

Background Information

- Muscle fibers exist along a spectrum from slow (type I) to fast (type IIa) to super-fast (type IIx)
- Along this spectrum, there are hybrid muscle fibers (type I/IIa, and type IIa/IIx)
- Super-fast twitch fibers (type IIx) are incredibly rare, even among elite athletes
- Compared to slow twitch fibers, fast-twitch fibers are 5-6x faster / more powerful, but fatigue much more quickly
- Super-fast twitch fibers (type IIx) are 4x faster / more powerful than standard fast-twitch fibers (type IIa)
- For explosive athletes, the goal is increasing fast-twitch (type IIa) fiber concentrations, and decreasing type I (slow twitch)
- Fast-twitch athletes include Usain Bolt, Ronald Acuna Jr, Christian McCaffrey, and other strong/fast athletes. Slow-twitch athletes include Eliud Kipchoge, Lance Armstrong, and other endurance athletes

Main Findings

- Elite powerlifters, MMA fighters, and sprinters are incredibly fast-twitch
- 6 weeks of weight training increased fast-twitch (IIa fibers) by 15%, but slow-twitch fibers remained the same
- 8 weeks of sprint training increased IIa fibers by 17%, and decreased slow-twitch (type I) fibers by 11%
- Both strength and speed training increases fast twitch fiber concentrations, but only speed training (plyometrics and sprinting) decreases slow-twitch fiber concentrations (which is good for explosive athletes)
- As you train, hybrid fibers are converted to fast or slow twitch fibers depending on your training
- To become as fast-twitch as possible, athletes should prioritize strength and speed with heavy lifting, sprint training, plyometrics, olympic lifts, and medicine ball work. All of this training should be high rest, low reps, max intent to target fast-twitch fibers instead of slow-twitch fibers

Fiber Transitions of HS Students with Training

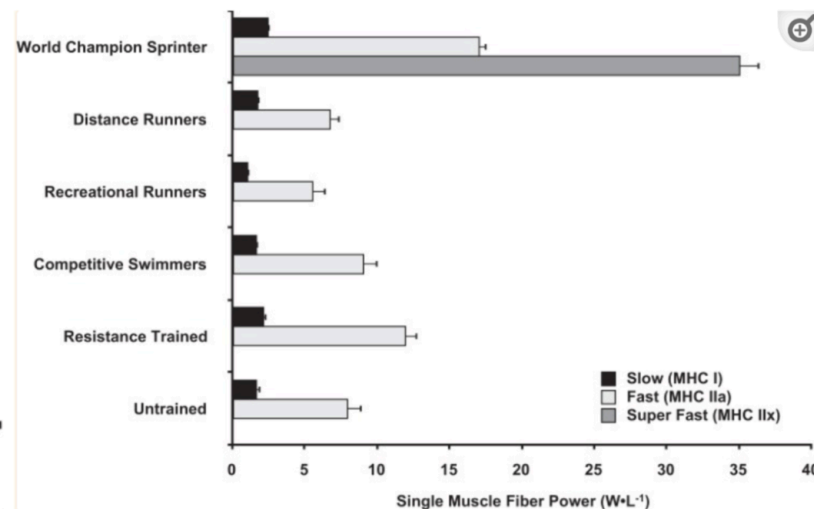
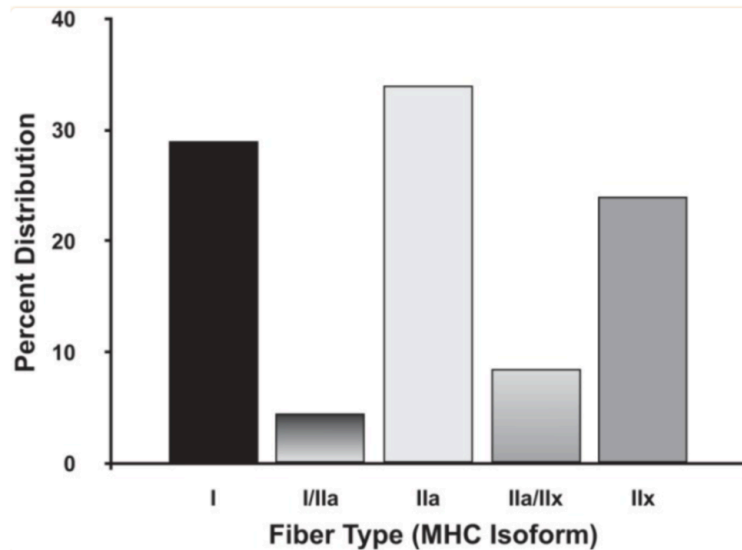
- Strength training doesn't really shift fibers from slow – fast twitch, but it does shift hybrid fibers (I/IIa and IIa/IIx) to pure IIa
- Power training (moving lighter weight fast) more effectively maintains IIa/IIx hybrids, while shifting type I fibers to IIa
- This study split HS students into two groups. Group 1 just did strength training, while group 2 did strength and plyometric training. After 6 weeks, here were the results
- Group 1: IIa fibers increased from 49.4 – 66.7%, and there was no change in type I fibers
- Group 2: IIa fibers increased from 47.7 – 62.7%, and type I fibers decreased from 18.2 – 9.2%
- Another study found that 8 weeks of sprint training in male sprinters increased IIa fibers from 35 – 52%, and decreased type I fibers from 52 – 41%

