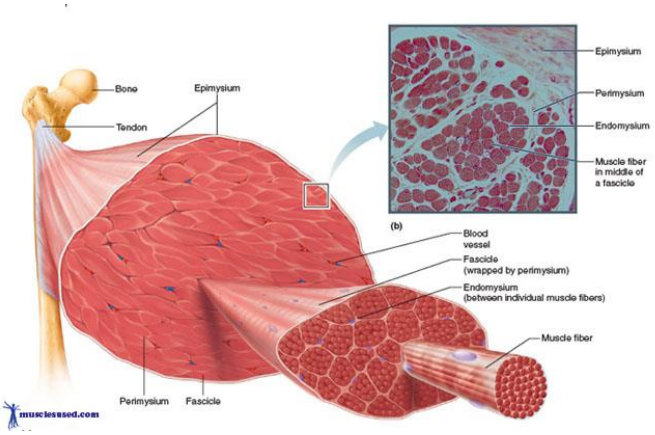
ARE YOU A SLOW- OR A FAST-TWITCH RUNNER?

How can we individualize our training towards our different goals based on our muscular makeup? In this article you will learn how to decide if you are a Fast-twitch, or a Slow-twitch runner. Once you know what kind of runner you are, you can use this information to modify your training for your individual goal and specific running event. As a FT-runner you will need different training stimulus than if you are ST-runner to improve and obtain particular training adaptations.

OUR RUNNING MUSCLES

Every human body has 650 different muscles divided into three different types of muscles groups. Examples of different groups are *cardiac* muscles found in our hearts, *smooth* muscles which controls functions like digestion and blood pressure, and the *skeletal* muscles which we use for movements such as running. Skeletal muscles are built-up by muscle fibers that are stacked together into larger bundles called fascicles. Imagine a bundle of spaghetti, and you get an idea of how muscle fibers are stacked within the fascicles. Fascicles are then banded together to form skeletal muscles (**Picture 1**).



Picture 1. Illustrates a skeletal muscle. Muscle fibers are stacked together into bundles, building the fascicles. The fascicles are banded together forming the skeletal muscle.

Our muscles are built by different muscle fibers

It is rather obvious for us that the physiological demands put on runners running the 100-meters event compared to runners running the 800-meters, to 5K, to marathons, or even to ultramarathons are quite different (**Chart 1**). There is also another parameter that quite differ between runners who all run the *same* event, and that is their muscular makeup. Human skeletal muscles are built up by three different muscle cell types defined as slow-twitch, intermediate, and fast-twitch which all have particular physiological characteristics (**Table 1**).

Slow-twitch (Type I): Small muscle fibers that contracts more slowly and less forcefully than the other two fibers. Distance runners love them for their aerobic (oxygen-utilizing) endurance potential.

Intermediate fast-twitch (Type IIa): These oxygen-utilizing fibers have tremendous aerobic potential of their own, but they also produce more force and contract faster than slow-twitch fibers. The combination of good endurance and good speed makes them perfect for middle-distance racing.

Fast-twitch (Type IIx): These are large fibers that has high contraction velocity giving them the highest force output of the three fiber types. The downside of FTIIx is their limited aerobic potential. They are great for short bursts, such as those required for sprints and jumps.

