Is there a speed and vertical jump gene?

When someone is born with great athletic ability many are quick to say, "It's all in the genes" It is true that qualities like speed and jumping ability can be highly influenced by genetic factors, but is there a single gene or combination of genes that identifies potential in events such as speed and vertical jump?

Well, scientists have identified a myriad of potential performance enhancing genes, and gene combinations work together to produce an enhanced or synergistic effect on performance. Genetic variants associated with over 200 genes are documented to effect athletic performance. They affect a variety of functions including blood flow to muscles, muscle structure, oxygen transport, lactate turnover, and energy production.

The thought is that an individuals genes can eventually be tested beforehand to identify potentially elite talent.

"The" Power Genes

The following 4 gene variants have been the most researched when it comes to to influencing power performance. They are the following:

ACE I/D, ACTN3 R577X, IL6 -174 G/C, and NOS3 -786T>C

Here is a bit of information about each one:

ACTN3: The alpha actin protein (ACTN3), or what some people are calling "*The Speed Gene*" is a component of the contractile apparatus in fast skeletal muscle fibers and is important for generating force at high velocity. The ACTN3 gene basically enhances the expression of high velocity fast twitch IIX fibers, important when jumping, sprinting, or doing anything else requiring force at high velocity.

Each person has 2 copies of the ACTN3 gene, with the R form expressing ACTN3 and the X form making it absent. Thus each person will have one of the following:

RR, XX, or R/X

People with the RR phenotype have 2 copies of the ACTN3, thus full ACTN3 expression.

People with XX have none, thus no ACTN3 expression.

People with R/X have one copy of R and one copy of X, thus they will express some ACTN3, just not full blown.

The RR genotype (2 copies) is associated with increased fast twitch fiber expression, particularly at high velocities - thus increased power.

The R/X genotype is a mix of both.

The XX variant (no copies) is associated with increased endurance.

The XX variant (no expression) occurs in 25% of Asians, 18% of europeans, and only 1% of africans, thus the vast majority of people have at least some ACTN3 expression.

ACTN3 has been called the speed gene because almost all top olympic caliber sprinters and power athletes have either the RR or R/X phenotype. There was one exception, an olympic long jumper was found to have the XX variant, thus no ACTN 3 expression.

How could someone competing in a "fast twitch" oriented sport rise to the top despite being at the low end of the fast twitch totem pole genetically?

Well, as I spend a lot of time demonstrating in VJ bible 2.0, factors such as body structure, tendon lengths, hormone levels, hormone sensitivity, and body composition are at least as important, if not moreso. Not to mention training and mental fortitude.

Moving on to the next gene:

ACE: The ACE gene, or angiotensin converting enzyme, influences constriction and dilation of blood vessels and thus impacts blood flow. It also has an association with fatigue resistance in skeletal muscle. The ACE gene is an insertion/deletion (I/D) element of the gene encoding ACE on chromosome 17. ACE influences circulatory homeostasis through the degradation of vasodilator bradykinin and generation of the vasopressor, angiotensin II (Ang II). There are 3 variations of the ACE gene and everyone has one. These are:

I/I (less ace)

D/D (lots of ace)

I/D (more ace than I/I, but less than D/D)

The I/I variant correlates to success in events requiring endurance and correlates with slow twitch fiber number, whereas the D/D genotype correlates to increased strength, power, and fast twitch fiber.

Now moving on:

IL-6: IL-6 is highly involved in inflammation. It is secreted by T cells and macrophages to stimulate immune response, e.g. during infection and after trauma, especially tissue damage leading to inflammation.

IL-6 also is elevated in response to muscle contraction. During exercise it is thought to act in a hormone-like manner to mobilize extracellular substrates and/or augment substrate delivery.

There are 3 different polymorphisms in the IL6 -174 G/C gene. These are G/G, G/C, and C/C. The G/G polymorphism tends to produce more IL-6 with C/C the least. More IL-6 means a tendency towards increased inflammation. Findings suggest that the G allele might favour sprint/power sports performance. Keep in mind that from an athletic perspective increased inflammation isn't necessarily always a bad thing. For example, the entire hypertrophy cascade is an inflammatory event.