- It seems that sprint and/or plyometric training is required to shift slow-twitch fibers to fast-twitch fibers

Colin Jackson (Olympic Hurdler) Muscle Biopsy

- This study did a muscle biopsy of Colin Jackson, a hurdler who set world records in both the 60m and 110m hurdles
- He was 71% fast-twitch, with **24% pure IIx muscle fibers**
- Pure IIx fibers are four times more powerful than IIa fibers (standard fast-twitch fibers)
- IIx fibers are *incredibly* rare— Dr. Andy Galpin has done thousands of muscle biopsies, and he's only seen two athletes that had ANY of these fibers. Both had less than 1% of these IIx fibers, but Colin Jackson had 24%
- Kohn and colleagues have shown a strong correlation between IIx fibers and sprinting speed in the animal kingdom. Cheetahs (fastest animal) are about 70% pure IIx
- Colin's full muscle fiber distribution: 29% type I (slow-twitch), 4.5% I/IIa hybrid, 34% pure IIa (fast-twitch), 8.5% IIa/IIx hybrid, 24% pure IIx (super-fast twitch)
- A single one of Colin's IIa fibers was approx twice as powerful as the average IIa muscle fiber

** Graphs below show Colin's muscle fiber distribution and compare his muscle fiber power to other groups



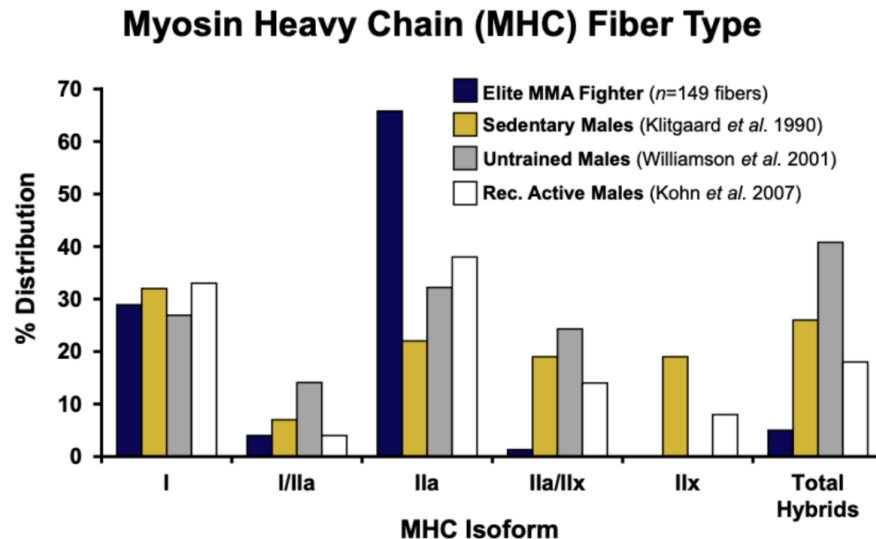
Muscle Biopsies of Elite Powerlifters

- Participants totaled three olympic games, 19 world championships, 25 national records, and more than 170 national / international medals
- Main finding: these world class and national level powerlifters had the highest fast-twitch (pure IIa) fiber concentrations ever reported
- Average muscle fiber distribution (of lifters in study): pure type I (23% +- 9), I/IIa hybrid (5% +-3), pure IIa (67% +- 13), IIa/IIx hybrid (6% +- 10), and no pure IIx
- Heavyweight lifters had 91% of the IIa/IIx hybrid fibers, showing a correlation between this fiber type and body weight
- Early research in the 70s – 80s found that men who lift weights have high percentages of fast-twitch fibers (60 – 65% IIa)
- Not a single pure IIx fiber was found in any of these elite powerlifters
- World class powerlifters had 8% less slow-twitch (type I) fibers and 8% more IIa fibers than the national caliber powerlifters
- The world class lifters were 71% pure IIa, the highest concentration ever seen
- National level male lifters were 63% pure IIa, while national level females were 67% pure IIa
- A study they referenced found that 19 weeks of strength training in untrained subjects increased IIa fiber concentration from 46 to 60%

Galpin Fiber Typing MMA Fighter

- Did a muscle biopsy on a male MMA fighter that was ranked in the top 10 of the UFC's light-heavyweight division
- Fighter's muscle fiber distribution: 29% type I (slow), 66% type IIa (fast), and only 5% hybrid
- Compared to regular guys, the MMA fighter had nearly twice the amount of fast-twitch fibers, and about 1/6 the amount of hybrid fibers. ** more info on next page

- Slow-twitch fiber concentrations were pretty similar between all the groups (shown in the image below)



004: Training Fast Twitch Muscle Fibers with Dr. Andy Galpin- The PJF Podcast

- Fast-twitch fibers are 5 – 6x faster than slow-twitch fibers
- Compared to other animals, humans have the greatest ability to shift their fiber type from slow – fast and vice-versa
