# The Young Athlete's Body: Physical Development

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An athlete's body greatly affects his or her athletic potential and has much to do with the enjoyment and satisfaction that comes from training and competition. The 126-pound high school boy trying to fill out a football uniform with little more than the skin and bones of a slowly maturing adolescent cannot contribute a star performance to the team, nor is he going to remember that one of the highs of his young life was playing football. He would probably be happy to trade in his current body model for something closer to six feet in height, 180 pounds in weight, and equipped with a well developed set of muscles.

What are the features of body structure that affect sport participation? Height is an obviously important characteristic. There is always one five-foot, eight-inch guard in a high school basketball tournament, but the six-foot, six-inch player is ten inches closer to the basket and has a better chance of scoring more points. Weight is another aspect body size that determines potential success. The two-hundred-pound football player has a distinct playing advantage over an opponent who weighs only two-thirds as much.

Body build, or physique, must also be considered. The three major body types are described as follows:

- Endomorphs are characterized by a soft roundness throughout the body, with a tendency toward fatness.
- Mesomorphs are muscular individuals with large, prominent bones.
- Ectomorphs have thin body segments and poor muscle development.

Successful athletes in a particular sport tend to have similar body builds, and their physiques are compatible with the requirements of the activity. Being a mesomorph or an ectomorph will have a lot to do with whether an individual must be satisfied with recreational jogging or will enjoy working his or her long, thin legs in competitive distance races. But having a certain body type does not guarantee success or failure. The outcome is not absolute. With this in mind, you can help your child select sports that are in harmony with his or her body build. This will give your child a better chance to achieve higher levels of performance.

In addition to body size and build, athletic performance is influenced by body composition-the relative amounts of bone, muscle, and fat that make up body mass. The role of muscle in moving the body and generating force is of prime importance. Quite simply, the more strength and power that an athlete has, the greater his or her advantage will be. On the other hand, fatty tissue represents excess baggage and is a performance-inhibitor. Fatness reduces speed, limits endurance and, in some sports, increases the risk of injury. In almost all sports, with the exception of sumo wrestling perhaps, elite athletes strive to be trim and muscular, with healthy minimal levels of body fat.

The physical characteristics that determine sport performance are constantly changing during the growing years of childhood and adolescence. Knowing something about normal growth will tell us much about what kind of athletic activity is appropriate for different ages. In other words, knowledge of the nature and extent of growth will help answer crucial questions about what sport for what child at what age. With such information, it is possible to project realistic expectations of sport performance on our children and to direct training programs to which their changing bodies will respond. As boys and girls move through the exciting stages of growing up in sports, some appreciation of the ever-changing body can make the experience the satisfying one it should be.

With the exception of identical twins, no two human bodies are exactly the same. Body size, shape, and composition, as well as the physiological characteristics, are unique to each individual. These physical traits are

influenced by age and sex, along with a host of internal and external (environmental) factors. For example, the endocrine glands secrete hormones directly into the bloodstream. Hormones are basically regulators of body functions, and they play an important role in physical growth and sexual maturation. With respect to environmental forces, body structure and function depend on how adequate nutrition has been, how free from disease the body has been, and how physically active one has been.

Most importantly, body characteristics are determined by genetic factors. Certainly we know that parent height is a prime determinant of offspring height. Hereditary influences on body structure and the body's many functions are so important in determining the potential for athletic performance that it is often said that great athletes are born, .not made. The significance of one's genetic endowment cannot be denied.

Aside from the size, shape, and makeup of the body, there are several ways in which body functions respond to exercise and training that are important contributors to athletic performance. As with the body's structure, these abilities to respond to training are in large part determined by genetic characteristics. They include (a) the potential for developing outstanding muscle strength, (b) the capability of producing muscle energy efficiently, and (c) the capability of increasing the body's metabolism to a very high level to meet the demands of vigorous exercise. Quick reaction and speed of movement are also important to the athlete, as are the potentials for speed and quickness. These traits are all hereditary.

