Themed Review: Clinical Interventions to Promote Physical Activity in Youth

Rebecca A. Meriwether, MD, MPH; Felipe Lobelo, MD; Russell R. Pate, PhD

Am J Lifestyle Med. 2008;2(1):7-25.
Posted 04/02/2008

Abstract and Introduction

Abstract

National recommendations call for children and adolescents to accumulate at least 60 minutes of moderate to vigorous physical activity on most days of the week and for physicians to counsel their patients about physical activity. Physical inactivity tracks from childhood into adulthood, and among youth, it is associated with unfavorable risk factor profiles that promote the development of cardiovascular and metabolic chronic diseases. Few studies of clinical interventions to promote physical activity in children and youth have been published, and the paucity of evidence describing effective interventions and significant barriers limit delivery of counseling. However, existing studies provide evidence about elements of counseling most likely to be effective to guide clinical interventions and inform future research. Based on a literature review, this article offers guidance for incorporating physical activity promotion into clinical care, identifies gaps in current evidence, and suggests methodologic considerations for future research.

Introduction

The purpose of this article is to review and summarize evidence related to clinical interventions for physical activity (PA) in children and youth and provide guidance for clinicians about the content and approach to counseling children and adolescents and their parents.

Rationale for Clinical Interventions for Physical Activity in Youth

Health Effects and Physical Activity Prevalence

National recommendations call for children and adolescents to accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) on most days, preferably everyday.[1] Children who are underactive are at increased risk for overweight and obesity;[2] insulin resistance, decreased glucose tolerance, and diabetes; hyperlipidemia (increased total cholesterol and low-density lipoprotein and decreased high-density lipoprotein); increased blood pressure and hypertension; and clustering of these risk factors.[3-22]

Physical inactivity, child overweight, and their metabolic consequences track from childhood into adulthood, especially for older children.[23-34] Physical inactivity accounts for at least 250,000 deaths annually in the United States.[35] Conversely, regular PA in children lowers percentage body fat, visceral adiposity, triglyerides, leptin, and inflammatory markers and increases insulin sensitivity and high-density lipoprotein.[7,36-39] Physical fitness in adolescence is associated with reduced cardiovascular disease risk factors in adulthood, though PA must be sustained into adulthood to maintain lower cardiovascular disease risk.[40] Among adults, PA improves mental health[41,42] and is associated with increased self-esteem in children.[43]

American children frequently fail to attain sufficient PA, and physical inactivity increases with age. In a study using accelerometers to objectively measure PA in 1996 to 1997, 69% of 375 first to twelfth graders in Massachusetts accumulated 60 min/week of MVPA.[44] However, compliance with guidelines fell dramatically from 100% in the youngest age groups to just 29.4% in 10th to

12th graders. Only 35.8% of youth (9th to 12th graders) reported getting 60 minutes of MVPA on 5 or more days in the previous week on the Youth Risk Behavior Survey in 2005.[45] Cardiorespiratory fitness, which is the net result of PA and genetic capacity, and is inversely related to cardiovascular disease and all-cause mortality in adults,[41,42,46-48] was estimated by maximal oxygen uptake during a submaximal treadmill exercise test in 3287 12- to 19-year-olds as a part of National Health and Nutrition Examination Survey in 1999 to 2002.[49] Older males and younger females had higher fitness levels, whereas overweight youth were less fit. Youth who reported commuting by walking or biking during the past 30 days (48.0%), vigorous PA in the past 30 days (69.0%), or less than 3 hours of TV, video, and computer use daily (47.5%) showed significantly higher fitness levels than their peers.

Inadequate PA and sedentary behaviors, as shown by contemporary youth, have been implicated as important contributors to the epidemic of childhood overweight. Overweight is caused by a chronic positive energy balance[50] and is inversely related to PA and positively related to sedentary behaviors.[51] The number of children who were overweight (body mass index [BMI] = 95% for age and gender) has risen dramatically over the past three decades, more than tripling.[52-54] By 1999 to 2002, 15.8% of 6- to 11-year-old children[55] and 16.1% of adolescent 12 to 19-year-olds were overweight. Another 15.4% of 6- to 11-year-olds and 14.8% of 12- to 19-year-olds were at risk for overweight (BMI 85% to 94% for age and gender). In clinical settings, the proportion of children and youth who are overweight or at risk for overweight may be even higher.[56] Forty-six percent of 11- to 15-year-olds in one clinical study conducted in 2001 to 2002 were overweight or at risk for overweight, and this was even greater (55%) among minority girls.[57] Children who were overweight or at risk participated in less PA and had more TV viewing, though they consumed fewer food calories and fewer grams of fiber each day than normal-weight children. Minutes of vigorous PA was the only modifiable risk factor associated with increased weight in this study. Preschool children with lower levels of PA have greater increases in body fatness by school entry than more active children.[58]

Sedentary behavior, including TV and video viewing, is associated with decreased PA, increased caloric intake, increased BMI and body fatness, and decreased scholastic achievement.[59-62] Increased BMI and body fatness in children is strongly associated with watching 4 or more hours of TV daily,[59] and TV watching is associated prospectively with weight gain and other health risks.[8,63] Two-thirds of children watch 2 hours or less of TV daily, whereas 28% of children watch 4 or more hours. Children with access to computers and videogames spend an additional 30 minutes and 45 minutes, respectively, each day in sedentary activities.[64] Child BMI is directly and positively related to TV time, and children consume significantly more calories while watching TV.[65] Young children with TVs in their rooms spend more time watching TV and are more likely to have BMIs > 85th percentile.[66]

Recommendations for, Impact, and Prevalence of PA Counseling in Clinical Settings

Annual counseling for PA in clinical settings is recommended for children and adolescents by the Bright Futures initiative[67,68] endorsed by the American Academy of Pediatrics, the American Medical Assocation in its Guidelines for Adolescent Preventive Services (GAPS),[69] and by the American Heart Association.[70] The American Academy of Pediatrics also recommends assessing children's media time and recommending limiting total media time to 1 to 2 hours daily, discouraging TV viewing for children under the age of 2 years, removing TV from children's bedrooms, and encouraging parents to role model appropriate TV use.[71] Dishman and Buckworth reviewed early behavioral interventions for PA and concluded that health care settings were high priority for PA interventions.[72] They concluded that PA interventions have moderate effects but are not long lasting and that repeated counseling and intervention may be needed. The US Preventive Services Task Force found insufficient evidence that physician counseling leads to sustained changes in *adult* patient behavior in part because of the lack of objective measures of PA and long-term follow-up.[73] However, physician advice does lead to short-term increases in PA in many patients[7379] and may increase by 50% the number of adult patients who increase their activity.[80] Patrick et al[81] found evidence that physician counseling can increase PA and decrease sedentary behaviors for some adolescent patients.

Though these effects appear to be modest, the public health impact of modestly effective interventions delivered to a large number of people may surpass that of some highly effective interventions delivered to a few.[79,82,83] With almost 1 million visits made annually by children and adolescents <18 years of age to physician offices and outpatient clinics in 2003 to 2004, or about 2.6 visits per person,[84] pediatricians and family physicians are in a unique and potentially powerful position to provide repeated, developmentally appropriate parental education and anticipatory guidance to children and adolescents about healthy levels of PA and limiting sedentary activities such as TV and video viewing and computer and computer game use. Yet physicians report that they often fail to counsel patients about PA because of lack of time, reimbursement, knowledge and skills, practical tools, administrative support systems, and confidence that patients will change their behaviors.[85-88] Competing demands[89-91] during [92]

clinical visits and pressures for high productivity have also been shown to decrease delivery of preventive services. These barriers are likely to be compounded by the paucity of evidence on effective clinical interventions for PA in children and youth.[92]

Only 13% of adolescents (11 to 21 years of age) received counseling about exercise during 445 family medicine visits that were directly observed over 2 days in 1994 to 1995,[94] comparable with rates for adults.[88] In a recent retrospective chart review[95] for overweight children aged 3 months to 16 years seen in tertiary-care hospital-based general pediatric clinics, only 15% of the charts included information on the child's PA or TV viewing compared with 69% with an adequate diet history. Among the 53% in which child overweight was identified as a problem, rates of documented assessment were somewhat higher, 27% for PA or TV viewing and 81% for diet. Dietary changes were recommended for 71%, but increased PA and limiting TV viewing for only 33% and 5%, respectively. Adolescent and older children were more likely to be identified as overweight and counseled than overweight preschool children.

