ISSA INTERNATIONAL SPORTS SCIENCES ASSOCIATION
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GENETICS-BASED
Program Design Report

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Report Summary

Weightloss

Weight Loss Tendency

FTO, TCF7L2, MTNR1B, PPARG, BDNF, ABCB11

Fat Loss Response To Cardio

ADRB2, LPL

Body Composition Response To Strength Training

NRXN3, GNPDA2, LRRN6C, PRKD1, GPRC5B, SLC39A8, FTO, FLJ35779, MAP2K5, QPCTL-GIPR, NEGR1, LRP1B, MTCH2, MTIF3, RPL27A, EC16B, FAIM2, FANCL, ETV5, TFAP2B

Food

Protein Utilization

FTO

Fat Utilization

PPARG, TCF7L2, APOA5, CRY2, MTNR1B, PPM1K

Carb Utilization

IRS1

Caffeine Metabolism

AHR, RP11-10017.3-001, ARID3B, CYP1A1

Cholesterol Response To Dietary Fat

LIPC

Polyunsaturated Fatty Acid Tendency

FADS1-2

Insulin Response To Dietary Fat

FTO, PPM1K

Report Summary

Nutrients

Vitamin B9 – Folate Tendency

MTHFR

Vitamin A Tendency

BCMO1

Vitamin B6 Tendency

NBPF3

Vitamin B12 Tendency

FUT2

Vitamin C Tendency

SLC23A1

Vitamin D Tendency

GC, NADSYN1, CYP2R1

Minerals

Iron Tendency

TRF2, HFE, HFE, TMPRSS6

Magnesium Tendency

MUC1, SHROOM3, TRPM6, DCDC5, ATP2B1, MECOM

Zinc Tendency

CA1, PPCDC, LINC01420

Calcium Tendency

CASR, DGKD, GCKR, LINC00709, CARS, LOC105370176, CYP24A1

Report Summary

Exercise

Hdl Response To Cardio

APOE

Glucose Response To Cardio

PPARG

Insulin Sensitivity Response To Cardio

LIPC

Trig Response To Cardio

CYYR1, GLT8D2, RBFOX1, ZNF385D

Mental and Physical Foundation

Intrinsic Motivation To Exercise

BDNF

Impulse Control And Taste Preference With Aging

FTO

Power and Endurance Potential

ACTN3, AGT, IL-6, NOS3, ACE, FTO, IGF1, GNB3, IL6-174

Training Response

VO2 Max

Exercise Heart Rate Response

Exercise Stroke Volume

Report Summary

AMPD1, APOE	CREB1	KIF5B

Recovery and Injury Risk

Systemic Inflammation

near CRP, APOC1 (APOE-CI-CII), HNF1A

Injury Risk

SPTBN1, MEPE, SLC25A13, MBL2/DKK1, LRP5, C18orf19

Sleep Duration

ABCC9, LOC101927400, DRD2

Weight Loss Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile is rated **NORMAL** for Weight Loss Tendency. Your score reflects the fact that your genotypes of the 7 genes investigated showed few, if any, of the unfavorable gene combinations. This means you likely would not exhibit a resistance to losing weight from a diet and exercise program. Thus you can expect to lose a usual amount of weight by cutting calories in your diet and burning extra calories through exercise. This result also suggests that you do not appear to have a greater-than normal chance of later regaining the weight you lose from a diet and exercise program.

Keep in mind that even though you may have a normal response to a lifestyle intervention, this doesn't mean that losing weight and keeping it off will be effortless. Not everyone loses the same amount of weight or body fat when they embark upon a diet and/or exercise program. Genetic predisposition can play a role, but a wide variety of other factors can also affect how much weight you lose and whether you maintain that weight loss over time.

While almost any diet will produce weight loss as long as you are cutting calories, the type of diet you choose can affect your ability to stick to a reduced- calorie diet. You might feel more full eating some foods over others, and therefore be less likely to overeat. Whole plant foods that are high in fiber and water can help you feel satiated. Foods with a higher protein content, such as nuts, beans, whole grains and seeds, or lean meats and lean dairy can also help you feel satiated.

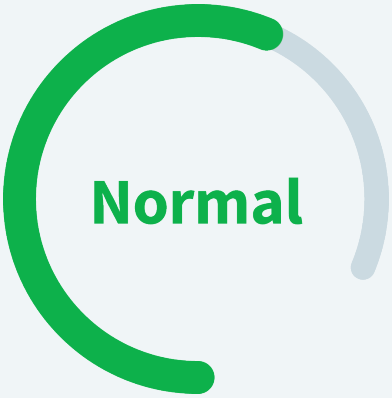
The type and amount of exercise you do can also affect the results you get. It's important to make sure you are following the most effective exercise prescription for you. Your results from the genetic analyses related to your responses to exercise will provide you with more guidance.

