Muscle fibers

Individual muscle fibers are formed during development from the fusion of several undifferentiated immature cells known as myoblasts into long, cylindrical, multi-nucleated cells. Differentiation into this state is primarily completed before birth with the cells continuing to grow in size thereafter. Skeletal muscle exhibits a distinctive banding pattern when viewed under the microscope due to the arrangement of cytoskeletal elements in the cytoplasm of the muscle fibers. The principal cytoplasmic proteins are myosin and actin (also known as "thick" and "thin" filaments, respectively) which are arranged in a repeating unit called a sarcomere. The interaction of myosin and actin is responsible for muscle contraction.

There are two principal ways to categorize muscle fibers: the type of myosin (fast or slow) present, and the degree of oxidative phosphorylation that the fiber undergoes. Skeletal muscle can thus be broken down into two broad categories: Type I and Type II. Type I fibers appear red due to the presence of the oxygen binding protein myoglobin. These fibers are suited for endurance and are slow to fatigue because they use oxidative metabolism to generate ATP. Type II fibers are white due to the absence of myoglobin and a reliance on glycolytic enzymes. These fibers are efficient for short bursts of speed and power and use both oxidative metabolism and anaerobic metabolism depending on the particular sub-type. These fibers are quicker to fatigue.

Genetics of body size, composition and muscle tissue

Each of body size, physique, body composition and biological maturation share similarities in genetic influences. Although human stature is mainly determined by genetics, it is also influenced by the environment (i.e., malnutrition). Segmental body lengths and bone-related mineral mass show a high degree of genetic control. Body weight, skinfolds and body circumferences show a lesser degree of genetic inheritance due primarily to changes occurring in the environment such as nutritional intake and variation in physical activity. However, fat patterning is apparently a highly heritable trait, which shows ethnic and racial variation (Mueller & Wohlleb, 1981) .

Medical geneticists have clearly shown that all muscular properties are subject to inherited influences. Muscle fiber numbers are presumably determined by the second trimester of fetal development (McArdle, Katch, & Katch, 1991) . The genetic contributions to muscle tissue fiber composition and size are significant. However, physical training may play a significant role in modifying fiber size and area, and the relative area composed of Type I (slow twitch, oxidative muscle) and Type II (fast twitch, glycolitic) fibers as well as their metabolic capacities. However, as will be discussed in the sections to follow, the proportion of slow and fast twitch muscle fiber types is genetically determined and cannot be influenced by training (Costill, Fink, & Pollack, 1976; Gollnick, et al., 1972; Pette & Staron, 1990).

	Type I fibers	Type II a fibers	Type II x fibers	Type II b fibers
Contraction time	Slow	Moderately Fast	Fast	Very fast
Size of motor neuron	Small	Medium	Large	Very large
Resistance to fatigue	High	Fairly high	Intermediate	Low
Activity Used for	Aerobic	Long-term anaerobic	Short-term anaerobic	Short-term anaerobic
Maximum duration of use	Hours	<30 minutes	<5 minutes	<1 minute
Power produced	Low	Medium	High	Very high
Mitochondrial density	High	High	Medium	Low
Capillary density	High	Intermediate	Low	Low
Oxidative capacity	High	High	Intermediate	Low
Glycolytic capacity	Low	High	High	High
Major Storage Fuel	Triglycreides	Creatine phosph glycogen	Creatine phosphate, gly	Creatine phosphate glycogen