Exercise and Children's Health

A Little Counseling Can Pay Lasting Dividends

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In Brief: Regular exercise is an important health maintenance strategy for children and adolescents: It facilitates weight control, helps strengthen bones, and can improve cardiovascular risk factors. Mental health may also benefit. An active childhood may also lay the groundwork for a lifetime of fitness. Physicians are in an important position to assess children's weight status and activity levels during a routine physical exam. And, with some simple recommendations to children and parents, they can play a key role in helping young patients find and maintain activities they enjoy, while keeping the risk of injury to a minimum.

Every child and adolescent needs exercise. It is a sound and largely risk-free investment in their present and future health. Physicians who care for young patients should take an active role in helping them choose and maintain activities appropriate to their age, physical condition, stage of development, and interests.

Ignoring health promotion in young people may reflect two beliefs: (1) that though inactivity is widespread in adults, children are naturally and spontaneously active, and (2) that the health risks associated with a sedentary lifestyle such as diabetes and heart disease are far more pressing in adults.

Ample evidence, however, documents that young people are not the dependably kinetic creatures of popular imagination. Fewer than half of US children engage in activity sufficient for cardiovascular benefit and long-term health promotion (1). According to the surgeon general's report on physical
activity and health (2), activity levels decline as grade levels advance--dramatically so as children enter adolescence. Nearly half of US young people ages 12 to 21 are not regularly vigorously active. One-fourth engage in no vigorous activity, and 14% report no recent activity at even the light-to-moderate level. Girls are at greater risk of inactivity than boys, particularly during and after puberty.

These trends have not been reversed with physical education. Just over one third of elementary and secondary schools offer daily physical education classes (1). High school enrollment in such classes has declined in recent years, from 42% in 1991 to 25% in 1995 (2).

How Exercise Improves Kids' Health

This decline is not without cost: A sedentary lifestyle in young people can have negative health consequences both now and later.

Weight control. According to a recent statistical analysis (3), nearly one fourth of American children were overweight in 1991, up 20% from 1981. The relationship between physical activity and adiposity in children is complex, especially at earlier ages, and studies have been inconsistent (4). But increasing physical activity while restricting calorie intake has been documented as an effective weight loss strategy (5).

The need for obesity interventions is clear. Overweight children are at increased risk of many health problems, including hypertension, hyperlipidemia, type 2 diabetes, growth hormone dysregulation, and respiratory and orthopedic problems. Self-esteem and socialization frequently suffer (6). And that is just the beginning. Not only does obesity follow children into adulthood--40% of overweight children and 70% of overweight adolescents become obese adults--obesity in adolescence is independently associated with chronic diseases that develop in adulthood (7). For information on evaluating children for obesity, see "Weight Assessment in Children and Adolescents," below.

Bone building. Physical activity in childhood may have lasting effects on bone development. Exercise may lower osteoporosis risk by increasing bone mineral density. Though most attention has focused on exercise in later years to reduce or restore bone loss, the skeleton appears to be most responsive to the effects of activity during growth (see "Osteoporosis: Understanding Key Risk Factors and Therapeutic Options") (8).

Evidence for a positive effect of childhood activity on bone density, either immediately or later in life, is mixed, but a number of studies have this implication. One followed 40 prepubertal boys (mean age, 10.4 years), half of whom participated in 30 minutes of weight-bearing exercise three times a week for 32 weeks (9). The increase in lumbar spine, leg, and total body bone mineral density was twice as great in the exercise group as in controls.

Another study (10) that involved 45 prepubertal female gymnasts (mean age, 10.4 years), 36 retired gymnasts (mean age, 25 years), and 50 matched controls found significantly greater bone mineral
density in the young and retired gymnasts. The researchers observed that bone density did not diminish during retirement, despite the lower frequency and intensity of exercise. They concluded that exercise before puberty may reduce fracture risk after menopause.

**Cardiovascular protection.** While cardiovascular disease is primarily manifested in adulthood, risk factors appear much earlier in life and typically persist. Evidence links lipid and lipoprotein profiles in childhood and adolescence with the development of atherosclerotic lesions (11) and high-normal blood pressure in young people. These conditions significantly increase the risk of essential hypertension in adulthood (12).

A substantial body of research documents the positive effect of physical activity, particularly at aerobic levels, on cardiovascular risk factors in adults, but the evidence for children is more limited and equivocal (4). Nevertheless, some well-designed studies (13,14) suggest that aerobic exercise is beneficial in this age-group, particularly for individuals at high risk. One trial (13) compared 28 prepubertal children who took part in a 12-week exercise program (stationary cycling for 30 minutes, three times per week) with 20 controls who did not. The exercise groups had significant improvement in low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and the total cholesterol/HDL and LDL/HDL ratios.