The purpose of this article is to review and synthesize evidence from published studies of or with implications for clinical interventions for PA in children and adolescents. Studies are categorized by clinical setting; whether subjects were healthy, overweight, or with or at risk for chronic diseases (eg, diabetes); and by targeted age group. Implications for clinical practice and research are discussed.

Methods

Medline was searched using OVID for all papers focusing on PA assessment or interventions conducted in clinical settings and published since 1996. We used the search terms physical activity, Motor Activity (SH), exercise and Intervention Studies (SH). Studies concerning athletic injuries were excluded, and searches were limited to humans and children (0 to 18 years). Including health education or health promotion as additional search terms did not identify additional relevant papers. Abstracts were individually reviewed by the first author to identify potentially relevant papers and the full papers reviewed to select those included in this review. Additional references were identified by hand searching references in these papers and by searching for additional publications of authors known to be working in the field. Our initial intent was to include papers describing randomized controlled trials in primary care settings that used direct, objective measures of PA. However, because of the small number of such high-quality studies, all identified studies were included and described, regardless of research methods and whether they concerned healthy or higher risk children and whether conducted in primary care or specialized settings. Two reviews, 2 descriptive papers, and 25 papers describing interventions were found and represent the work of 13 teams of researchers. No attempt was made to summarize these studies quantitatively.

Summary of Evidence: Clinical Interventions for Physical Activity in Youth

We found no studies in health care settings focused exclusively on promoting youth PA and no evidence clearly defining the elements of efficacious clinical interventions for PA in children and youth. All the studies found addressed multiple health behaviors and a majority targeted weight loss. Preschool children were included in only 1 descriptive study[95] and 1 formative study.[96] Published primary care-based interventions have primarily targeted adolescents and used computers[81,97-99] or personal digital assistants (PDAs)[100] to assess PA and other behaviors and sometimes to assist patients in developing personalized behavior change goals and plans.[81,97,98] One additional primary care-based pilot study focused on reducing TV viewing among school-aged children and their families.[101] The majority of published studies targeted weight loss for school-aged children,[102-112] adolescents,[113,114] or both[115-121] who were overweight (BMI > 95%) or at risk for overweight (BMI > 85%). One aimed to reduce diabetes risk for overweight school-aged children and adolescents.[121] In 2 of these, children and adolescents were recruited from primary care settings,[114,121] whereas the remainder were conducted as part of specialized clinical weight loss programs.

Methodologic Issues

A number of the studies identified were pilot or feasibility studies, whereas a few randomized trials were found in primary care settings.[81,98,101,114] Few studies used direct, objective measures of PA,[81,109,111] though several used fitness[106-109,120] as an objectively measured outcome that is related to PA; some studies directly observed PA that occurred during structured PA sessions.[115-121] Several weight loss studies in specialized settings were randomized controlled trials,[102-112,120] whereas others were uncontrolled. Several studies had high dropout rates.[98,115-119,121] The studies, their attributes, and findings are summarized in Table 1 .

To provide guidance for clinical counseling and identify potentially effective elements for inclusion in future research, we have summarized the evidence from these studies about effective and promising intervention components.

Primary Care Interventions for Promoting Physical Activity

Patient-Centered Assessment and Counseling for Exercise plus Nutrition (PACE+) for Adolescents[81,97,98] is an interactive, computerized health behavior program designed for use with adolescents in primary care offices and clinics that addresses PA and nutrition jointly. PACE+ has been evaluated in 3 studies of healthy adolescents in primary care settings. Interactive, computerized software screens adolescent patients in the office waiting room for MVPA, fat, and fruit and vegetable intake. It is based on social cognitive theory and the transtheoretical model; was developed using available literature, consultation with experts, focus *(text continues on pg. 16)* groups with adolescents, parents, and health care providers;[97] and is an extension of an earlier paper-based intervention for adult PA in primary care but content and communication messages were designed specifically for adolescents. Based on computerized assessments of PA and nutrition behaviors, a health behavior profile is created comparing current behaviors with health guidelines. Teen patients are then encouraged by computer prompts to make a plan to change 1 PA and 1 nutrition behavior. Clinicians deliver brief counseling based on a 1-page provider summary of the health behavior profile and plan and ask the patient to sign a behavioral contract.

In initial feasibility testing,[97] providers counseled adolescents for a mean of 8.6 minutes. The majority of adolescent patients rated the computer program and printouts and provider interaction highly. Providers also gave PACE+ positive evaluations but advised shortening the program. PACE+ has been evaluated in 2 randomized trials. The first—a feasibility trial—enrolled 117 adolescents (11 to 18 years of age) in 4 pediatric and adolescent medicine clinics and evaluated self-reported outcomes at baseline and 4 months after the intervention.[98] Participants were randomized to clinician counseling based on PACE+ or counseling plus 1 of 3 extended interventions— mail only, infrequent telephone and mail, or frequent telephone and mail. All outcomes except vigorous PA increased significantly in all 4 groups and no differences were found between groups. Patients were more likely to increase the behaviors they chose to target, except for vigorous PA.

In the second randomized trial of PACE+, provider counseling and 12 months of monthly mail and telephone counseling or a comparison intervention addressing sun exposure protection were provided to 878 adolescents.[81] Accelerometers were used to measure PA objectively and nearly two-thirds of participants completed 9 of 11 scheduled counseling calls. Boys and girls receiving the PACE+ intervention significantly reduced self-reported sedentary behaviors. Boys reported more active days per week and were more likely to meet PA guidelines at 12 months, but there was no dose–response effect. Intervention girls reported decreasing their saturated fat and increasing their fruit and vegetable intake, but did not improve their PA. Based on these studies, the authors concluded that an office-based intervention targeting multiple behaviors followed by telephone counseling and targeted materials to support long-term behavior changes is feasible, promising, and warrants further research. Of note, in the first study, less than half of the patients invited to participate actually did so. More than one-quarter declined, 12.5% were unable to complete the computer program because of lack of time or technical problems, and 12% did not complete follow-up assessments. African American adolescents were more likely than other participants to drop out. These well-designed studies suggest that computer-assisted, individually tailored counseling for PA can increase PA at least in adolescent boys when it is supported by long-term counseling though mail and telephone. This finding is supported by evidence from PA interventions with adults that indicate that repetitive, individually tailored PA counseling can be effective,[122-128] but time spent in counseling by clinicians in these studies was longer than family physicians currently spend for all health education activities combined during typical visits.[92]

Primary Care Interventions to Reduce Sedentary Behavior

In a small, pilot randomized trial, 28 families seen at an urban, primary care clinic were randomized to receive counseling or counseling plus a behavioral intervention that included an electronic TV time manager to reduce sedentary behaviors—TV, videotape, and video-game use—in 7- to 12-year-old African American children.[96] Both the intervention and control groups received 5 to 10 minutes of counseling from a medical student using 3 brochures following a routine visit. The intervention group received an additional 15 to 20 minutes of counseling based on social cognitive theory, instructions for setting TV budgets, and an electronic TV time manager. Both groups reported similar reductions in children's use of TV, videos, and videogames at 4 weeks, but the intervention group reported significantly greater increases in organized PA and increased time playing outside. This study suggests that primary-care-based interventions to reduce sedentary activities have the potential to decrease sedentary behavior and increase PA. However, the amount of counseling time provided in this intervention would be difficult to incorporate into most primary care practices.

Interestingly, in a focus group study with parents of children of all ages,[95] parents indicated that counseling to limit TV viewing and computer use conflicted with their views that these media can be educational. At the same time, they agreed that they should be good role models for their children about media use and that physicians should remind them of this. This suggests that counseling about media use may need to address parental beliefs and guide parents to select high-quality TV, video, and computer options for children to choose from.

Primary Care Interventions to Assess Physical Activity

In addition to the PACE+ studies previously described, 2 projects have used computers or PDAs to assess a broad range of health behaviors and risk factors in adolescent patients and used this information to help clinicians target key behaviors for counseling. One used computers to assess PA and other health behaviors and provided 20 minutes of targeted counseling by a mobile team consisting of a nurse educator and 2 health education graduate students at alternative sites such as schools and shopping malls. Overall, more problems were identified and documented using this approach than were documented in charts of patients of comparable age, sex, race, and geographic distribution seen for preventive visits by 16 pediatricians and family physicians. Although physical inactivity was the most commonly identified issue (20%), there was no difference between the 2 groups.