We've emphasized that hereditary factors are critical in determining which children can look forward to being outstanding, and perhaps even elite, athletes. However, the effects of genetics are never absolute, because genes do not operate in isolation. We cannot undervalue the influence of the environments in which we live-natural and manmade.

During childhood and adolescence, regular exercise is among the many environmental factors essential to achieve full potential for growth. Moderate physical stress from the muscle activities found in most sports is generally a positive force on bone growth. Yet it is doubtful whether training programs for young athletes have any growth-promoting effect on their height. Dramatic exercise effects do, however, occur in muscle and adipose (fat) tissue. Following the start of adolescence in males, the increase in muscle mass is directly related to the intensity and duration of training programs. And, of course, the loss of fatty tissue from exercise is a desirable effect of sport participation.

On the side of caution, relatively little is known about the limits beyond which strenuous physical activity can be harmful to a young athlete's growth. Unfortunately, there is no exact guide for determining how much activity is appropriate. The issue includes consideration of the maturation level of the child and the frequency and duration of the activity. The most reasonable approach is to rely on the child's Own tolerance. The young athlete will generally know when his or her limit has been reached.

A related and equally important issue concerns the exercise tolerance of healthy children. Do endurance sports place excessive demands on the hearts of young athletes? No. This is a popular myth. There is increasing evidence that the growing child's heart responds favorably to physical exertion.

The key to safely handling the demands of heavy exercise resides in the health of the child. This points to the need for careful medical screening, which includes probing for a family history of cardiac problems and any early cardiovascular difficulties. Also, in protecting the wellness of child athletes, parents cannot ignore the importance of appropriate endurance-training procedures that are supervised by competent coaches.

**Patterns of Physical Growth**

The most rapid period of growth occurs immediately after birth, and then the growth rate slows to a modest, steady process during childhood. This is followed by an adolescent growth spurt and then by deceleration until

growth finally stops. There is little difference in the relative growth rates of boys and girls during childhood. However, during childhood boys are slightly taller and heavier than girls of the same age. This difference is a relatively minor one and of no real practical significance for sport performance.

When girls experience the rapid growth spurt that occurs between the ages of ten and a half and thirteen, they become taller than boys. During pubescence, tall girls will be taller than tall boys, and all girls will be taller than the shortest 3 to 5 percent of boys. This is a temporary situation that changes when boys begin to experience their adolescent growth spurt in height some two years after girls have experienced their peak velocity in gaining height.

Prior to adolescence, sex differences in body composition are minor. However, boys do have slightly more bone and muscle tissue and less fat than girls. Following the period of maximum gain in height that occurs in early adolescence (about age twelve to thirteen for girls and fourteen to fifteen for boys), there is a period of maximum gain in weight. In girls this is due primarily to a large increase in body fat, with a relatively small increase in muscle tissue. In boys the rapid gain in body weight that follows a rapid gain in height is due to a decrease in body fatness and a striking increase in muscle mass. Consequently, post-adolescent girls have only about two-thirds as much muscle as males, and young adult females have almost twice the amount of body fat.

Because boys on the average begin their rapid gain in height at the age of twelve and a half, they have about two more years of preadolescent growth than girls have. During this two-year period, they continue to grow, and at age fourteen or fifteen they are about Four inches taller than girls were when they began their rapid growth. In the immediate preadolescent period, boys' legs grow much faster than their trunks. Thus, the longer period of preadolescent growth for males is responsible for the fact that legs of adult males are longer than those of females.

The age at which the adolescent growth spurt begins varies widely from one child to another. The variation is so great in a sample of normal males, for example, that some boys may have their most rapid growth as early as their twelfth birthday, whereas others will not have this growth experience until they are nearly sixteen. These slower-maturing boys will not have their muscle growth and rapid gain in body weight until more than fourteen months later, at seventeen or eighteen years of age. A very normal but slowly maturing young male will have completed high school, before he is physically suited to compete in many sports requiring large size, strength, and a mature skeleton.