Another study (14) found positive effects on blood pressure. Ninety-nine ninth-grade girls whose systolic or diastolic blood pressure was in the top third for their grade were randomized to a semester of aerobic exercise or standard physical education (PE) classes. Among the 88 who completed the study, systolic blood pressure dropped significantly more in the aerobic exercise group than in the standard PE group (6 mm Hg versus 3.7 mm Hg). Though decreases were modest, the blood pressure reduction was notable, considering that the girls were not hypertensive. The authors concluded that changes of this magnitude, if widely achieved, could have important public health benefits and observed that similar reductions have been seen in other trials of physical training in adolescents.

**Mental health benefits.** That exercise has a beneficial effect on mental health for children as well as adults is an attractive, intuitive, and widely held notion. For example, one review (15) states that most studies, which have primarily involved adults, have documented improvements in depressive and anxiety symptoms. However, in areas such as self-concept, hard data are scarce. Some studies suggest that the positive effect of exercise is limited and that exercise improves children's physical self-image but not academic or general self-worth (16). Sports participation has not been shown to foster moral development, which appears to depend on the specific context and conditions such as role models and leadership (17).

Exercise may improve the ability of young people to cope with stress. A study (18) of 220 adolescent girls during a high-stress period found that those who adhered to a rigorous exercise program reported less physical and emotional distress than those who exercised less.

**Does Activity Follow Into Adulthood?**
It would be gratifying to report that early exercise patterns continue into adulthood. While this seems intuitively so, supporting data have been limited and reflect the fallibility of recall and the difficulty of following individuals from preteen years to adulthood.

One recent study (19) compared 174 men and women who had five PE sessions per week in the 6 years of elementary school (in the early 1970s) with a control group of 720 who had less frequent PE. When surveyed in the mid 1990s, women, but not men, in the high-frequency PE group reported more frequent physical activity than controls. Men who had more frequent PE as children, however, were significantly less likely to smoke than controls (11.3% vs 30.8%).

Another study (20) suggested that childhood exercise, if promoted unwisely, can impede adult physical activity. An analysis of the preteen and teenage experience of 105 middle-age men found that coercion to exercise in youth had a weak but statistically significant negative effect on physical activity in adulthood. The authors noted that the results seem to emphasize the need to give children a voice in their physical activity and sports participation.

Tailoring the Program

In sum, the lesson for physicians seems to be: Promote exercise in young patients, but do it positively and realize that activities must be individualized for each child (See the Patient Adviser, "Channel Kids' Energy Toward Exercise"). In light of the prevalence of sedentary behavior and its potential health consequences, a discussion of physical activity should be part of every exam. The issue deserves the same kind of attention as counseling on smoking and other aspects of health maintenance.

Exercise promotion is particularly important when working with girls or minority or low-income youth (21), who, for many reasons, have been shown to have more sedentary lifestyles. Children who have disabilities are generally less fit than those who are able-bodied; ironically, they probably need higher fitness levels to improve their function later in life. Except for that promoted by organizations such as the Special Olympics, exercise opportunities are few for children who have disabilities, and individuals, schools, and communities should do more to foster sports and recreation programs for them.

Obtaining an activity inventory can help physicians more fully understand patients' activities and energy expenditure. It can also help physicians suggest activities that are most appropriate for children's age, size, abilities, interests, and medical conditions. Questions may be asked about:

- Physical education, including the frequency of classes and types of activities;
- Aerobic activities such as running and soccer versus relatively nonaerobic activities such as baseball;
- Sedentary activity, including time spent with computers, video games, and television; and
- Recreational and other physical activities such as snowboarding, in-line skating, hiking, and working at a physically demanding job.
No single sport or exercise regimen is uniquely beneficial for the physical or emotional well-being of children. It is far more important to find, with the help of parents, activities that will be interesting and enjoyable for the child and are appropriate to his or her age and physical abilities (see "Which Sports When?" below).

Though it is not necessary to exercise at anything approaching maximum capacity, aerobic activities are ideal. A reasonable goal, as suggested by the recent surgeon general's report on health and physical activity (2), is 30 minutes of moderate activity on most days of the week. Greater daily activity such as walking or climbing stairs also contributes to overall fitness and well-being.

Strength training has grown in popularity, and even prepubescent children can achieve measurable gains with little risk of injury and no adverse effect on bone, muscle, or joint development (22). Adequate supervision is essential, however, with emphasis placed on correct form and technique. Children should not lift maximum weights and should avoid ballistic movements until skeletal growth is completed.