The Healthy Teen Project[100] is an ongoing project being conducted in collaboration with 6 family medicine and pediatric practices in the Clinicians Enhancing Child Health practice-based research network. A PDA-based adolescent risk screener is being used to assess 90 items based on Guidelines for Adolescent Preventive Services (GAPS). Adolescent patients are able to complete the screener in 7 to 8 minutes while waiting to see their physicians. Physicians use a summary of the results to guide discussion and help adolescent patients develop health action plans. The use of the PDA appears feasible, was well received by teens and clinicians, and most clinicians continued using them after the conclusion of the feasibility study. Teens reported that the PDA made it easier to discuss issues candidly with their health care provider. However, teens, especially young teens, had difficulty developing action plans even with the assistance from their health care provider. Interestingly, teens were more adept at making a plan for concerns they selected for themselves, suggesting that choice and readiness for change may need to be incorporated into algorithms supporting counseling. Most teens did not want to participate in e-mail follow-up on their action plans.

These studies combined with the PACE+ studies indicate that using computers or PDAs to assess adolescent patients and help them make behavior change plans is promising and warrants further study. However, it may be important that health behaviors targeted for change be selected by the patients. It is also possible that there is a developmental threshold in early adolescence for using computers to assist with behavior change plans and that these children may need additional guidance and support. The finding that teens did not want e-mail follow-up contrasts with successful interventions using e-mail and interactive computer follow-up in adults[122,125-127,129,130,132] and may have been because of targeted behaviors being selected by health care providers rather than by teens.

Primary Care Interventions to Reduce Weight or Diabetes Risk for Overweight Children and Youth

Two studies recruited overweight or at-risk children and adolescents from primary care settings for interventions to reduce weight or diabetes risk factors. One pilot feasibility study[102] combined a nutrition and PA intervention in an urban primary care office for 36 African American patients aged 8 to 18 years at increased diabetes risk. At baseline all participants had a BMI > 85% and a fasting glucose-insulin ratio (FGIR) < 6. After a 12-week program held at the primary care office, the mean FGIR improved significantly for 26 of the 36 participants who completed follow-up. The intervention consisted of 24 individual 45-to 60minute sessions with an exercise specialist using stationary recumbent bicycles and a video dance game, 3 individual sessions with a registered dietician, and 3 visits with a pediatrician. Patients attended about one-third of the exercise sessions, 2 of 3 nutrition visits, and 1.5 of 3 pediatrician visits.

The Healthy Habits study[103] randomized 47 overweight adolescent patients to typical care or a behavioral weight loss program initiated in primary care with a single session of physician weight counseling. Typical care patients received nontailored physician counseling to accumulate 60 minutes/day of MVPA and eat healthy based on the Food Guide Pyramid. Patients randomized to the intervention began by completing a modified version of PACE+, met with a pediatrician to discuss and finalize individualized action plans, and received tailored counseling. Subsequently, they received a comprehensive behavioral weight loss intervention emphasizing self-monitoring and using the Epstein's Traffic Light Diet (discussed below) and a manual to help them acquire behavioral skills for weight control. They met in person with a health psychologist and then received 10 to 20 minutes of telephone counseling weekly from a psychologist or nutritionist for 8 weeks, then biweekly for 3 additional calls over a total of 14 to 16 weeks. BMI-*z* scores were significantly lower posttreatment and at 3-month follow-up in the Healthy Habits than the typical care group. Thereafter, BMI rose somewhat in the intervention group and continued to increase in the typical care group. Interestingly, self-reported PA, sedentary behavior, and fat intake did not change differentially over time between the 2 groups; however, Healthy Habits patients reported higher rates of behavioral skills, particularly for eating and PA behaviors.

These studies suggest that interventions initiated in primary care that incorporate nonclinician health professionals and provide intensive, ongoing behavioral treatment may be effective in helping overweight adolescents increase their PA, alter their dietary intake, and limit weight gain. This conclusion is supported by research in adults.[79,133,134] However, a substantial portion of patients may be unwilling to participate in intensive interventions. The second study suggests, as have others, that a single episode of nontailored counseling is not sufficient to alter PA and that self-monitoring may be a key component of effective interventions. This study also demonstrates the potential danger of using self-reported behaviors rather than objectively measured

study outcomes, because the two groups did not differ in self-reported behavior but did in objectively measured BMI.

Interventions in Specialized Settings to Reduce Weight for Overweight Children and Youth

Four research groups have contributed to evidence about child and adolescent weight loss programs in specialized settings. Two of these have also published reviews on the role of PA in treating overweight children.[104,117]

Epstein[104] reviewed 13 studies, conducted in schools, clinical settings, and nonclinical research settings. Two weight loss studies that compared exercise and no exercise without a diet intervention showed no effects on weight. Five studies found better changes in weight and fitness for diet plus exercise than for diet alone, whereas 3 studies that also included a no-treatment control group found no differences between diet only and diet plus exercise arms. They concluded that with the variety of designs and outcomes few conclusions could be drawn.

Epstein and colleagues[106-115] have reported a series of high-quality, randomized, family-based behavioral intervention studies designed to help overweight 8-to 12-year-old children reduce their BMI and maintain weight control over long periods of follow-up up to 10 years. Parents and children are seen weekly for 60 minutes in individual and group sessions during which parents and children weigh-in, participate in separate interactive behavioral group sessions designed to promote mastery of behavioral skills including self-monitoring, positive reinforcement, stimulus control, modeling, and social skills. Families are provided the Traffic Light Diet that groups foods by nutrient density into high fat or simple carbohydrate foods with low nutrient density (red), foods such as most fruits and vegetables that have less than 20 kcal/average serving (green), and foods that are diet staples containing important nutrients with intermediate nutrient density (yellow). Parents and children receive a list of activities and their associated energy expenditure in terms of metabolic equivalents. Points are earned based on metabolic equivalent values such that participants can earn points in less time with higher-intensity activities or more gradually with lower-intensity choices. This maximizes participants' choices for the PA component of their program, consistent with research showing that this is preferred and leads to better performance. These studies have demonstrated that although lifestyle and structured PA combined with diet results in better weight loss than calesthenics and diet, maintenance of weight loss is better with lifestyle than with structured PA.[102,106] Providing positive reinforcement for decreased sedentary behaviors, such as TV viewing and video gaming, is more effective than negative reinforcement. Reinforcing decreased sedentary behavior results in better weight loss than reinforcing increased PA or a combination of decreased sedentary behavior and increased PA. Children given positive reinforcement for reducing sedentary behaviors had greater reductions in percentage overweight and percentage body fat and showed a stronger preference for high-intensity activities than children given positive reinforcement for increasing PA. Children reinforced for increasing PA had higher energy intake than those reinforced for decreasing sedentary behaviors or those reinforced for changing both sedentary behavior and PA.[107-111]

Sothern[115] notes that although individual and group programs combining diet, behavior modification, and PA are recommended for treatment of childhood obesity, it is unclear what types, amounts, and intensities of exercise are appropriate and safe for overweight children. She notes that young children are naturally active, typically exhibiting intermittent, nonstructured PA and that encouraging free play may help prevent obesity. Heavier children may have more challenges in maintaining and increasing PA than other children as they are often ignored or ridiculed and may choose indoor sedentary activities to escape situations in which they feel disadvantaged. Obese and very obese children typically expend more energy to accomplish a fixed PA workload than overweight and normal weight children. Consequently, exercise interventions need to be carefully designed so that overweight children do not experience failure, pain, or physical injury. They should be entertaining and enjoyable, especially for young children. She emphasizes the importance of providing safe environments for outdoor activities, which can only be accomplished through policy changes, environmental planning, and school and community efforts.