Once you lose weight, it is very common for most people to regain some weight after they lose it. Although your genotype suggests that you are less likely to regain weight, other factors also can affect your tendency to regain lost weight. Physiological changes occur as a result of the weight loss and these can encourage body fat regain. Research shows that continuing to exercise after you have lost weight appears to be one of the best ways to keep lost weight off.

SUCCESS STRATEGIES

Your genetic profile predicts that you can expect a favorable result from a regular diet and exercise program.

Keep in mind that weight loss is the result of sticking to a plan, and many personal factors can affect your ability to stick to a program. If you get busy and don't stick to an exercise routine, or if you don't remove the triggers that cause you to overeat, your results can be affected. It's important to implement behavior changes that help you succeed. You may already have identified some strategies that help you to diet and exercise. Here are some tips to help you stay with the program.



Your genetic profile indicate that your weight loss tendency is Normal

You can expect to successfully lose weight and keep it off if you stick to a well-planned program of diet and exercise.

Related Gene / SNPs

FTO	TCF7L2	MTNR1B
PPARG	BDNF	ABCB11

TIPS TO AVOID OVEREATING:

- Use smaller plates to control portion sizes.
- Avoid buying splurge foods and keeping them in your kitchen cabinets.
- Drink a glass of water before a meal and have a light vegetable soup as a starter to help eat less during the main course.
- When you go on a diet, choose foods that are similar to, but healthier than your usual diet so that you can easily continue eating more healthfully once you are 'off' the diet
- Identify obstacles that prevent you from choosing healthful food choices.

TIPS TO STICK TO REGULAR EXERCISE:

- Schedule workouts just like you would any other appointment.
- On days that you want to skip a workout, make yourself walk outside or on the treadmill for at least 15 to 20 minutes.
- Enlist your spouse or a friend to be a workout buddy at least twice a week.

Exercise is a crucial component of any weight-reduction plan, since by burning calories you can reduce body fat, and by strengthening muscles you can improve body shape and strength. But you need to make sure to do it right; if you exercise but do not do enough or do the right type that leads to weight loss, your results may be less than expected. For best weight loss results from exercise, you should exercise for at least 150 to 300 minutes per week.

Study your GxSlim results in the FOOD and EXERCISE categories. They will give you more insight into what could be the most favorable type of diet and exercise plan that you should follow.

Genetic Research

The genes and their associated SNPs that are included in this category have all been shown in scientifically sound studies to have statistically significant associations with a person's tendency to lose weight and keep it off. Several large studies have shown that people who participated in intensive and long-term diet and exercise programs exhibited significantly different weight loss responses based upon their genetic profile. Those people who carried the most 'unfavorable' pairs of these 7 genes lost weight with the diet and exercise program—but, on average, they tended to lose less weight compared to other participants who had fewer, or who did not carry the 'unfavorable' genotypes. Also, after completing the diet and exercise program, people with more of the 'unfavorable' genes were, on average, also likely to regain some of the weight that they had lost. Keep in mind, however, that great individual variation is seen in research studies like these. The stated results are an average of all those withina group, but there can still be differences even among those with the same genotype.
Our analysis investigated which genotype for each of these 7 genes was present in your DNA. Your rating of either **NORMAL** or **BELOW AVERAGE** reflects whether your genotypes included those that carried a risk of reduced weight loss tendency.

Fat Loss Response to Cardio

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits an **ENHANCED** fat loss response to cardio. Your score reflects the fact that your genotype showed 'favorable' gene combinations. This means that, based on your genes, you likely would show a slightly higher fat loss response to a basic cardio exercise program than other genotypes. Thus you can expect to lose a usual to higher amount of body fat by participating in cardio exercise that is of a moderate-to-vigorous intensity.

Even though you may have an enhanced response to a lifestyle intervention, this doesn't mean that losing body fat and keeping it off will be effortless. Not everyone loses the same amount of body fat when they embark upon an exercise program. Genetic predisposition plays a role in fat loss, but other factors can also affect how much fat you lose. You can experience greater fat loss by exercising longer, and/or at a higher intensity.