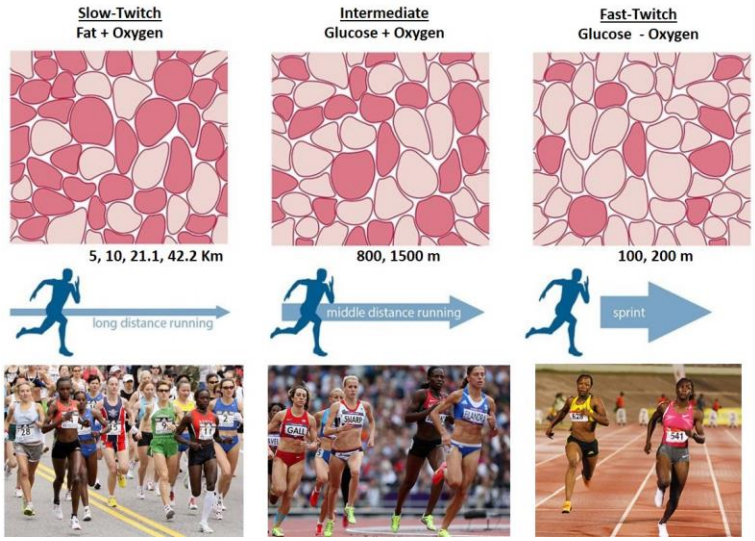


Chart 1. Illustrates the appearance of different muscle fiber types in our skeletal muscles. Note the different fiber type makeups due to specialization for the different running events. Runners competing in long distance events tends to have high percentage of slow-twitch fibers (ST) whereas middle-distance runners and sprinters has much higher percentage of intermediate and fast-twitch fibers (FT).

Table 1. List of physiological characteristics and how these vary between the fiber-types constituting our skeletal muscles.

TYPE OF FIBER	**SLOW-TWITCH**	**INTERMEDIATE**	**FAST-TWITCH**
Characteristics	*Slow-Oxidative (Type I)*	*Fast-Oxidative (Type IIa)*	*Fast-Glycolytic (type IIx)*
Speed of Contractions	Slow	Fast	Fast
Resistance to Fatigue	High	Intermediate	Low
Oxidative Phosphorylation Capacity	High	High	Low
Enzymes for Anaerobic Glycolysis	Low	Intermediate	High
Mitochondria Count	Many	Many	Few
Myoglobin Content	High	High	Low
Color of Fiber	Red	Red	White
Glycogen Content	Low	Intermediate	High

How are muscle cells recruited? What type is recruited when, and in what way?

When we run at different paces we make use of different muscle fibers. Sprints require hundred percent recruitment of all three fiber types, and less intense efforts such as walking require only recruitment of slow-twitch. We can describe the activation and recruitment of different muscle fibers in terms of a **muscle fiber ladder,** where movement up the muscle fiber ladder is triggered by mainly two factors; force and fatigue (**Chart 2**). When we increase our pace during a run, or make the transition from flat running to a steeper hill, our legs need to generate more force - then we climb the muscle fiber ladder.

Another example when we climb the ladder would be during long distance runs. When the energy stores of the slow-twitch fibers become depleted it forces the recruitment of intermediate fibers to lend support - even fast-twitch fibers cycle in and out. So, when one fiber type runs low on energy, we will climb the ladder.

