein LH, Salvy SJ. Peer modeling influences girls' snack intake. J Am Diet Assoc. 2009;109:133–6.
81. Epstein LH, Raja S, Daniel TO, Paluch RA, Wilfley DE, Saelens BE, et al. The built environment moderates effects of family-based childhood obesity treatment over 2 years. Ann Behav Med 2012:[Epub ahead of print].
82. Bouton ME. Context, ambiguity, and unlearning: sources of relapse after behavioral extinction. Biol Psychiatry. 2002;52:976–86.
83. Shomaker LB, Tanofsky-Kraff M, Stern EA, Miller R, Zocca JM, Field SE, et al. Longitudinal study of depressive symptoms and progression of insulin resistance in youth at risk for adult obesity. Diabetes Care. 2011;34:2458–63.
84. Khanolkar AR, Byberg L, Koupil I. Parental influences on cardiovascular risk factors in Swedish children aged 5–14 years. Eur J Public Health 2011:[Epub ahead of print].
85. Klein JD, Sesselberg TS, Johnson MS, O'Connor KG, Cook S, Coon M, et al. Adoption of body mass index guidelines for screening and counseling in pediatric practice. Pediatrics. 2010;125:265–72.
86. Rhodes ET, Ebbeling CB, Meyers AF, Bayerl CT, Ooi WL, Bettencourt MF, et al. Pediatric obesity management: variation by specialty and awareness of guidelines. Clin Pediatr. 2007;46:491–504.
87. Holt N, Schetzina KE, Dalton WT, Tudiver F, Fulton-Robinson H, Wu T. Primary care practice addressing child overweight and obesity: a survey of primary care physicians at four clinics in southern Appalachia. South Med J. 2011;104:14–9.
88. Spivack JG, Swietlik M, Alessandrini E, Faith MS. Primary care providers' knowledge, practices, and perceived barriers to the treatment and prevention of childhood obesity. Obesity. 2010;18:1341–7.
89. Taveras EM, Gortmaker SL, Hohman KH, Horan CM, Kleinman KP, Mitchell K, et al. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: The High Five for Kids Study. Arch Pediatr Adolesc Med. 2011;165:714–22.
90. Miller WR, Rollnick S. Motivational interviewing: preparing people for change. New York: Guilford Press; 2002.
91. Resnicow K, Taylor R, Baskin M, McCarty F. Results of go girls: a weight control program for overweight African American adolescent females. Obes Res. 2005;13:1739–48.

92. Schwartz RP, Hamre R, Dietz WH, Wasserman RC, Slora EJ, Myers EF, et al. Office-based motivational interviewing to prevent pediatric obesity. Arch Pediatr Adolesc Med. 2007;161:495–501.
93. Berg-Smith S, Stevens VJ, Brown K, van Horn L, Gernhofer N, Peters E, et al. A brief motivational intervention to improve dietary adherence in adolescents. Health Educ Res. 1999;14:399–410.
94. Chomitz VR, McGowan RJ, Wendel JM, Williams SA, Cabral HJ, King SE, et al. Healthy Living Cambridge Kids: a community-based participatory effort to promote healthy weight and fitness. Obesity. 2010;18:S45–53.
95. Economos CD, Hyatt RR, Goldberg JP, Must A, Naumova EN, Collins JJ, et al. A community intervention reduces BMI z-score in children: shape up Somerville first year results. Obesity. 2007;15:1325–6.
96. HEALTHY Study Group, Foster GD, Linder B, Baranowski T, Cooper DM, Goldberg L, et al. A school-based intervention for diabetes risk reduction. N Engl J Med. 2010;363:443–53.
97. Huang SH, Weng KP, Hsieh KS, Ou SF, Lin CC, Chien KJ, et al. Effects of a classroom-based weight-control intervention on cardiovascular disease in elementary-school obese children. Acta Paediatr Taiwan. 2007;48:201–6.