Sothern has conducted a series of cohort studies evaluating a long-term integrated diet, PA, and behavioral intervention based on social cognitive theory.[115-118] This program is conducted in an outpatient setting and encourages short-term (12-week) goal setting, feedback, and motivational techniques to improve health behaviors. Twice weekly sessions incorporate medical management, nutritional therapy, a behavioral component led by a psychologist, and structured PA led by an exercise physiologist. Children receive a workbook describing a Moderate Intensity Progressive Exercise Program and are encouraged to choose a variety of aerobic activities they enjoy on their own and to self-monitor their PA. This program provides specific recommendations for type and modality of moderate-intensity exercise based on individual weight and physiologic functioning and adjusts these every 10 to 15 weeks. Supervised non-weight-bearing exercise (eg, swimming, recumbent biking, seated aerobics, or circuit training) is recommended for the heaviest children (BMI > 97th percentile). For overweight children (BMI 95th to 97th percentile), mainly non-weight-bearing activities are recommended along with interval walking with frequent rest breaks, gradually working up to longer periods of walking. For overweight children (BMI 85% to 95%), weight-bearing aerobic activities such as brisk walking, stair climbing, dancing, swimming, participation in field sports, roller blading, and martial arts are recommended. Sothern has shown that regular resistance training can be safely included in a pediatric obesity treatment program and may increase retention in 7- to 12year-old children.[116] Significant reductions in BMI and percentage body fat compared with baseline have been

reported at 1 year in children who complete the program, though dropout rates are high, and a substudy of 50 children found reduced total cholesterol and triglycerides in boys and girls and decreased low-density lipoprotein in girls after 10 weeks.[116]

Eliakim and colleagues[119,120] conducted 2 studies of a multidisciplinary weight loss intervention for overweight children aged between 6 and 16 years. Participants received a balanced hypocaloric diet, met with dieticians once or twice monthly, and were encouraged to reduce sedentary behaviors. They also participated in a twice weekly structured exercise program led by professional youth coaches at a child health and sports training center where they engaged in endurance activities, including team sports and running games. Each child was also asked to add at least 30 to 45 minutes of walking or other weight-bearing sports at least once weekly and report these to the coach weekly. No theoretical model was reported. Primary outcomes were BMI and fitness assessed by progressive treadmill exercise test. The first study[119] was nonrandomized and compared outcomes for 177 volunteer participants who completed the program with 27 volunteers who withdrew (primarily because of difficulties getting to the exercise facility). At the end of the 3-month intervention, 65 children were asked to complete an additional 6 months. At 3 months, BMI was significantly reduced and endurance time significantly increased from baseline. Children who completed 6 months had further decreases in BMI and improvements in endurance, which were greater than those of children who participated for only 3 months. Children who dropped out during the first 3 months continued to gain weight, had increased BMI, and improved fitness to a lesser extent. Children in the intervention group reduced self-reported screen time whereas dropouts did not. In the second study,[120] 54 children were randomized to a 3-month intervention group or a control group monitored in a pediatric obesity clinic. Self-reported PA and fitness were assessed. At 3 months, BMI and body fatness were significantly reduced in children in the intervention group whereas both increased significantly in control children. At 12 months, intervention children had increased their fitness and maintained their weight, whereas fitness was unchanged for control children who also gained additional weight. Intervention children reported significant short-term increases in habitual PA. Both groups reported decreased screen time at 12 months but there were no between-group differences.

Taken together, these studies indicate that sustained, comprehensive behavior change programs that target PA and diet can help overweight children and adolescents increase PA, reduce sedentary behaviors, lose weight, and keep it off. However, a substantial proportion of children who enroll in such programs drop out. Furthermore, the interventions described here are beyond the capacity of most primary care practices, but referral to evidence-based, theory-directed behavioral weight loss programs is warranted where such programs exist.

Parental Involvement

Epstein[104] found that direct involvement of at least 1 parent as an active participant improves short-term and long-term weight control in 6-to 12year-old children and that increasing PA is important for long-term maintenance of weight control. Children were significantly more likely to lose weight and maintain weight control at 5 and 10 years if parents were also targeted for weight loss than if the child alone was targeted or neither was targeted. Weight loss among participating overweight parents predicted weight loss in their children.[108] Children were more successful when they participated in separate groups from their parents.[104]

Brownell[113] conducted a successful behavioral weight loss program for overweight adolescents. The intervention consisted of 16 weekly group sessions of 45 to 60 minutes and a treatment manual that was given to participants in weekly installments. PA was encouraged by discussing caloric expense of exercise, aerobic conditioning, programmed versus lifestyle activity, and methods for gradually increasing energy expenditure. Self-monitoring, stimulus control, social support, attitude restructuring, and cognitive control were taught. At program completion, adolescents in the mother–child separately group had lost more weight (8.4 kg) than those in the mother–child together group (5.3 kg) or the child-only group (3.3 kg). Children in the mother– child separately group maintained weight loss at 1 year, whereas both the other groups had gained weight.

These studies indicate that engaging parents is critical for success but that it is important that older children and adolescents receive at least some components of the intervention separately from their parents. The mechanisms by which parental involvement enhances child behavior change have not been specifically studied, though it is reasonable to hypothesize that they do so through increased social support and possibly by also enhancing environmental control. However, the evidence that older children and adolescents do better when they are in separate groups from their parents suggests that the locus of control for successful behavior change rests with the child.

Implications for Clinical Settings: Counseling Messages, Challenges, and Opportunities

There is no conclusive evidence about how clinicians should assess and counsel child and adolescent patients about PA. However, we can draw some conclusions from current evidence to guide clinical care and future research (Table 2). At a minimum, parents and children should be made aware of national recommendations for children to accumulate at least 60 min/day of MVPA, for parents to accumulate at least 30 min/day of MVPA, and to limit TV viewing to no more than 2 hours daily. Because long-term interventions are more likely to be effective, assessment and counseling should probably be repeated at sequential

preventive visits and opportunistically included in other visits when relevant. Interventions and messages should be developmentally appropriate and driven by health behavior theories.[29,93,134] Tailored counseling that incorporates shared decision making and is accompanied by a written prescription, supportive printed materials, and follow-up has been shown to increase the likelihood of success in adult interventions.[79,83,134-137] Group interventions, when feasible, may be more effective than one-on-one interventions, particularly in adolescents for whom peer opinions and support are especially important,[134] but parents should be in separate groups from older children and adolescents.[104,113] The use of computers and PDAs to assist with assessment and targeted counseling appears promising, and adolescents may benefit from computer programs that provide assistance in creating individually tailored health behavior change plans.[81,97-100]

Overall, children and adolescents appear to do better with making individual behavior change plans when they are able to choose their own behavioral targets,[81,97,98,100,102-114,117,118] select lifestyle physical activities that appeal to them,[81,98,102,106,111,112] self-monitor their progress,[81,98,101,102,114-119] receive positive reinforcement for behavior change,[102-112] and are supported by parents who are attempting to change their personal behavior as well.[102-105,113,138] Physicians should generally advise lifestyle PA[102-112,139] and be cautious about prescribing specific types of PA. However, providing guidance about types of activity may be useful for children and adolescents whose weight makes participation in many activities difficult. For these patients, expert opinion favors encouraging non-weight-bearing activities (eg, water aerobics and recumbent stationary bicycling) and progressive resistance weight training to help them improve their fitness levels prior to starting more traditional weight-bearing moderate-intensity activities such as walking.[116-118]

Targeting sedentary behaviors for reduction appears to be important, particularly for weight control, and may result in increased PA time and intensity.[107-111,140] Positive reinforcement is more effective than restriction for reducing sedentary activities.[107-111] Clinicians should focus on messages about reducing sedentary activities and engage parents and children to establish a media (TV, video, computer game) budget and self-monitoring with positive reinforcement.[101] Children should be allowed to make media selections from a list of options acceptable to parents.[95]

The role of parents in helping children and adolescents adopt and maintain healthy behaviors is critical but changes as children grow and mature. For young children, parents should be the primary recipients of counseling messages and anticipatory guidance.[135] As children reach school-age, it becomes important to address the intervention to parents and children separately.[104,113] Parents should be encouraged to establish a health-supporting home environment, to model healthy PA, and to foster family activities that incorporate moderate to vigorous PA.[138]

Although there are barriers to implementation of health promotion interventions in clinical practice, there are also opportunities, and several groups of researchers are actively working on developing and testing primary-carebased health behavior interventions. The existing evidence base for increasing delivery of preventive services in clinical practice should guide interventions for changing office systems to support these behavioral interventions.