The differences in age at which adolescent growth and physical development occur are most evident during junior high school or middle school, or at twelve to fifteen years of age. Normal boys can vary as much as fifteen inches in height, ninety pounds in weight, and five years in maturation status, that is, biologic age. (Biologic age is commonly determined by an X-ray examination of skeletal maturation.) Most youth sport programs match competitors on the basis of calendar age. Therefore, large numbers of boys who do not experience their growth and maturation close to the average risk some very significant problems. This is true for both the slow later maturer and the advanced early maturer.

**Changes in Physical Abilities During Childhood and Adolescence**

During the childhood years, as boys and girls grow-resulting in longer levers and increased muscle tissue-both have the potential to increase their strength. Boys and girls show similar increased ability to perform motor skills prior to puberty. However, in general, boys are eventually able to develop greater strength and thus surpass girls in the performance of most sport-related skills.

During adolescence, males show a steady increase in performance and endurance that extends into early adulthood. The same is not true for girls. There has been a tendency for girls' performance to reach a plateau

around the time of puberty (approximately thirteen years of age) and decline thereafter. Because of physical changes that accompany adolescence, such as increases in fat, girls are placed at somewhat of a disadvantage for motor performance. But the leveling off and subsequent decline in girls' performance and endurance have been related more to social factors than to biological changes.

Like other aspects of motor skill, strength shows a steady increase during childhood, with boys being slightly stronger than girls. Boys continue to improve during adolescence, whereas girls' strength scores level off and then tend to decrease. In boys there is a delay, on the average, of at least fourteen months between the period of the most rapid gain in height and the most rapid gain in muscle weight. The adolescent male who is nearing the completion of his rapid gain in height will have little muscle tissue and strength potential for the next year or two. He must await the development of muscles to go along with his newly acquired taller body. Thus, the adolescent male is not as strong as his stature might suggest.

Research on strength development of boys under fourteen in training programs is not extensive. The best information available indicates that prior to this age (and the production of the male sex hormone testosterone), weight training cannot be expected to result in any worthwhile gains in either muscle development or strength. In addition, weight training for preadolescent boys is an activity with high injury risk if not properly supervised.

Because the increase in weight of the adolescent female is due primarily to a gain in fat (and, to only a small extent, to a gain in muscle), her potential for strength development via exercise is much less that the male's. The extent to which girls' smaller amount of muscle tissue can be increased and strength gained by weight training has not been systematically studied. In young adult women, weight training has been shown to produce significant gains in strength, but in the absence of male hormones, the female will experience minimal gains in the size and mass of muscles.

### Should Boys and Girls Compete Against Each Other?

We have pointed out that during childhood years, only very slight sex differences in body structure and motor performance are present. On a purely physical basis, there is no reason why boys and girls should not be on the same teams competing with and against each other. The potential for performance and the chances for causing or sustaining injury related to size and strength do not differ significantly between the two sexes.

However, this situation changes drastically during adolescence. As boys gain more in height, weight, muscle mass, and strength, it is not possible for girls to fairly and safely compete against them in most sports.

There is little merit to the argument that if a girl is good enough, she should be allowed to compete on the boys' team. If one accepts this position, then boys who are good enough should be allowed to play on girls' teams. Boys would occupy most of the places on both teams because of their greater size and strength, and almost all girls would be denied places on either team. After age eleven, boys and girls should have their own competitive opportunities in those sports in which strength and body size are determinants of proficiency and injury risk.

### The Growing and Maturing Skeleton

The body skeleton is obviously involved in the normal growth of children. In' adolescents the skeleton first grows in size and length, after which it gains in density and strength. As mentioned earlier, the principal sites of growth before the start of rapid adolescent growth are in the legs and arms. During the adolescent growth spurt, the trunk grows most rapidly. The long bones of the arms and legs increase their length by the activity of specialized cells located in a so-called growth plate at either end of the shaft of the long bones.