SUCCESS STRATEGIES

Your genetic profile predicts that you can expect a favorable fat-loss result from doing at least 150-250 minutes of cardio exercise 3-5 days per week, working out at a moderate-to-high intensity.

- If you want to see greater fat loss benefits from exercise, you should increase one or all of the following: the number of days per week you exercise, the length of time of your exercise session, and/or the intensity of your exercise session. See What You Should Know About Exercise [give link] and find ideas on how to experience greater fat loss in the Exercise section of this portal. [give link]
- Make sure to include muscle-strengthening moves such as squats, lunges and upper body exercises with weight on at least 2 days per week.
- Begin your cardiovascular exercise session in a semi-fasted state; First thing in the morning or 3-5 hours since your last meal/caloric drink.

Your genetic profile indicates that your fat loss response to cardio is Enhanced

You should experience slightly more fat loss than other genotypes when performing cardio exercise 3-5 days per week for a total of 90 to 150-250 minutes. Examples of what this type of exercise plan would look like are either several exercise dance classes and 1 an indoor cycling class per week, or 3-5 sessions in a week walking or climbing briskly on a treadmill or elliptical trainer for 30 to 50-60 minutes.

Related Gene / SNPs

ADRB2 LPL

Genetic Research

The genes and their associated SNPs that are included in this category have been shown in a study to have significant associations with a person's ability to lose fat from a regular program of 3 days per week of cardio exercise. A large study investigating these genes put sedentary men and women on a 20-week cardio exercise program. The study volunteers exercised on a bike 3 times per week, starting at a moderate intensity for 30 minutes per session over the first few weeks. They built up to a longer, slightly harder workout that lasted 50 minutes for the last 6 of the 20 weeks. Men in the study did not appear to have a different response based on their genotype. Women's fat loss was influenced by genotype, however. Women who carried the most 'favorable' genotypes lost slightly more fat in response to a cardio exercise program than those who did not carry these 'favorable' genotypes. Our genetic analysis investigated which genotype for each of these genes was present in your DNA. Your rating of either **NORMAL** or **ENHANCED** reflects whether your genotypes included those that carried an enhanced fat loss response from a regular program of cardio exercise.

Body Composition Response to Strength Training

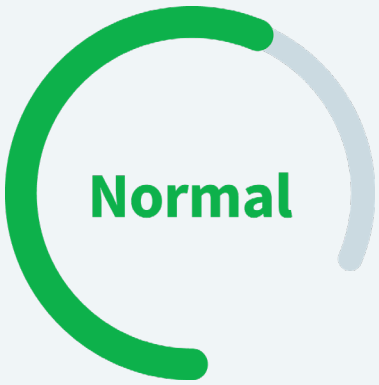
WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a **NORMAL** body composition response to muscle-strengthening exercise. Your score reflects the fact that your genotype showed a few of the 'unfavorable' gene combinations. This means that you are likely to experience some weight loss and reduced body fat from weight training, but not as much as someone with a more favorable genotype might. Since cardio exercise does result in greater amounts of weight and fat loss, make sure to include it in your weekly routine.

SUCCESS STRATEGIES

Although resistance training does improve strength and the amount of muscle mass a person has, it does not typically burn enough calories to cause clinically-significant weight loss or fat loss unless it is done in an interval style. For example, do an upper body exercise such as a chest/pectoral muscle exercise followed by a lower body exercise such as squats, followed by another upper body exercise, back to another lower body exercise, without taking rest time between sets. Heart rate will be elevated by having to move the blood volume from the upper body to the lower body and back to upper body, etc, in order to provide oxygen to the working muscle groups, as well as increasing caloric burn. For optimal body composition with less body fat, you should include 250 to 350 minutes of cardio on most days of the week and adhere to a healthy, reduced-calorie diet.

You may also benefit from trying different forms of resistance training. Barbell-type workouts that focus on challenging weights with high reps may produce a greater calorie burn that results in more fat loss. Kettlebell workouts may provide a more endurance-based approach that leads to a greater calorie burn.



