DNA FITNESS genes Single Nucleotide Polymorphism (SNP)

Everyone has sections of DNA that are unique to that particular individual. One kind of such genetic variation is called single nucleotide polymorphism (SNP) located at a very specific location. These variations in individual's genetic material may be beneficial in some circumstances, and problematic in others. Some SNPs have been very strongly associated with body's response to physical activity.

ACTN3 gene encodes alpha-actinin 3 protein which is very important for muscle function. Muscle tissue consists of two types of muscle cells: slow twitch and fast twitch. Slow twitch cells have been shown to be important for endurance type of activities due to larger number of mitochondria and myoglobin present. These cellular components help to utilize oxygen more efficiently to generate energy and prevent lactate build up. This allows a person to exercise for long periods of time before experiencing fatigue. The fast twitch muscle fibers are capable of producing force more rapidly therefore being beneficial for the sprint or power performance. Alpha-actinin 3 protein has been associated with the fast twitch muscles. People who produce an active form of the protein have the C/C polymorphism and have sprint and power abilities. The T/T variation prevents the synthesis of the protein and results in improved endurance performance. People with C/T combination have been shown to retain some characteristics of both. While in the general population a person with a C/C allele would be better suited for the workout routine like circuit training, a person with a T/T genotype would do better with endurance type of the work out.

ADRB2 (beta-2 adrenergic receptor) protein is expressed in fat cells and activates the breakdown of fats in response to specific hormones. This regulating mechanism is affected by both amount of exercise and body weight. A variation in codon 27 in ADRB2 gene can result in reduced fat break down causing accumulation of fat. Scientific research has indicated that people who have G/G genotype can have up to 20 kg (40 lb) of excess weight and up to 50% increase in the size of fat cells compared to people with C/G or C/C genotypes. It was established that people who exercise regularly are not affected by this genetic variation. For people who would like to start exercising for weight loss purposes, aerobic activity is recommended as the most effective way to decrease body fat in addition to strength training to keep up the healthy muscle mass. Scientific studies show that people who have G allele at codon 16 (i.e. G/G or G/A) and G/G allele at codon 27 will respond more favorably to exercise. They will have greater stroke volume, cardiac output and increased vasodialation. Additionally, people with this genotype possess an improved ability to clear fluid from lungs resulting in ability to perform longer and more intense workout routine.

Several SNPs of this gene have been identified; two of the main ones are in codon 16 and codon 27. There are many studies that show a relationship between the codon 27 allele G and codon 16 allele G carriers and abdominal and central obesity. In some such studies that focused on the overfeeding of identical twins, codon 27 G/G was found to be a risk allele, with individuals having higher weight gain and subcutaneous fat compared to individuals with the C/C genotype. Other studies suggest that the codon 27 G allele is related to an increased risk of obesity and abdominal obesity with a high carbohydrate diet. In scientific studies, people who are carriers of a G allele for codon 16, have been found to be more resistant to weight loss and were at higher risk to gain it back after 6 months.