In some cases, physicians may steer children toward exercises that are appropriate to their strengths and vulnerabilities. Patients with ligamentous laxity, for example, might be encouraged to swim or bicycle rather than play sports such as basketball that involve pivoting and twisting. Times of rapid growth often increase vulnerability to certain injuries, and a temporary switch to low-impact activities can prevent injury during these times.

**Minimizing Injury Risk**

Safety is paramount. Though exercise-related mishaps are common--one study (23) found that 22% of school-aged children sustained injury during physical education class or in outside sports each year--most injuries are minor. A prudent approach will minimize overuse injuries and more serious trauma.

For example, parents should assess whether organized sports are conducted with appropriate attention to safety and injury prevention. Little League, for example, uses pitch counts to avoid overuse injuries; Pop Warner football divides players into leagues based on age and weight. While there is nothing wrong with competition, children should not be encouraged to push themselves to the point at which injuries are more likely.

Children should not play when in pain or take painkillers to participate. Coaches and parents should be alert to signs that an overuse injury may be developing, such as limping on the field or rubbing of the arm after throwing.

In general, sensible precautions will minimize risk. Children should use appropriate equipment for each sport, including footwear that provides appropriate support and traction. Bicycle helmets are a must. Play areas should be free of debris, ruts, and divots.
Stretching and warm-up to minimize hamstring pulls and similar injuries should become habitual preludes to strenuous exercise. Children's bones often grow at a faster rate than adjacent muscles and tendons. Physes also grow at different rates. Seventy percent of the growth of the lower extremities occurs at the physes at the knees. These factors predispose children and adolescents to muscle tightness, especially at the hamstrings and quadriceps.

Don't overlook the obvious. The most common, severe, recreation-related injuries to children are caused by motor vehicles. Play areas should be away from traffic, and safe practices emphasized for walking and biking. The risk of injury when traveling to or from organized or casual play areas is far higher than the risk of play itself.

Counsel about sun and heat protection. Children, like adults, should wear sunscreen when exercising outside. To avoid dehydration, to which children's smaller size makes them more vulnerable, they should be taught to drink fluids before and after exercise and during activity that lasts longer than 20 to 30 minutes—without waiting until they are thirsty. Though carbohydrate-electrolyte sports drinks may have no special merit, they may enhance voluntary drinking because of their taste or ability to induce thirst (24).

The goal—safe, enjoyable exercise—is readily attainable by virtually all youngsters. In children's exercise, a relatively modest amount of physician counseling will likely pay lasting dividends.

References


Weight Assessment in Children and Adolescents

Physical activity can help patients of all ages achieve body proportions that are suited to their height and frame. Being overweight is not a normal part of child physical development. However, it is important for patients to understand that there is a wide range of body types and that some body types are genetically determined.
Measurement Tools

Obesity definitions or standards have not been clearly established for children and adolescents (1). However, body mass index (BMI, measured in kg/m²) can be used to evaluate obesity in this age-group. In adolescents, BMI has been found to be highly specific but variably sensitive (2). Suggested thresholds for obesity vary between the 85th and 95th BMI percentiles.

Though the BMI is a noninvasive and general estimate of a patient's percent body fat, it is important to consider factors such as race, sex, sexual maturation, and body-fat distribution when interpreting the results. BMI should be considered a screening tool, and patients identified as obese or at risk of becoming obese should be referred for counseling (2).

BMI in athletic patients can be misleading. Elite athletes may have a higher BMI because they have a greater lean body mass or bone mass that skews the results. In these patients, skinfold testing should be used with the BMI to assess their body fat.

The US national growth charts for infants and children up to age 18 were drafted in 1977. Since then, the charts are being revised to reflect demographic changes and the increased prevalence of obesity (3). The use of BMI for age, instead of a strict height-for-weight measurement, has also been incorporated into the revised growth charts.

How Much Weight to Put on Weight?

Though it is important to assess weight in young patients, physicians should not dwell on body habitus. Weight evaluation is primarily useful for diet and exercise counseling and screening for underlying medical conditions such as hypothyroidism, Prader-Willi syndrome, and the effects of medications such as corticosteroids.

Just as obesity has its own set of health risks, being significantly underweight and obsessed with one's body habitus can be equally, if not more, detrimental to health and well being: Dangerous eating disorders such as anorexia nervosa may be the result (4). These patients may most benefit by hearing reassurance of their self-worth. When discussing exercise with these young people, it is helpful to emphasize fitness benefits rather than appearance benefits.

REFERENCES

Which Sports When?