- One study compared two identical twins who had very different lifestyles. One had done marathons, ironmans, and other intense endurance training for the last 30 years, and the other was sedentary. After a muscle biopsy, the active twin was 95% slow-twitch (from his endurance training) and the lazy twin had a 50 / 50 fast / slow twitch muscle fiber distribution. This shows how dramatically training can affect fiber type, even when DNA is controlled for
- Fiber type is probably a better predictor of speed than strength
- Even if two athletes are equally fast-twitch, one can be faster / stronger than the other because of other factors
- Plyometrics, strength training, and speed training are all very good at increasing fast-twitch muscle fiber concentrations. Incorporating speed and plyos (instead of just lifting) works best because you're training both speed and strength
- Training should be high rest, low fatigue, short sets, max intent
- Hybrid muscle fibers (type I/Ia, type IIa/IIx, etc) tend to go away as you train– they get converted to pure fibers

- When comparing world class (Olympic) and national level powerlifters, they found a significant difference in Ila fiber concentration (world class athletes had more)

How to Train Fast Twitch Muscle Fibers

- From lifting heavy and / or going close to failure, all muscle fibers will be recruited
- Henneman size principle says that slow-twitch fibers are recruited first, then progressively more fast-twitch fibers as lift is taken closer to failure
- Well-trained athletes can recruit fast-twitch fibers immediately with explosive lifting
- To optimize your fast-twitch athleticism, strength train so you can generate a lot of force, but do power / speed training (sprinting, plyos, med ball work) so you can exert that force very quickly

How this type of training can impact your performance on the field

- We had a discussion with former top recruit and Oregon baseball commit JT Rican, and how training to become more explosive, powerful and fast twitch changed his career.
- “I came into highschool at 140 pounds, and graduated at 200 pounds. Training to be explosive not only helps you become faster and more explosive, but it also helps me become a lot stronger.”
- “My favorite lifts designed from this study for fast twitch were definitely RDL’s, Deadlifts, and Squats. Mastering the form with progressive overload (adding weight over time) changed the dynamic of my career. I was able to hit home-runs, run really fast, and also improve my arm strength. The most fascinating part of my journey was how this type of training affected all parts of my game as a player, even when in-directly training for it. My fastball velocity went from 78-92mph after 2 years of this training. Being able to generate a lot of force really quickly is a cornerstone for how to increase and maintain velocity on your fastball. Whether your a position player or a pitcher, recruiting more fast-twitch fibers are scientifically shown to be an essential element in taking your game to the next level. If you want to accomplish your dreams and play Division 1 baseball, training to be stronger, faster, and more explosive is going to get you there.

