

METABOLIC FACTORS OF DEVELOPMENT  
AS RELATED TO PHYSICAL FITNESS

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Metabolism--The phenomena in synthesizing foodstuffs into complex tissue elements (assimilation) and in breaking down its complex substances into simple ones in the production of energy (disassimilation) is naturally related to physical fitness. Of the numerous effects of metabolism in the growing child, I shall limit this discussion to some metabolic factors controlling ligamentous tone and osseous maturity. I believe that these are of primary importance to athletic directors.

By the time a young man is ready to participate in a competitive sport, his physical development has largely been determined by his prenatal influences, by his health from infancy until the time you see him, and by whatever physical training he has received prior to coming out for a place on your team.

Beginning with his life in utero, the metabolism of his mother has had a bearing on the ligamentous structures and quality of his bones. Blessed is she if of superlative health from conception to delivery, for her offspring is not healthy by chance alone. If she is sub-metabolic, her diet inadequate, if she suffers from illness during gestation particularly at the time of the development of the joints, her infant will likely begin life with a disturbed metabolism indicated by poor ligaments and bones. Post-natal submetabolism and metabolic insults of early childhood, especially when the epiphyses are developing, can play a further important role in producing soft bone, loose joints and weak ligaments.

Certain cardinal signs of poor ligamentous structure that can be observed in infancy and tend to be carried through life are:

Hyperextensile joint of the elbow  
 Hyperextensile joint of the shoulder  
 Wrist bones that can be pulled apart  
 Waddling roll to the hip  
 Hyperextension and lateral play of the knee  
 Weak ankles  
 Dynamically and statically flat feet

A trained medical examiner can readily pick up these conditions on physical examination. Later in life, the X-ray will reveal these problems more clearly. At the time of the completion of the development of the bones and cartilages of the joints, mal-alignments become obvious.

It is important to understand the development of the epiphyses or growing ends of the bones, and how they indicate the adequacy of the individual's metabolic effort and physical fitness. To clarify this, let us consider two infants, one born to a mother who had relatively uneventful pregnancy, enjoying a high state of metabolic drive, the other to a mother fraught with severe metabolic problems before and throughout her pregnancy. Not only were the two children born with diametrically opposed metabolic patterns, but their lives and physical fitness have been poles apart. The one had an enviable record of physical excellence, the other, slow to mature, keeping a high soprano voice until much later than average, always shunning physical activity and sports.

Let us follow the effect of their divergent metabolism on the development of their feet, for it illustrates the points of discussion.

The healthy child was born with good osseous centers of compact bone, the other child had porous bone. The husky child continued to develop good bone, strong muscle and excellent coordination. At the age of 1½, he suffered a severe metabolic insult in the form of measles, which left its mark and took three years to heal. The other child passed through a series of continual metabolic upsets--poor assimilation of formula,

frequent colds, bouts of asthma, poor coordination causing many injuries due to falling. As these boys progressed in age, the husky boy rarely missed school, except for an occasional hooky, was interested in sports and games, rarely sustained an accident. His foot matured normally. The other boy continued to have minor accidents, was withdrawn socially, had to be forced to participate in school sports; he had flat feet with evidence of his continual metabolic insults in the scars on his bones.

The one boy was early recognized as athletically superior. He was excellent in several sports though one was best; he played it regularly, day after day. His foot continued to show the excellence of physical development, the ligaments remained tight with dense bones. He was not accident-prone. The other boy's physical exertion was thrust upon him by paid athletic tutors. His feet remained flat, he continued accident-prone. The stronger boy passed through school with unflagging interest in sports, was superior not only in his own school but in southern California. He remained non-accident prone, and his feet showed superior osseous development. His metabolic pattern showed a high level of activity. The other boy's voice had not changed until age 15. He continued to show the ligamentous failure of his feet, numerous sprained ankles. His main interest was in hot rods, and he demonstrated social maladjustments.

The healthy boy participated in his sport for four college years, still a champion, coordination superb, good student, development of feet excellent. The other never participated in college sports, remained accident prone, both with automobiles as well as with feet.

To briefly discuss the hand, generally used by anatomists to demonstrate physical development: the hand is composed of two types of bones, carpal bones in the wrist, the ends of the radius and the ulna of the forearm, and the phalanges. The latter are modified long bones similar to the radius and ulna but having epiphyses on their proximal ends only. The carpal bones mature by altering their shape and size. These bones are laid

down in a matrix of cartilage, leaving a lesser and lesser amount of cartilage as maturity proceeds while at the same time the ligaments are strengthened. Also at the same time, the phalanges grow at the epiphyseal line. The epiphyses change shape with maturity and finally fuse to the phalanges. The hand is thus mature in the young man at about 18-19 years, and two years earlier in the young woman.

The elbow is one of the most complex joints and is early composed of centers which eventually fuse to the shaft of the humerus, radius and ulna. The knee, too, is a complex mechanism, built similar to the elbow, but lacking that universality of motion.

Epiphyses are vulnerable; they can slip, but they can also heal until maturity. Injury during growth, metabolic or mechanical in origin, can leave a functionally deformed joint which may not injure the individual seriously in his youth but may lead to painful and crippling disability in later life. Each joint of the body has a period of maturity, and how it matures is an index of the adequacy of a child's metabolism.

It has been my experience with children largely drawn from middle class and professional parentage that those children who excelled physically have been slightly in advance in the maturity of the joints, especially those used in their chosen sport, and as a rule, have shown a slight total physical advance.

You who are experienced physical education directors have probably learned to judge the physical stability of your athletes. Perhaps your long experience has qualified you to make "trained guesses" that are almost as accurate as those of the physician who can demonstrate development by X-ray studies of bones and joints. I once heard a college football coach stun his subordinates and alumni backers by saying "I would rather have a freshman team of healthy boys who had never played high school football to draw from because they are less likely to have suffered joint injury and are now ready to play a man's game." He intuitively recognized the importance of mature, fused epiphyses.

Perhaps you have discovered that all-around athletes have had excellent physiques since childhood, and possibly you believe that "champions are born, not made." However, much basic truth there is in these tenets, you will also have found exceptions. You will have shown that training of good order for a determined and willing boy may strengthen his ligaments and develop him into a tough team-mate, and even a champion. But is it not also true that his spirit of perseverance to work and fight and train stubborn nerves and muscles to perform a desired feat is the mark of a "born champion"?