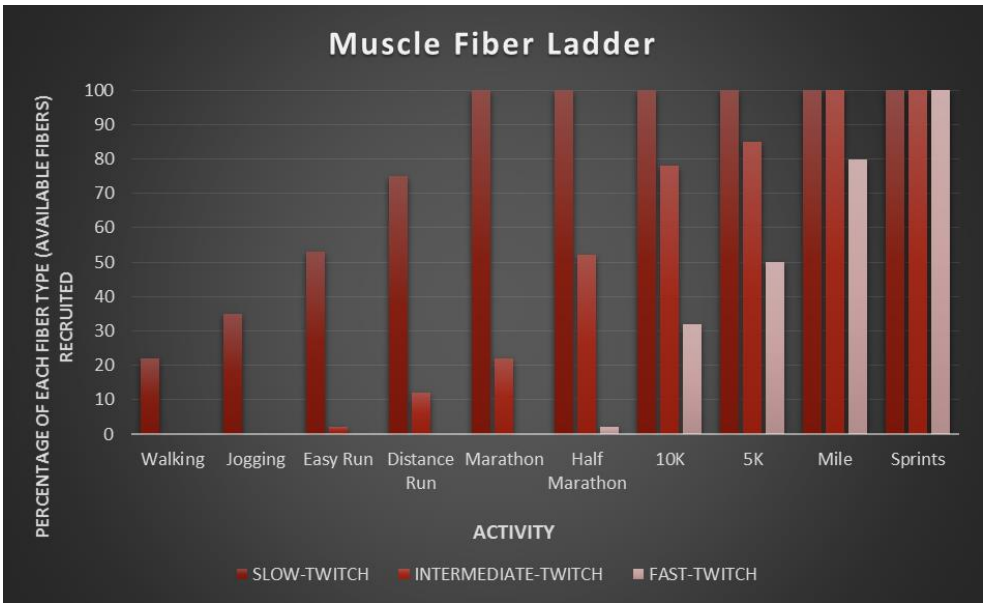


Chart 2. Illustrates how a hypothetical distance runner (i.e., a runner with mostly slow-twitch fibers) might recruit different fiber types at different paces. At less intense efforts-like walking- slow-twitch fibers are recruited. At increased efforts, more slow-twitch and some intermediate fibers are added. At half-marathon pace, the maximum available slow-twitch fibers, half the available intermediate fibers, and a few fast-twitch fibers are recruited. Sprints require 100 percent recruitment of all three fibers types. Different runners will have different muscle fiber makeups (i.e., ST or FT) and will vary in their recruitment of fibers at different efforts and paces. Chart adapted from (Magill, et al., 2014).

SLOW-TWITCH AND FAST-TWITCH RUNNERS HAVE DIFFERENT PHYSIOLOGY

Differences in physiology between FT- and ST-Runners

The reasons for different general training recommendations to slow-twitch runner (ST) and fast-twitch runner (FT) runners are mainly due to three main factors:

1) Difference in anaerobic (***power***) and aerobic capacities (***endurance***).

2) Difference in muscle fiber recruitment.

3) Difference in the strengths of their fuel systems.

Training will change our genetic fiber-type makeup with but it takes time and requires effort

Although our running muscles contain all three types of fibers, not all runners possess the same percentage of each fiber type. Our genetics determines the percentage of fiber types in our bodies, but how we train can alter how those fibers function. With acute training, the shifts are very small, but with long term training larger shifts can occur. A high amount of volume (or in other words, DAMAGE) is needed to change fiber types. Runners specialized on marathons tend to have muscles that are mostly built by slow-twitch fibers (80% or more), while sprinters are equally rich in fast-twitch. The need for large amounts of training/DAMAGE, to achieve muscle fiber type conversion from fast-twitch and intermediate fibers into slow-twitch fibers could explain why distance runners tend to reach peak performance levels later than sprinters and power athletes (Magill et al., 2014).

Where do you as a runner fall on the fiber type spectrum?

Fibers are classified into different types mainly based on what type of protein (called myosin) the fiber predominantly has. The problem is that each muscle fiber type does not contain only one kind of myosin form, but instead most have a mixture of fast and slow forms. Therefore it is not a distinct division in fiber types but fiber types are more like a spectrum (Magness, 2014). Where a fiber then falls depends on its individual characteristics, which include mitochondria density, capillary density, oxidative and glycolytic enzyme activity, creatine phosphate stores, and contraction velocity (see **Table 1**). On one side of the spectrum we have the pure ST fiber and on the opposite the pure FT fiber. Each different runner will fall somewhere on the fiber type spectrum. Finding out exactly where you are is unnecessary but to have a general idea where you as a runner fall on the spectrum will help you individualize your training. This information can guide you in to what running events you should preferably train for. Below are a few tests described that allows you to estimate your muscular makeup.

Tests to reveal you running type

A) Personal Record's Comparison

A simple method is to compare your personal records on distances both below and above the distances for your main events. For example, your main event is 5K. Then you should try to run as fast as you can on 1500-meters, 3000-meters, 10K, even up to the half-marathon. Your average pace in relation to the other runners running these different distances will tell you whether you have a trend at being better at the longer or shorter distances. It gives you a hint if you run on speed and power, or more on endurance.

B) Speed and Power Tests

100-meter Test: The faster the 100m time, the more FT fibers you are likely to have.