Because it is composed of cartilage (soft tissue), the growth plate is structurally the weakest point in the bone.

It is weaker than any point in the shaft of the bone and actually weaker than the ligaments that align the neighboring joints. Additionally, the growth plate is weakest during periods of most rapid growth. Injury to this area of the bone can destroy those cells responsible for the future growth of the long bone. During the period of the most rapid gain in height (on the average, ages fourteen to fifteen in boys and twelve to thirteen in girls), severe injury to the ends of long bones can threaten the growth plate. Growth arrest and a shortened leg could result in lifelong crippling if a long bone of the leg is involved.

Fortunately, growth-plate injuries are not common in sports. But the threat of a growth-plate injury would temporarily direct early adolescents away from participation in collision sports, such as football and wrestling, where severe blows to a leg or arm may be encountered. As growth nears completion in later adolescence, the growth plate ceases its function, fuses firmly with the shaft of the long bone, and is no longer the site of vulnerability that it was during early adolescence.

As the skeleton matures, the bones become denser, stronger, and more able to withstand the trauma of hard use in intensive training. There is little information on the effects on the skeleton of intense, repeated athletic activity during childhood and very early adolescence. In the absence of well-documented research, it is wise to follow the recommendations of such concerned organizations as the American Academy of Pediatrics' Sports Medicine Committee, which discourages intense athletic activities, such as long-distance running and weight training during childhood and until the rapid growth of early adolescence has been completed.

## Sport Participation and Physical Maturity

We have mentioned that body structure and a variety of basic functions that relate to athletic performance undergo striking change during the early years of adolescence. And there is great variation in the age at which individuals experience these changes. Therefore, the age at which children (boys in particular) are physically ready for many types of sports will also vary greatly. Youth sport programs present the early adolescent junior high or middle school-aged person) with opportunities for highly organized sports. It thus becomes important to identify late-maturing and early-maturing individuals if they are to be directed into appropriate sport experiences. The late maturer will have increased risk of injury, with his undeveloped muscles and immature skeleton. More importantly, playing with and competing against larger, stronger, and more mature boys, the late maturer will be a less skilled athlete. He is a prime candidate to drop out at the earliest opportunity.

The considerable variation in the onset of physical development at adolescence raises the question of the appropriateness of collision sports for junior high school and middle school boys. After one junior high school football game, twenty-two players were weighed. They varied in weight from 84 to 212 pounds. Although the players' physical maturity was not scientifically assessed, the range of maturity seemed also to be extremely varied-as much as four or five years' variation in skeletal maturity.

### The Early Maturer

The early-maturing individual is bigger, stronger, and quicker, acquires sport skills faster, and has more endurance potential than his or her peers. Thus, the early-maturer can be expected to be a star grade school and junior high school athlete. A major problem is that the early maturer enjoys outstanding sport success during elementary, middle, and early junior high school simply because of the physical advantages he or she has over his or her teammates and opponents. With the elaborate sport programs available for very young athletes in most communities, the eight to twelve-year-old can readily become a true sports star.

The sport success of an early-maturer can lead to a fulltime commitment to one or more sports at a very early age. Sport achievements may eliminate the desire for accomplishment in other areas, such as schoolwork or the arts, or an interest in exploring other sports. Positive reinforcements come from coaches, teammates, and most particularly parents, who sometimes begin to think of their star athlete in terms of outstanding high school performances, college scholarships, and perhaps even a high-salaried career in professional sports. What does it matter if the only musical instrument the child will ever be interested in playing is a tape deck or that his report card is full of C's and D's?

The world can fall apart for this youngster, male or female, and his family about high school time, when as a sophomore he lines up against some juniors and seniors who possess his same maturity. Having lost the advantage of his early development, the young athlete is now less than an outstanding athlete. As all of his former grade school teammates and opponents catch up to him in maturity and as other athletes begin to do outstanding things, the grade school star may find only an uncomfortable place on the bench. Unable to understand the true reason that the star no longer outshines others, insensitive coaches and even parents may accuse him of "dogging it." The young athlete has lost the limelight of sport success on which his self--esteem was built. He is left with no other interests or talents because of his early all-consuming commitment to the sport, and he is keenly aware of the great disappointment he is to his parents. At sixteen or seventeen, an age of considerable vulnerability to a number of disturbing antisocial alternatives, he is a depressed has-been.