Personal health behaviors of providers,[141] provider skills and readiness to change their clinical practices, systems support, and reinforcement are thought to be important predictors of successful adoption of health behavior interventions.[94,142,143] Tools for assessment, intervention, and documentation; changes in office systems; and teamwork are necessary for successful implementation of health behavior interventions.[144] Patient and physician reminders, feedback to practices and providers on performance, organizational interventions, and combinations of these have been shown to increase delivery of preventive services.[145,146] Sustainability has been documented for some interventions that are tailored to address practice-specific barriers[147] and that take advantage of the strengths and health care delivery approach of individual practices.[148]

Although time is a barrier to PA counseling in clinical settings, family physicians spend 1½ to 3 minutes providing health education and counseling during typical visits and somewhat longer in health promotion visits.[91] Similar data are not available for pediatric practice. It may be possible to redirect some of this time to interventions for PA in children and youth, but time limitations in clinical practice and available evidence suggest that physician counseling may need to be supplemented with other components.[79,132] Computer-assisted assessment and counseling is a promising innovation that may help address several barriers, including lack of time, tools, and knowledge, to delivery of PA counseling in clinical care.[122-132,149] Follow-up mail, e-mail, and telephone contact may be effective ways to extend the intervention beyond the clinical encounter and enhance its potency, but there is some evidence that this may not be acceptable to some patients[100] and research on these modalities has had mixed results thus far.[80,122-132,149] Additional studies are warranted.[80,132]

Health behavior change resources were enthusiastically embraced by both health care practices and patients in the first round of

Robert Wood Johnson Foundation's Prescription for Health projects.[150] These projects conducted in collaboration with practice-based research networks, designed and tested practice-level interventions for at least 2 of 4 specified health behaviors—PA, nutrition, tobacco, and problem alcohol use. They further found that practice extenders require extensive training, that integrating health behavior change tools into primary care requires considerable time and effort as well as specialized expertise, and that even simple interventions require practice change.

Implications and Recommendations for Research

Development and testing of clinical interventions for PA in children and youth remain in early stages. Such interventions by their nature are complex, requiring changes in both the health care delivery process and parent and patient behavior for health outcomes to improve.[79,132] Only a few studies have focused on assessment and counseling for PA in primary care settings and all those have included other health behaviors.[81,97-101,114] Many have focused on intervening in the health care delivery process and have not collected data on patient behavior change.[97,99,100] Those that have collected data on patient behavioral outcomes have, with the exception of one PACE+ study,[81] used self-reported, rather than objectively measured, PA, which is known to be biased,[151] and have not included long-term follow-up. Research on obesity interventions in children are more numerous and this field of research more mature. Yet these studies also vary in quality and seldom include objective measures of PA. Future studies should use high-quality research designs; investigate the effect of interventions on health care settings and patients separately and jointly; use validated, objective measures of PA outcomes; evaluate whether or not effects are sustained in the long term; and use the RE-AIM (Reach, Effectiveness, Adoption, Implementation and Maintenance) framework for designing and evaluating interventions.[79,82,83,132,152,153] Research is particularly needed on primary care interventions to increase PA, reduce sedentary behaviors, and prevent overweight for preschool and school-aged children.

Conclusion

Despite sparse evidence about the efficacy and optimal content of counseling and method of delivery, national recommendations call for annual PA counseling for children and youth in clinical settings. Currently available evidence suggests that counseling may have beneficial effects on PA and sedentary behaviors.[73-81] Therefore, routine care for children and adolescents should include assessment and at least brief counseling about these behaviors.[68-71] At present, available evidence supports counseling that is individually tailored, developmentally appropriate, and incorporates the attributes described above. It is unlikely that such advice alone will be sufficient to change behaviors, and health care providers are encouraged to refer patients to community resources.[79,132] Health care providers should set an example by getting adequate PA themselves[141] and should advocate for evidence-based school and community programs that promote youth PA, support active commuting to school, and work for the implementation of the American Heart Association recommendations that schools "ensure that all children and youth participate in a minimum of 30 minutes of MVPA" during each school day[29,49,140,148,152-156] to increase the likelihood that children will attain a total of at least 60 minutes of MVPA daily.[1] In addition, physicians should advocate for and support public policies and changes in the built environment that ensure that all children have safe places to play,[117,156] that neighborhood structures and community infrastructures facilitate lifestyle activities, such as walking and biking for transportation and pleasure, and that sports facilities are available.[156]

Table 1. Published Studies of Assessment or Intervention for Physical Activity in Children and Youth[a]

Table 1: Published Studies of Assessment or Intervention for Physical Activity in Children and Youth^[a]

Table 2. Recommended Elements for Clinical Counseling for Physical Activity in Children and Youth[a]

Table 2: Recommended Elements for Clinical Counseling for Physical Activity in Children and Youth^[a]

References

1. US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans, 2005.* Washington, DC: US Department of Health and Human Services, US Department of Agriculture; 2004.
2. Freedman DS, Srinivasan SR, Valdez RA, Williamson DF, Berenson GS. Secular increases in relative weight and adiposity among children over two decades: the Bogalusa Heart Study. *Pediatrics.* 1997;99:420-426.
3. Boreham CA, Ferreira I, Twisk JW, Gallagher AM, Savage MJ, Murray LJ. Cardiorespiratory fitness, physical activity, and arterial stiffness: the Northern Ireland Young Hearts Project. *Hypertension.* 2004;44:721-726.
4. Brage S, Wedderkopp N, Ekelund U, et al. Features of the metabolic syndrome are associated with objectively measured physical activity and fitness in Danish children: the European Youth Heart Study (EYHS). *Diabetes Care.* 2004;27:2141-2148.
5. Brage S, Wedderkopp N, Ekelund U, et al. Objectively measured physical activity correlates with indices of insulin resistance in Danish children. The European Youth Heart Study (EYHS). *Int J Obes Relat Metab Disord.* 2004;28:1503-1508.
6. Dionne I, Almeras N, Bouchard C, Tremblay A. The association between vigorous physical activities and fat deposition in male adolescents. *Med Sci Sports Exerc.* 2000;32:392-395.
7. Carrel AL, Clark RR, Peterson SE, Nemeth BA, Sullivan J, Allen DB. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. *Arch Pediatr Adolesc Med.* 2005;159:963-968.
8. Ekelund U, Sardinha LB, Anderssen SA, et al. Associations between objectively assessed physical activity and indicators of body fatness in 9- to 10-y-old European children: a population-based study from 4 distinct regions in Europe (the European Youth Heart Study). *Am J Clin Nutr.* 2004;80:584-590.
9. Gutin B, Yin Z, Humphries MC, Hoffman WH, Gower B, Barbeau P. Relations of fatness and fitness to fasting insulin in black and white adolescents. *J Pediatr.* 2004;145:737-743.
10. Gutin B, Yin Z, Humphries MC, Barbeau P. Relations of moderate and vigorous physical activity to fitness and fatness in adolescents. *Am J Clin Nutr.* 2005;81:746-750.
11. Imperatore G, Cheng YJ, Williams DE, Fulton J, Gregg EW. Physical activity, cardiovascular fitness, and insulin sensitivity among U.S. adolescents: the National Health and Nutrition Examination Survey, 1999-2002. *Diabetes Care.* 2006;29:1567-1572.
12. Janssen I, Katzmarzyk PT, Boyce WF, King MA, Pickett W. Overweight and obesity in Canadian adolescents and their associations with dietary habits and physical activity patterns. *J Adolesc Health.* 2004;35:360-367.
13. Raitakari OT, Taimela S, Porkka KV, et al. Associations between physical activity and risk factors for coronary heart disease: the Cardiovascular Risk in Young Finns Study. *Med Sci Sports Exerc.* 1997;29:1055-1061.
14. Ribeiro JC, Guerra S, Oliveira J, et al. Physical activity and biological risk factors clustering in pediatric population. *Prev Med.* 2004;39:596-601.
15. Ruiz JR, Rizzo NS, Hurtig-Wennlof A, Ortega FB, Warnberg J, Sjostrom M. Relations of total physical activity and intensity to fitness and fatness in children: the European Youth Heart Study. *Am J Clin Nutr.* 2006;84:299-303.
16. Steinberger J, Daniels SR. Obesity, insulin resistance, diabetes, and cardiovascular risk in children: an American Heart Association scientific statement from the Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young) and the Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). *Circulation.* 2003;107:1448-1453.
17. Andersen LB, Harro M, Sardinha LB, et al. Physical activity and clustered cardiovascular risk in children: a cross-sectional study (the European Youth Heart Study). *Lancet.* 2006;368:299-304.
18. Myers L, Coughlin SS, Webber LS, Srinivasan SR, Berenson GS. Prediction of adult cardiovascular multifactorial risk status from childhood risk factor levels: the Bogalusa Heart Study. *Am J Epidemiol.* 1995;142:918-924.
19. Berenson GS, Radhakrishnamurthy B, Bao W, Srinivasan SR. Does adult-onset diabetes mellitus begin in childhood? The Bogalusa Heart Study. *Am J Med Sci.* 1995;310(suppl 1):S77-S82.
20. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. Relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics.* 1999;103(6, pt 1):1175-1182.
21. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood obesity to coronary health disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatrics*. 2001;108:712-718.
22. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. Inter-relationships among childhood BMI, childhood height, and adult obesity: the Bogalusa Heart Study. *Int J Obes*ity. 2004;28:10-16.
23. Andersen LB, Hasselstrom H, Gronfeldt V, Hansen SE, Karsten F. The relationship between physical fitness and clustered risk, and tracking of clustered risk from adolescence to young adulthood: eight years follow-up in the Danish Youth and Sport Study. *Int J Behav Nutr Phys Act.* 2004;1:6.