Your genetic profile indicates that your body composition response to strength training is **Normal**

You are likely to lower your body fat percentage with weight training, but not as much as someone with a more favorable genotype. For optimal weight and fat loss results, make sure to include cardio workouts on most days of the week, along with challenging resistance training sessions

Related Gene / SNPs

NRXN3	GNPDA2	LRRN6C
PRKD1	GPRC5B	SLC39A8
FTO	FLJ35779	MAP2K5
QPCTL-GIPR	NEGR1	LRP1B
MTCH2	MTIF3	RPL27A
SEC16B	FAIM2	FANCL
ETV5	TFAP2B	

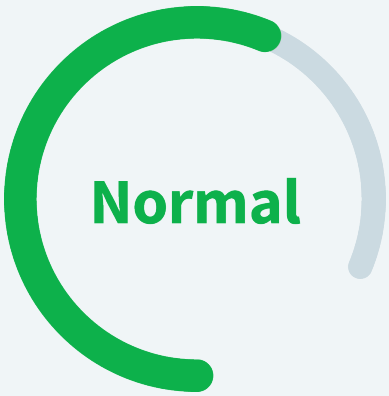
Genetic Research

The genes and their associated SNPs that are included in this category all have been shown to have significant associations with a person's ability to improve their body composition and decrease their body fat percentage from resistance exercise. Resistance training, or weight training, improves strength and the amount of muscle a person has. Weight training can also reduce the percentage, and sometimes amounts, of body fat. An improved body composition, which is a higher proportion of muscle to body fat, contributes to a leaner look and, potentially, a greater number of calories burned each day. Although resistance training alone has not been shown to produce clinically significant weight loss (because weights workouts do not burn as many calories as cardio), people with the more 'favorable' genotype in a large study experienced an improved ability to lose weight and reduce their body fat percentage with resistance training. Those with the 'unfavorable' genotypes showed a decreased ability to lose weight and reduce body fat percentage from resistance training. When you are trying to lose weight, it is very important to include resistance training in your routine. Resistance training can minimize or prevent that loss of muscle mass that occurs with weight loss when you are dieting. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of either **ENHANCED**, **NORMAL** or **BELOW AVERAGE** reflects whether your genotypes included those that carried a risk of an enhanced or reduced body composition response to strength training.

Protein Utilization

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a **NORMAL** utilization of protein. Your score reflects the fact that your genotype did not carry the allele combinations that seem to influence weight loss and lean body mass loss in response to the percentage of protein in the diet. This suggests that the amount of weight or body fat that you lose from a diet is not likely to be affected by the percentage of protein that you eat.



Your genetic profile indicates that your response is **Normal**

This indicates that the amount of weight you lose from a diet is not likely to be affected by the percentage of protein that you eat. Choose a diet that is 10 to 30% protein from plant or animal food sources.

SUCCESS STRATEGIES

Your genotype suggests that you are not likely to be affected in terms of greater or lesser amounts of weight loss from eating either a lower or a higher protein diet. However, it is important to note that the percentage of protein that you should eat is relative to the total amount of daily calories you take in, and so what is a “low” vs “high” amount can vary depending upon how many calories you ingest overall.

The body must get a certain minimum amount of protein for normal functioning, and that is considered to be around 10% of total daily calories when you are eating enough food to meet your daily energy needs. This minimum amount of protein must be eaten to support processes such as enzyme and hormone production, cell repair and synthesis of skin and hair cells. But this means that when you cut calories by dieting, you may need to opt for a slightly higher percentage of protein because you are eating less food overall.

On the other hand, eating a high percentage of protein is not necessarily beneficial, especially if you are not dieting. This is because excess protein is not stored in the body. If you consume more calories than you burn, the insulin release that is triggered by dietary protein (as well as by carbohydrates) spurs any excess amino acids from protein to be converted to body fat.

If you are dieting and therefore eating a reduced-calorie diet, consuming a “high” percentage of protein is recommended so that you make sure to obtain the minimum amount your body needs. The recommended daily allowance for protein is determined based on your body weight.

It’s a good idea to get a sense of how much you are getting by recording your food intake for at least a week and entering it into a diet app or online nutrition log that can calculate the percentage of each of the macronutrients you eat.

SUGGESTED PROTEINS

suggested servings contain listed grams of protein

- Chicken Breast (3oz) - 25g
- Ground Turkey (3oz) - 22.5g
- Lean Beef (3oz) - 22g
- Broiled Fish (3oz) - 20g
- Lentils/Black Beans (1/2c) - 9g
- Turkey (3oz) - 24g
- Pork/Lean Ham (3oz) - 18g
- Lamb (3oz) - 21g
- Quinoa (1/2c) - 12g
- Tofu (1/2c - 4.4oz) - 11g