Power Test: Gives a strong indication of what fiber type grouping you as runner a belongs to because your power is dependent on your rate of force development (RFD). How fast you can produce high muscle force is highly related to your muscular makeup, as fast-twitch fibers are able to produce large amounts of force much more quickly than slow-twitch fibers.

- **Standing Broad Jump Test:** How long can you jump from a stationary position?
- **25-Meter Hopping Test:** Jumping 25 meters on one leg with as few hops as possible (*World class 800-meter runners score 10 hops (males) and 11 hops (female)*).

What event are you training for?

Once you know approximately what kind of runner you are you can find out where you as runner are in relation to the event you are training for. Basically, looking into how your speed and endurance is compared to other runners racing the same event. Then you can classify yourself as being a FT- or ST orientated runner for that particular event. Imagine you are a ST-runner in the 5K event, but you decide to move up to a half-marathon or a marathon, then you should be trained from the FT side for these longer events. Your endurance may be your strength at 5K but your weakness at the longer distances. In the article "**I AM A SLOW-TWITCH RUNNER**", I describe my own muscular makeup and my learnings when training for different events.

You need different workouts to target your different running muscles

To train your muscles fibers correctly for endurance running you will have to recruit all of them during your running. The best way to strengthen each fiber type is to design workouts that recruit a fiber type continuously, thereby maximizing the amount of training that the fiber type receives. Slow-twitch fibers

need lots of endurance training, while fast-twitch fibers require shorter, high-intensity efforts. *We cannot train both fiber types with one approach.* That is the main reason why successful runners train at different paces. It is the only effective way to train different fiber types to their maximum potential. **Table 2** describes differences and modifications to workouts depending whether you are a FT- or ST-runner. Details about the different running workouts are further described in the article: "**THE RUNNING WORKOUT TOOLBOX**".

Table 2. Describes how different running workouts can be executed and modified depending on your muscular makeup, whether you rely more on your fast-twitch or your slow-twitch muscles fibers. Table adapted from (Magness, 2014).

5K, 10K and Cross-Country	**Fast Twitch Runner**	**Slow Twitch Runner**
GENERAL		
Endurance Side	• Long runs can be kept relaxed and slower. • Include more progression work, starting at a slower pace than threshold and progressing past threshold. • Moderate volume/mileage.	• Long runs can be faster and include more "stuff" (pickups, surges, etc). • Higher volume/mileage.
Speed Side	• Very short sprint work (< 8-10 sec), to maintain stimulus on the harder to recruit FT-fibers. • Flat sprints preferable for power development with longer rest between sprints.	• Sprint work is aimed at increasing the recruitable fiber pool and at improving the neuromuscular system. • Hill sprints preferable for fiber recruitment benefits.
SUPPORT		
Endurance Side	• Responds better to faster work, rather 5k-10k paced intervals rather than of lots of "fast" tempo.	• Heavy emphasis on work done just below and right at "fast" tempo.
Speed	• Use lots of short intervals at moderate (1500-5k) pace with short rest in between. • Minimize large volumes of speed work (3k pace or faster) because FT will respond quickly to it, and it will negatively impact aerobic capacity.	• Work at 1500-3k pace done using maintenance type of intervals. • More use of 5k paced intervals as speed side support.
SPECIFIC		
	• Alternations of specific speed and easy, with easy being further away from specific speed. • Moderate length repeats (400-1500m) with longer rest periods for specific work.	• Alternations of specific speed and steady pace with the steady being a pace much closer to specific race pace. • Long repeats (800-3000m) included at +/- specific race speed.

REFERENCES & FURTHER READING:

Magness, S. (2014). *The Science of Running – How to find your limit and train to maximize your performance*. Origin Publishing.

Magill, P., Schwartz, T., & Breyer, M. (2014). *Build Your Running Body – A Total-Body Fitness Plan For All Distance Runners, From Milers To Ultramarathoners - Run Further, Faster, And Injury-Free*. The Experiment Publishing, New York.