24. Boreham C, Robson PJ, Gallagher AM, Cran GW, Savage JM, Murray LJ. Tracking of physical activity, fitness, body composition and diet from adolescence to young adulthood: the Young Hearts Project, Northern Ireland. *Int J Behav Nutr Phys Act.* 2004;1:14.
25. Eisenmann JC, Wickel EE, Welk GJ, Blair SN. Relationship between adolescent fitness and fatness and cardiovascular disease risk factors in adulthood: the Aerobics Center Longitudinal Study (ACLS). *Am Heart J*. 2005;149:46-53.
26. Ferreira I, Twisk JW, van Mechelen W , Kemper HC, Stehouwer CD. Current and adolescent levels of cardiopulmonary fitness are related to large artery properties at age 36: the Amsterdam Growth and Health Longitudinal Study. *Eur J Clin Invest*. 2002;32:723-731.
27. Ferreira I, Twisk JWR, van Mechelen W, Kemper HCG, Stehouwer CDA. Development of fatness, fitness, and lifestyle from adolescence to the age of 36 years: Determinants of the metabolic syndrome in young adults: the Amsterdam Growth and Health Longitudinal Study. *Arch Intern Med.* 2005;165:42-48.
28. Li S, Chen W, Srinivasan SR, et al. Childhood cardiovascular risk factors and carotid vascular changes in adulthood: the Bogalusa Heart Study. *JAMA*. 2003;290:2271-2276.
29. Telama R, Yang X, Laakso L, Viikari J. Pain childhood and adolescence as predictor of physical activity in young adulthood. *Am J Prev Med*. 1997;13:317-323.
30. Freedman DS, Shear CL, Burke GL, et al. Persistence of juvenile-onset obesity over eight years: the Bogaulsa Heart Study. *Am J Public Health*. 1987;77:588-592.
31. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood form childhood and parental obesity. *N Engl J Med*. 1997;337:869-873.
32. Freedman DS, Khan LK, Serdula MK, Srinivasan SR, Berenson GS. BMI rebound, childhood height and obesity among adults: the Bogalusa Heart Study. *Int J Obesity*. 2001;25:543-549.
33. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr*. 1999;70:145S-148S.
34. Stone EJ, McKenzie TL, Welk GL, Booth ML. Effects of physical activity interventions in youth. Review and synthesis. *Am J Prev Med*. 1998;15:298-315.
35. Booth FW, Gordon SE, Carlson CJ, Hamilton MT. Waging war on chronic diseases: primary prevention through exercise biology. *J Appl Physiol.* 2000;88:774-787.
36. Berenson GS, Foster TA, Frank GC, et al. Cardiovascular disease risk factor variables at the preschool age—the Bogalusa Heart Study. *Circulation*. 1978;57:603-612.
37. Ferguson MA, Gutin B, Le NA, et al. Effects of exercise training and its cessation on components of the insulin resistance syndrome in obese children. *Int J Obesity.* 1999;22:889-895.
38. Gutin B, Barbeau P, Owens S, et al. Effects of exercise intensity on cardiovascular fitness, total body composition, and visceral adiposity of obese adolescents. *Am J Clin Nutr.* 2002;75:818-826.
39. Gutin B, Owens S. Roles of exercise intervention in improving body fat distribution and risk profile in children. *Am J Hum Biol.* 1999;11:237-247.
40. Twist JW, Kemper HC, van Mechelen W. Relationship between physical fitness and physical activity during adolescence and cardiovascular disease risk factors at adult age. The Amsterdam Growth and Health Longitudinal Study. *Int J Sports Med*. 2002; 23(suppl 1):S8-S14.
41. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA*. 1995;273:402-407.
42. US Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Public Health Service, CDC, National Center for Chronic Disease Prevention and Health Promotion; 1996.
43. Strauss RS, Rodzilsky D, Burack G, Colin M. Psychosocial correlates of physical activity in healthy children. *Arch Pediatr Adolesc Med*. 2001;155:897-902.
44. Pate RR, Freedson PS, Sallis JF, et al. Compliance with physical activity guidelines: prevalence in a population of children and youth. *Ann Epidemiol*. 2002;12:303-308.
45. Centers for Disease Control and Prevention. Youth risk behavior surveillance—United States, 2005. *MMWR*. 2006;55(SS-5).
46. Blair SN, Kohl HW III, Paffenbarger RS Jr, Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. *JAMA*. 1989;262:2395-2401.
47. Paffenbarger RS Jr, Hyde RT, Wing AL, Hsieh CC. Physical activity, all-cause mortality, and longevity of college alumni. *N Engl J Med*. 1986;314:605-613.
48. Lee CD, Blair SN, Jackson AS. Cardiovascular fitness, body composition, and all cause and cardiovascular disease mortality in men. *Am J Clin Nutr*. 1999;69:373-380.
49. Pate RR, Wang CY, Dowda M, Farrell SW, O'Neill JR. Cardiorespiratory fitness levels among US youth 12 to 19 years of age. *Arch Pediatr Adolesc Med*. 2006;160:1005-1012.
50. Rippe J, Hess S. Role of physical activity in the prevention and management of obesity. *J Am Diet Assoc*. 1998;98(suppl 2):31-38.
51. Sothern MS. Obesity prevention in children: physical activity and nutrition. *Nutr J*. 2004;20:704-708.

52. Troiano RP, Flegal KM, Kuczmarski RJ, et al. Overweight prevalence and trends for children and adolescents. The National Health and Nutrition Examination Surveys, 1963 to 1991. *Arch Pediatr Adolesc Med*. 1995;149:1085-1091.
53. Troiano RP, Flegal KM. Overweight children and adolescents: description, epidemiology, and demographics. *Pediatrics*. 1998;101(suppl):497-504.
54. Ogden CL, Flegal KM, Carroll MD, et al. Prevalence and trends in overweight among US children and adolescents, 19992000. *JAMA*. 2002;288:1728-1732.
55. Hedley AA, Ogden CL, Johnson CL, Caroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA*. 2004;291:2847-2850.
56. Gautier BM, Hickner JM, Ornstein S. High prevalence of overweight children and adolescents in the Practice Partner Research Network. *Arch Pediatr Adolesc Med*. 2000;154:625-628.
57. Patrick K, Norman GJ, Calfas KJ, Sallis JF, Zabinski MF, Rupp J. Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. *Arch Pediatr Adolesc Med*. 2004;158:385-390.
58. Moore LL, Nguyen U, Rothman KJ, Cupples LA, Ellison RC. Preschool physical activity level and changes in body fatness in young children. *Am J Epidemiol*. 1995;143:982-988.
59. Anderson RE, Crespo CJ, Barlett,SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children. *JAMA*. 1998;279:938-942.
60. Bar-on ME. The effects of television on child health: implications and recommendations. *Arch Dis Child*. 2000;83:289-292.
61. Marshall SJ, Biddle SJH, Gorely T, Cameron N, Murdey I. Relationship between media use, body fatness and pain children and youth: a meta-analysis. *Int J Obes*. 2004;28:1238-1246.
62. Sharif I, Sargent JD. Association between television, movie, and video game exposure and school performance. *Pediatrics*. 2006;118:e1061-e1070.
63. Berkey CS, Rockett HR, Field AE, et al. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics*. 2000;105:E56.
64. Marshall SJ, Greoly T, Biddle SJH. A descriptive epidemiology of screen-based media use in youth: a review and critique. *J Adolesc*. 2006;29:333-349.
65. Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE. Television watching, energy intake, and obesity in US children: results from the Third National Health and Nutrition Survey, 1988-1994. *Arch Pediatr Adolesc Med*. 2001;155:360-365.
66. Dennison BA, Erb TA, Jenkins PL. Television viewing and television in bedroom associated with overweight risk among low-income preschool children. *Pediatrics*. 2002;109:1028-1035.
67. Green M. Palfrey JS, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 2nd rev ed. Arlington, VA: National Center for Education in Maternal and Child Health; 2002.
68. Patrick K, Spear B, Holt K, Sofia D, eds. *Bright Futures in Practice: Guidelines for Physical Activity*. Arlington, VA: National Center for Education in Maternal and Child Health; 2001.
69. Levenberg PB, Elster AB, eds. *Guidelines for Adolescent Preventive Services (GAPS): Clinical Evaluation and Management Handbook*. Chicago, IL: American Medical Association; 1995.
70. Kavey REW, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K. American Heart Association Guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. *Circulation*. 2003;107:1562-1566.
71. Committee on Public Education, American Academy of Pediatrics. Children, adolescents, and television. *Pediatrics*. 2001;107:423-426.
72. Dishman RK, Buckworth J. Increasing physical activity: a quantitative synthesis. *Med Sci Sports Exerc*. 1996;28:706-719.
73. Eden KB, Orleans CT, Mulrow CD, Pender NJ, Teutsch SM. Does counseling by clinicians improve physical activity? A summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2002;137:208-215.
74. Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies: effectiveness and implications for practice and future research. *J Fam Pract*. 2000;49:158-168.
75. Pinto BM, Goldstein MG, Marcus BH. Activity counseling by primary care physicians. *Prev Med*. 1998;27:506-513.
76. Petrella RJ, Lattanzio CN. Does counseling help patients get active? Systematic review of the literature. *Can Fam Physician.* 2002;48:72-80.
77. Hillsdon M, Foster C, Thorogood M. Interventions for promoting physical activity. Cochrane Heart Group. *Cochrane Database Syst Rev*. 2006;(3):CD003180.
78. Adams J, White M. Are activity promotion interventions based on the transtheoretical model effective? A critical review. *Clin J Sport Med*. 2003;37:106-114.
79. Eakin, EG, Smith BJ, Bauman AE. Evaluating the population health impact of physical activity interventions in primary care —Are we asking the right questions? *J Phys Act Health.* 2005;2:197-215.
80. Kreuter MW, Chheda SG, Bull FC. How does physician advice influence patient behavior? Evidence for a priming effect. *Fam Med.* 2000;9:426-433.
81. Patrick K, Calfas KJ, Norman GJ, et al. Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors; PACE+ for adolescents. *Arch Pediatr Adolesc Med*. 2006;160:128-136.
82. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the REAIM framework. *Am J Public Health*. 1999;89:1322-1327.