The answer, of course, is to prevent the problems from occurring. This can be done by first recognizing the signs of early maturity. The early maturer will probably be the child of a parent who likewise was an early maturer, and he will experience growth changes and sexual maturation well ahead of schedule. Once identified as an individual who is maturing more rapidly than usual, the child should have the opportunity to participate in sports with individuals who are of similar maturity, not the same calendar age. The early-maturing star basketball player of junior high school age should have a chance to work out with the high school junior varsity. Matches can be arranged for the twelve-year-old tennis star with some sixteen-year-old members at the tennis club. Early-maturing athletes need to know how really good they are if they are to keep their athletic performances and potentials in proper perspective.

### The Late Maturer

With sport successes so closely related to maturity, it isn't difficult to imagine the problems of the late-maturing athlete-especially for parents who were late maturers themselves. Many, but certainly not all, late maturers will be small in stature for their age. They will have less strength, endurance, and skeletal maturity and lower motor skills than their average peers. These children are going to be handicapped in many sports where size, strength, and endurance determine the outcome, and in some situations they will be at undue risk to injury.

The late-maturing individual will often be recognized as such in the elementary school years. A parent’s own maturation experience from twelve to sixteen years of age can be an indicator of the maturation rate to be expected of the child. If early sport participation is important for the late maturer, he should be directed to sports that are not primarily dependent on size and strength for proficiency such as racket sports, diving, and some track events. He may not become state champion, but he may achieve levels of accomplishment sufficient to earn him a comfortable place in the sport scene.

Many late maturers can comfortably postpone their entry into sport programs until they are physically mature. It is most important that these athletes know the normal sequence of changes that occur during adolescence so that they know where they are in the maturation process, where they are going, and when they get there. With this insight they will know when sports can be rewarding, when a vigorous training program can be effective and satisfying and when they can be competitive on the field or court. It is possible at ages fourteen to sixteen to avoid a devastating, negative sport experience due to delayed maturity. The late maturer doesn’t have to suffer consistent setbacks and be turned off to sports and their benefits.

Parents and coaches should know the implications of delayed adolescent development, and they should develop their expectations accordingly. Properly managed, the late maturer can be a budding sport star. Being constantly yelled at by a coach or put down by a disappointed parent can produce a demoralized dropout at an age when dropping out can be very serious.

## The Body of Today's Young Athlete

Those responsible for sport programs for children and youth must recognize that athletes are a different population from those of a generation or two ago. Athletes today are bigger and stronger at younger ages. Particularly at the junior and senior high school levels, the "new model" athletes not only perform better, they demand a higher degree of sophistication and concern in dealing with their protective equipment, training facilities, coaching, refereeing, and even rule changes.

The young athlete's body is the prime determinant of proficiency and satisfaction in sports. Since physical features are constantly changing during childhood and adolescence, sport programs and expectations must be adjusted according to these developmental changes. From a purely physical viewpoint, the sport programs of elementary school children must minimize demands for strength and endurance. The potential for developing these traits is not present at this age. Prior to the age of twelve or thirteen, sports should be for fun, for experiencing a variety of opportunities, and for being introduced to some sport skills.

During the rapidly changing years from twelve to sixteen, with the tremendous variation in adolescent body changes, more attention should be paid to the proper matching of competitors. Young athletes should ideally be of a similar maturational level regardless of their calendar ages. Sports provide a critical opportunity to acquire much-needed confidence in oneself and in one's newly developed physique. The adolescent should not be denied this opportunity or have a negative experience because of inappropriate matching or the unrealistic expectations of parents and coaches.