Nos-3: nitric oxide is one of the main regulators of blood pressure and blood vessel dilation - two main factors found to be important for exercise performance. Exercising muscles require an increased delivery of oxygen and metabolic substrates

There are 3 different polymorphisms in the Nos3 -786 gene. These are C/C, T/C, and T/T. The T/T allele seems to exert a beneficial effect in power-oriented athletic events (throwing, jumping, sprinting), while the C/C polymorphism has been linked to performance in more endurance related sports, such as soccer.

Those above mentioned genes have probably been the most researched. The research arises not so much for how they influence athletic potential, but with how they may influence health.

Are "good" genes always a good thing?

What I find most interesting is that several of the polymophisms relating to speed and power (ACE, IL-6) also correlate to a decreased resistance to common health ailments such as obesity, heart disease, and diabetes. For example, ACE D/D genotype correlates with increased strength and power, but also correlates to an increased risk of obesity, heart disease, stroke, and high blood pressure. Increased IL-6 propensity correlates to increased risk of various inflammatory diseases and diabetes.

This makes sense from an evolutionary perspective. Genes enabling one to go hard and go fast would be best in a stressful environment where food must be hunted, fought for, and gathered. Those same genes could be a negative thing when facing a sedentary environment like the majority of people live in today. Thus, those with genes such as ACE D/D and IL6-174 G/G might have a natural advantage when it comes to whipping someones

butt, but they need to pay careful attention to minimizing the negative affects of their physiology in today's sedentary, high calorie environment.

Is it possible to identify athletic potential?

Now going back to the original question, is it possible to identify athletic potential solely off of genetic endowment? As of yet the answer to that is, "in theory only"

Spanish researchers studied what they considered an optimal profile of 6 power/speed specific genes(the above mentioned 4 plus a couple of others). One in 500 athletes had all 6 genes.

The vast majority of people, elite athletes included, have what could be called a typical genetic profile. One researcher selected 24 gene variants most often associated with sprinting or endurance prowess and looked for them in the genes of four men who have held the world record in the 100-meter dash and five who have held the world record in the marathon. What he saw was that based on those genes, the world-beaters are not much different from average at all. In fact, a non-athlete grad student was found to have a better genetic profile for sprinting than Usain Bolt. Environment also has a big impact on how individual genes get expressed.

As we stand now probably the best way to evaluate genetics is with a stopwatch and tape measure.

The Value of Genetic Testing

One value genetic testing has is it enables us to consider individual genetic endowment and develop a training program that will allow parts of it to be more optimal. Home testing kits are already available to test your genetic endowment for many health and performance markers. Services such as the gene testing kits enable you to identify and see hundreds of potential health impacting genes. This will be most useful not necessarily because it tells you whether you're going to be good or terrible at a certain sport, but it can help optimize your training and health promoting strategies.

For example, someone who lacks expression of the ACTN3 gene will likely find it advantageous to pay careful attention to anything that negatively impacts fast twitch fibers, such as excessive conditioning and volume of higher repetition training.

Someone with a less than optimal IL-6 gene will want to pay attention to excessive inflammation by paying attention to things like fish oil intake.

The Apoe gene is a gene involved in brain recovery from trauma. People with a certain type of Apoe gene have an 8x greater risk of alzheimers and are much more apt to suffer

problems from brain injury or concussions. Someone with this particular gene might be better off avoiding contact sports like combat sports, football, or hockey.

The Future

The future of sport likely involves gene doping. For example, virtually everyone has heard of EPO, the endurance drug that increases red blood cell count. Administration of exogenous EPO will eventually be replaced by the introduction of an EPO-related gene that directly targets the production of EPO.

I have no doubt that one day parents will be paying big bucks to engineer their elite genetic offspring athletes in test tubes, however, as of now (2013) there's not much you can do other than work with what you have and bust your butt. We are at the point where it is possible to identify some of what you might have to work with and we're probably not far from the point where evaluating someones genetic makeup prior to embarking on a training program in order to optimize it will be as common as trainers having their clients go thru a movement and strength assessment now.