83. Whitlock EP, Orleans CT, Pender N, Allan J. Evaluating primary care behavioral counseling interventions: an evidence-based approach. *Am J Prev Med*. 2002;22:267-284.
84. Health, United States. *National Ambulatory Medical Care Survey. National Center for Health Statistics. Health United States, Data Table for Figure 22*. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Health Statistics.
85. McKenna J, Naylor PJ, McDowell N. Barriers to physical activity promotion by general practitioners and practice nurses. *Br J Sports Med*. 1998;32:242-247.
86. Wee CC, McCarthy EP, Davis RB, Phillips RS. Physician counseling about exercise. *JAMA*. 1999;282:1583-1588.
87. Damush TM, Stewart AL, Mills KM, King AC, Ritter PL. Prevalence and correlates of physician recommendations to exercise among older adults. *J Gerontol A Biol Sci Med Sci*. 1999;54:M423-M427.
88. Glasgow RE, Eakin EG, Fisher EB, Bacak SJ, Brownson RC. Physician advice and support for physical activity: results from a national survey. *Am J Prev Med*. 2001;21:189-196.
89. Podl TR, Goodwin MA, Kikano GE, Stange KC. Direct observation of exercise counseling in community family practice. *Am J Prev Med*. 1999;17:207-210.
90. Flocke SA, Stange KC, Goodwin MA. Patient and visit characteristics associated with opportunistic preventive services delivery. *J Fam Pract*. 1998;47:202-208.
91. Stange KC, Woolf SH, Gjeltema K. One minute for prevention: the power of leveraging to fulfill the promise of health behavior counseling. *Am J Prev Med*. 2002;22:320-323.
92. Zyzanski SJ, Stange KC, Langa D, Flocke SA. Trade-offs in high-volumes primary care practice. *J Fam Pract*. 1998;46:397-402.
93. Sallis JF, Patrick K, Frank E, Pratt M, Wechsler H, Galuska DA. Interventions in health care settings to promote healthful eating and physical activity in children and adolescents. *Prev Med*. 2000;31:S112-S120.
94. Goodwin MA, Flocke SA, Borawski EA, Zyzanski SJ, Strange KC. Direct observation of health-habit counseling of adolescents. *Arch Pediatr Adolesc Med*. 1999;153:367-373.
95. O'Brien SH, Holubkov R, Reis EC. Identification, evaluation, and management of obesity in an academic primary care center. *Protein Eng Des Sel*. 2004;114:154-159.
96. Ariza AJ, Greenberg RS, LeBailly SA, Binns HJ. Parent perspectives in messages to be delivered after nutritional assessment in pediatric primary care practice. *Ann Fam Med*. 2005;3(suppl 2):S37-S39.
97. Prochaska JJ, Zabinski MF, Calfas KJ, Sallis JF, Patrick K. PACE+: interactive communication technology for behavior change in clinical settings. *Am J Prev Med*. 2000;19:127-131.
98. Patrick K, Sallis JF, Prochaska JJ, et al. A multicomponent program for nutrition and physical activity in primary care: PACE+. *Arch Pediatr Adolesc Med*. 2001;155:940-946.
99. Paperny DMN, Hedberg VA. Computer-assisted health counselor visits: a low-cost model for comprehensive adolescent preventive services. *Arch Pediatr Adolesc Med*. 1999;153:63-67.
100. Olson AL, Gaffney CA, Hedberg VA, et al. The Health Teen Project: tools to enhance adolescent health counseling. *Ann Fam Med*. 2005;3:S63-S65.
101. Ford BS, McDonald TE, Owebs AS, Robinson TN. Primary care interventions to reduce television viewing in African-American children. *Am J Prev Med.* 2002;22:106-109.
102. Epstein LH, Valoski A, Wing RR, McCurley J. Ten year outcomes of behavioral family-based treatment for childhood obesity. *Health Psychol.* 1994;13:373-383.
103. Epstein LH, Roemmich JN, Raynor HA. Behavioral therapy in the treatment of pediatric obesity. *Pediatr Clin North Am.* 2001;48:981-993.
104. Epstein LH. Family-based behavioural intervention for obese children. *Int J Obes Relat Metab Disord*. 1996;20(suppl 1):S14-S21.
105. 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;158:342-347.
106. Epstein LH, Wing RR, Koeske R, Valoski A. A comparison of lifestyle exercise, aerobic exercise, and calisthenics on weight loss in obese children*. Behav Ther.* 1985;16:345-356.
107. Epstein LH, Valoski AM, Vara LS, et al. Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health Psychol*. 1995;142:109-115.
108. Epstein LH, Paluch RA, Gordy CC, Dorn J. Decreasing sedentary behaviors in treating pediatric obesity. *Arch Pediatr Adolesc Med*. 2000;154:220-226.
109. Epstein LH, Pauch RA, Kilanowski CK, Raynor HA. Effect of reinforcement of stimulus control to reduce sedentary behavior: the treatment of pediatric obesity. *Health Psychol.* 2004;23:371-380.
110. Epstein LH, Roemmich JN, Saad FG, Handley EA. The value of sedentary alternative influences child physical activity choice. *Int J Behav Med.* 2004;11:236-242.
111. Epstein LH, Roemmich JN, Paluch RA, Raynor HA. Physical activity as a substitute for sedentary behavior in youth. *Ann Behav Med.* 2005;29:200-209.
112. Epstein L, Coleman K, Myers M. Exercise in treating obesity in children and adolescents. *Med Sci Sports Exerc.* 1996;29:428-435.