Though exercise is good for all children, every activity isn't suitable for every child. One question that often comes up in discussions with parents is age: When is the child ready for distance running (or skiing, or weight training)?

"It's a matching game," says Steven J. Anderson, MD, clinical professor in the Department of Pediatrics at the University of Washington in Seattle and chair of the American Academy of Pediatrics (AAP) Committee on Sports Medicine and Fitness. "The idea is to match the demands of the sport or exercise activity to the developmental maturity of the child."

Motor and Cognitive Readiness

Readiness issues are clearest in motor development, according to Sally Harris, MD, MPH, a pediatrician in the Department of Sports Medicine at the Palo Alto Medical Foundation in Palo Alto, California, and pediatric chair of the AAP Section on Sports Medicine and Fitness. Skills relevant to sports, such as throwing and kicking, can't be rushed any more than developmental milestones like rolling over or sitting up. "If the child doesn't have them, the sport will be a frustrating experience."

Less obvious but also important are the cognitive and social capacities that enable the child to interact with teammates, visualize their place on a team, and understand strategy. "In these areas, adults forget that children are not as mature as they are," Harris says.

Because the pace of development varies widely, it's impossible to specify sports-readiness ages with precision. "We go mostly by common sense and experience," Harris says. But she does suggest some general guidelines for the following age-groups:

- **2 to 5 years.** Children are just learning fundamental skills like throwing, catching, running, and jumping. It's best to stick with activities that use these skills but don't combine them in a complicated way.
- **6 to 9 years.** Children put the fundamentals together in moves related to actual sports: throwing for distance or accuracy; rearing back to kick a ball. Better memory and decision-making enable them to deal with basic strategies of simplified forms of baseball or soccer.
- **10 to 12 years.** Youngsters can master the complex motor skills they need and have the cognitive ability to learn strategies for "adult" forms of most sports, including football and basketball.

Readiness for competition is controversial (1). "Competitive sports for preschool-age kids is frowned upon," Anderson says. "Even in early elementary school, the emphasis should be on learning basic
skills and rules, without the added pressure of competition." Equal participation rather than winning should be the goal at this age.

Injury prevention is a legitimate concern but rarely an age-limiting factor. "People worry about intensive training for young children, but that's not the time of highest risk," Harris says. Overuse and traumatic injuries are actually more common during and after puberty, as size, strength, and growth rate increase. The AAP discourages headfirst sliding in baseball for children under age 10 (2), for example. The risk of injury may actually be greater for adolescents, however, because they are heavier and faster than their younger counterparts.

**Sport-Specific Concerns**

In general, rule modifications and special equipment have widened the sports activity options for children, and "readiness" often comes down to motivation: the point at which participation reflects the child's real interest, as opposed to adult or peer pressure. In conversations with children and parents, questions often arise about the demands of specific sports.

**Soccer.** Children can kick the ball by age 6 or 8 but can't fully grasp concepts of player positioning, passing, and making plays until several years later. The result: "beehive soccer," a popular adaptation in which they swarm around the ball without much concern for adult rules.

**Baseball.** Most 6-year-old children lack the eye-hand coordination to hit a pitched ball but can play "tee-ball," swinging at the ball on a tee. Bigger bats and balls, smaller fields, and more fielders also make the game more fun at this age. For children under 12 in organized leagues, "pitch count" guidelines (eg, limiting pitchers to 6 innings per week, or 2 days rest for every 30 pitches thrown) reduce the risk of overuse injury.

**Running.** Distance running doesn't seem to harm young joints or growth plates, and there's no reason to preclude even marathoning for prepubertal children (3). Children do, however, have less tolerance for heat stress, so adequate hydration before, during, and after running is essential. The same applies to triathlons if they are specifically designed for the age-group. However, the emphasis should be on fun and fitness rather than competition (4).

**Strength training.** Using free weights and machines to increase strength appears to pose no great risk of injury, even to prepubertal youngsters (5). However, the activity should be well supervised, and children should not attempt maximal weight--the most they can lift just one time--before skeletal maturity (Tanner stage 5--typically at age 15 in girls and age 17 in boys). Before that point, they should likewise avoid ballistic maneuvers such as Olympic-style weight lifting (a single-repetition maximum lift in two stages: the snatch and the clean and jerk) power lifting (three separate maximum lifts), and bodybuilding (6).

**Skiing.** Cross-country skiing of reasonable distances is adaptable for children who are adept at walking and running. Downhill skiing can similarly be enjoyed by those as young as age 3 or 4, particularly
with modifications and special equipment such as connectors to keep the skis in a permanent snowplow position, and harnesses and tethers to let parents control the young skier.

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