Related Gene / SNPs

FTO LCT

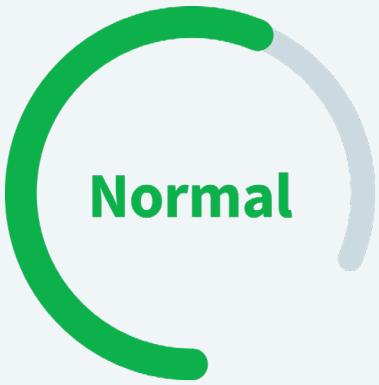
Genetic Research

The gene and associated SNPs included in this category has consistently been shown to be associated with body fat mass and BMI. One large study found that people with the unfavorable genotype who dieted lost more weight, body fat and fat in the torso if they ate a moderate-to-high protein diet (25% or more of total daily calories) compared to a lower protein diet (15% of total daily calories), regardless of fat and carbohydrate distribution. However, they also lost more non-fat mass — which includes muscle — with the weight loss, even though they were eating a higher protein diet and exercising. Our analysis of your genes investigated which genotype for this SNP was present in your DNA. Your rating of either **NORMAL** or **ENHANCED** reflects whether your genotype included those alleles that exhibited protein sensitivity because their presence resulted in increased weight and fat loss on a moderate-to-high protein, reduced calorie diet.

Fat Utilization

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a **NORMAL** utilization of fat. Your score reflects the fact that for the genes investigated, your genotype showed few, if any, of the unfavorable allele combinations. **This means that you appear to have a normal ability to lose weight from a diet and exercise program, whether the diet that is low, moderate or high in fat, as long as you are eating fewer calories than you expend each day. This result also suggests that you have a normal level of fat oxidation, or fat-burning ability in response to different levels of fat in your diet.**



Your genetic profile indicates that your utilization of fat is **Normal**

If you are dieting, or reducing calories to create a negative energy balance, you can expect to lose similar amounts of weight on either a low or a moderate fat diet.

SUCCESS STRATEGIES

While you may experience similar results in terms of weight loss from following a reduced-calorie diet, no matter if it is low, moderate or high in fat, you may still be sensitive to other effects that higher intakes of fat may have on the body, especially from saturated fat from animal foods. It's tough to know how much fat you are consuming unless you are actively tracking what you eat and entering it into a diet app or online nutrition log. You might find it helpful to first determine how much fat you are currently eating so that you can identify ways to keep it at desired levels.

If you choose to eat higher-fat foods, be mindful of their high energy density. Since fat contains more calories per gram compared to the other macronutrients, foods and meals that are high in fat tend to have more calories. This makes it easier to overeat because you can easily consume more calories than you may realize.

While your genetic profile suggests that you may be better able at handling higher levels of fat when you diet, if you are trying to lose weight, you will still need to reduce the number of calories that you eat. You may still need to reduce how much of these foods that you eat. You may be better able to handle a high-fat food, but if you are trying to lose weight, limit yourself to a small portion of the food.

SUGGESTED FATS

suggested servings contain listed grams of fat

Avocado (1/2 fruit) - 10g

Coconut Oil (1T) - 14g

Olive Oil (1T) - 14g

Nut Butters (1T) - 8g

Coconut (1 piece, 2" x 2" x 1/2") - 15g

Olives (1T) - .9g

Nuts/Seeds (1/4c) - 13g

Butter (1T) - 12g

Oils (1T) - 14g

Related Gene / SNPs

PPARG TCF7L2 APOA5
CRY2 MTNR1B PPM1K

Genetic Research

The six genes and their associated SNPs that are included in this category all have been shown in scientifically sound studies to have statistically significant associations with how sensitive people are to eating a diet high in fat. In other words, these studies showed that the amount of fat in the diet affected how much weight individuals lost from a lifestyle intervention depending on the genotype at these genes. One study found that those people with an unfavorable genotype were more likely to have more body fat, a larger waist size and a higher BMI the more fat they ate, compared to others without the same genotypes. Another study found that people with a protective genotype appeared to be able to consume greater amounts of fat, but without exhibiting higher BMIs. Another study found that people who went on a low-calorie diet that was higher in fat lost less weight if they had an unfavorable genotype. Our analysis of your genes investigated which genotype for each of these 6 genes was present in your DNA. Your rating of either **NORMAL** or **LOW** reflects whether your genotypes included those that carried a risk of reduced weight loss ability from a diet that was high in fat.