113. Brownell KD, Kelman JH, Stunkard AJ. Treatment of obese children with and without their mothers: changes in weight and blood pressure. *Pediatrics.* 1983;71:515-523.
114. Saelens BE, Sallis JF, Wilfrey DE, Patrick K, Cella JA, Buchta R. Behavioral weight control for overweight adolescents initiated in primary care. *Obes Res.* 2002;10:22-32.
115. Sothern MS, Despinasse B, Brown R, Suskind RM, Udall JN, Blecker U. Lipid profiles of obese children and adolescents before and after significant weight loss. *South Med J*. 2000;93:278-282.
116. Sothern MS, Loftin JM, Udall JN, et al. Safety, feasibility, and efficacy of a resistance training program in preadolescent obese children. *Am J Med Sci.* 2000;319:370-375.
117. Sothern MS. Exercise as a modality in the treatment of childhood obesity. *Pediatr Clin North Am*. 2001;48:995-1015.
118. Sothern MS, Schumacher H, von Almen TK, Carlisle LK, Udall JN. Committed to kids: an integrated, 4-level team approach to weight management in adolescents. *J Am Diet Assoc*. 2002;102(3 suppl):S81-S85.
119. Eliakim A, Kaven G, Berger I, Friedland O, Wolach B, Nemat D. The effect of a combined intervention on body mass and fitness in obese children and adolescents: a clinical experience. *Eur J Pediatr.* 2002;161:449-454.
120. Nemet D, Barkan S, Epstein Y, Friedland O, Kowen G, Eliakim A. Short- and long-term beneficial effects of a combined dietary-behavioral-physical activity intervention for the treatment of childhood obesity. *Protein Eng Des Sel.* 2005;115: e443-e449.
121. Cotton B, Smith A, Hansen I, Davis C, Doyle A, Walsh A. Physician-directed primary care intervention to reduce risk factors for type 2 diabetes in high-risk youth. *Am J Med Sci.* 2006;332:108-111.
122. Marshall AL, Leslie ER, Bauman AE, Marcus BH, Owens N. Print versus website physical activity programs: a randomized trial. *Am J Prev Med*. 2003;25:88-94.
123. Sciamanna CN, Novak SP, Hoston TK, Gramling R, Marcus BH. Visit satisfaction and tailored health behavior communications in primary care. *Am J Prev Med*. 2004;2:426-430.
124. Sciamanna CN, Novak SP, Marcus BH. Effects of using a computer in a doctor's office on patient attitudes toward using computerized prompts in routine care. *Int J Med Inform.* 2005;74:357-365.
125. Sciamanna CN, Marcus BH, Goldstein MG, et al. Feasibility of incorporating computer-tailored health behavior communications in primary care settings. *Inform Prim Care*. 2004;12:40-48.
126. Pinto BM, Friedman R, Marcus BH, Kelley H, Tennstedt S, Gilman MW. Effects of a computer-based telephone-counseling system on physical activity. *Am J Prev Med.* 2002;23:113-120.
127. Marcus BH, Napolitano MA, King AC, et al. Examination of print and telephone channels for physical activity promotion: rationale, design, and baseline data from Project STRIDE. *Contemp Clin Trials*. 2007;28:90-104.
128. Marcus BH, Nigg CR, Riebe D, Forsyth LH. Interactive communications strategies: implications for population-based physical activity promotion. *Am J Prev Med*. 2000;19:121-126.
129. Glasgow RE, Buss SS, Piette JD, Steiner JF. Interactive behavior change technology; a partial solution to the competing demands of primary care. *Am J Prev Med*. 2004,27:80-87.
130. Revere D, Dunbar PJ. Review of computer-generated outpatient health behavior interventions: clinical encounters "in absentia." *J Am Med Inform Assoc*. 2001;8:62-79.
131. Balas EA, Jaffrey F, Kuperman GJ, et al. Electronic communications with patients: evaluation of distance medicine technology. *JAMA*. 1997;278:152-159.
132. Meriwether RA, Wilcox S, Parra-Medina D. Physical activity interventions in clinical settings. *Curr Cardiovasc Risk Rep*. 2007;1:237-246.
133. Tulloch H, Fortier M, Hogg W. Physical activity counseling in primary care: who has and who should be counseling? *Patient Educ Couns*. 2006;64:6-20.
134. Sigman-Grant M. Strategies for counseling adolescents. *J Am Diet Assoc*. 2002;102: S32-S39.
135. Jacobson DM, Strohecker L, Compton MT, Katz DL. Physical activity counseling in the adult primary care setting: position statement of the American College of Preventive Medicine. *Am J Prev Med*. 2005;29:158-162.
136. Bull FC, Kreuter MW, Scharff DP. Effects of tailored, personalized and general health messages on physical activity. *Patient Educ Couns*. 1999;36:181-192.
137. Von Korff M, Gruman J, Schaefer J, Curry SJ, Wagner EH. Collaborative management of chronic illness. *Ann Intern Med*. 1997;127:1097-1102.
138. Kalakanis LE, Goldfield GS, Paluch RA, Epstein LH. Parental activity as a determinant of activity level and patterns of activity in obese children. *Res Q Exerc Sport*. 2001;72:202-209.
139. Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: a randomized trial. *JAMA*. 1999;281:327-334.
140. Robinson TR. Reducing children's television viewing to prevent obesity. *JAMA*. 1999;282:1561-1567.
141. Frank E, Rotherberg R, Lewis C, Belodoff BF. Correlates of physicians' prevention-related practices: findings from the Women Physicians' Health Study. *Arch Fam Med*. 2000;9:359-367.
142. Preisser JS, Cohen SJ, Wofford JI, et al. Physician and patient predictors of health maintenance visits. *Arch Fam Med*. 1998;7:346-351.
143. Woolf SH. Changing physician practice behavior: the merits of a diagnostic behavior. *J Fam Pract*. 2000;49:126-129.
144. Dickey LL, Gemson DH, Carney P. Office system interventions supporting primary care-based health behavior change

counseling. *Am J Prev Med*. 1999;17:299-308.
145. Davis DA, Thomson MA, Oxman AD, Haynes B. Changing physician performance—a systematic review of the effect of continuing medical education strategies. *JAMA*. 1995;274:700-705.
146. Hulscher MEJL, Wensing M, Grol RPTM, van der Weijden T, van Weel C. Interventions to improve delivery of preventive services in primary care. *Am J Public Health*. 1999;89:737-746.
147. Shaw B, Cheater F, Baker R, et al. Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev*. 2006;(2):CD005470.
148. Stange KC, Goodwin MA, Zyzanski SJ, Dietrich AJ. Sustainability of a practice-individualized preventive service delivery intervention. *Am J Prev Med*. 2003;25:296-300.
149. Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventive care in the ambulatory setting. *J Am Med Inform Assoc*. 1996;3:399-409.
150. Cohen DJ, Tallia AF, Crabtree BF, Young DM. Implementing health behavior change in primary care: lessons from prescription for health. *Ann Fam Med*. 2005;3(2, suppl 2): S12-S19.
151. Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions [published correction appears in *Res Q Exerc Sport*. 2000;71:409]. *Res Q Exerc Sport*. 2000;71(2 suppl):S1-S14.
152. Pate RR, Ward DS, Saunders RP, Felton G, Dishman RK, Dowda M. Promotion of physical activity in high school girls: a randomized controlled trial. *Am J Public Health*. 2005;95:1582-1587.
153. Glasgow RE, Bull SS, Gillette C, Klesges LM, Dzewaltowski DA. Behavior change intervention research in health care settings: a review of recent reports with emphasis on external validity. *Am J Prev Med*. 2002;23:62-69.
154. Glasgow RE, Goldstein MG, Okene JK, Pronk NP. Translating what we have learned into practice: principles and hypotheses for interventions addressing multiple behaviors in primary care. *Am J Prev Med*. 2004;27(2 suppl):88-101.
155. Caballero B, Clay T, Davis SM, et al; Pathways Study Research Group. Pathways: a school-based, randomized controlled trial for prevention of obesity in American Indian schoolchildren. *Am J Clin Nutr*. 2003;78:1030-1038.
156. Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: planet health. *Arch Pediatr Adolesc Med*. 1999;153:409-418.
157. Pate RR, Davis MG, Robinson TN, Stone EJ, McKenzie TL, Young JC. Promoting physical activity in children and youth: a leadership role for schools. *Circulation*. 2006;114:1214-1224.

Reprint Address

Address for correspondence: Rebecca A. Meriwether, MD, MPH, Department of Family and Preventive Medicine, School of Medicine, University of South Carolina, 3209 Colonial Drive, Columbia, SC 29203; e-mail: rebecca.meriwether@sc.edu .

Rebecca A. Meriwether, MD, MPH, Felipe Lobelo, MD, and **Russell R. Pate, PhD,** from the Departments of Family and Preventive Medicine (**RAM**) and Exercise Science, Arnold School of Public Health (**FL, RRP**), University of South Carolina School of Medicine, Columbia, South Carolina.