Carb Utilization

WHAT YOUR GENES SAY ABOUT YOU:

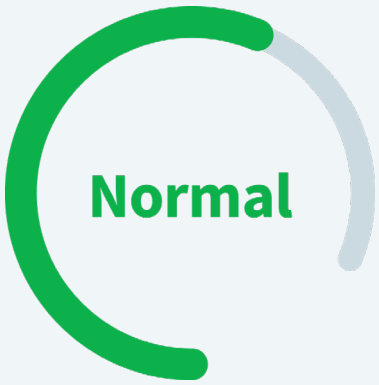
Our analysis indicates that your genetic profile exhibits a **NORMAL** utilization of complex carbohydrates. Your score reflects the fact that your genotype does not appear to produce greater weight loss with a higher complex carbohydrate diet, and you can expect to lose around the same amount of weight with either a low, moderate or higher complex carb diet. Complex carbs provide the most nutrients and fiber and, if you exercise, can provide you with longer-lasting energy.

SUCCESS STRATEGIES

To lose weight, your genotype suggests that you can lose weight with any reduced calorie diet, regardless of proportions of the macronutrients (fat, protein and carbs) as long as you reduce overall calories to less than you burn each day.

Study your results from the other Macronutrient genetic analyses for more guidance on the best type of diet to choose. Also, if you have certain health conditions, it may be optimal to adapt your eating choices based on established dietary recommendations for specific issues. For example, if you have health conditions like poor cholesterol or hypertension, a lower carb and higher fat diet may not be beneficial. You may experience more health benefits from a plant-based diet that is very low in fat from foods (such as meat, cheese and even avocado) or added fats (like oils and butter).

But remember, to achieve success with any approach, and to keep the weight you lose off for the long term, you must choose a plan that is easy to stick to. It's the long term adherence that will make a difference in how lean you are over time. Choose the type of plan that will help you maintain the healthier lifestyle changes that you make.



Your genetic profile indicates that your utilization of complex carbohydrates is **Normal**

This suggests that the percentage of complex carbohydrates in a reduced-calorie diet may not affect your weight loss results – you can expect to lose a similar amount of weight with either a low, moderate or high complex carbohydrate diet. Complex carbs provide the most nutrients and fiber and, if you exercise, can provide you with longer lasting energy.

Related Gene / SNPs

IRS1 FGF21

SUGGESTED CARBOHYDRATES

Preferred Vegetables - 1 1/2 cups raw or cooked contains 15g of carbohydrates

Artichoke
Asparagus
Bean sprouts
Beans (green, wax, Italian)
Beets
Broccoli
Brussels sprouts
Cabbage
Carrots
Cauliflower
Celery
Cucumber
Eggplant
Green onions or scallions
Greens (collard, kale, mustard, turnip)
Kohlrabi
Leeks
Mixed vegetables (no corn or peas)
Mushrooms
Okra
Onions
Pea pods
Peppers
Radishes
Salad greens
Sauerkraut
Spinach
Summer squash
Tomato (canned, sauce, juice)
Turnips
Water chestnuts
Watercress
Zucchini

Preferred Legumes (Beans) - 1/2 cup contains 15g of carbohydrates

Garbanzo/Chickpeas
Pinto beans
Northern beans
Fava/Broad beans
Kidney beans
White beans
Black beans
Split peas
Black-eyed peas
Lentils
Edamame beans
Navy beans
Mung

Preferred Starchy Vegetables - suggested serving size contains 15g of carbohydrates

Peas, green (1/2 c)

Red/New Potato, baked or boiled, 1 small (3 oz)

Yam, sweet potato, plain (1/2 c)

Squash, winter - acorn, butternut (1 c)

Genetic Research

The gene and associated SNPs included in this category has been shown to be associated with a person's insulin sensitivity and the potential effects of the amount of carbohydrates and fat in the diet. Insulin is a hormone released by the body that helps cells take in glucose, or sugar, for energy. Glucose is present in the blood after the digestion of carbohydrates from foods like fruit, vegetables, legumes and grains. Insulin is also released in response to eating protein as it helps to shuttle amino acids into cells, as well. Our body relies on glucose, and this is why blood sugar levels are maintained within a consistent range. In fact, brain cells and red blood cells use glucose as their primary source of energy. Cells also use fat as a fuel source, but to metabolize fat, there must be some glucose present to complete the process. Glucose is a very important nutrient. But sometimes cells do not respond to the insulin being released, a condition known as insulin resistance. The result is the bloodstream can be overloaded with glucose. Chronic high blood glucose levels can lead to diabetes, or uncontrolled high blood sugar. People who are overweight and/or physically inactive are at higher risk of insulin resistance. Since carbohydrate intake triggers insulin release, many people assume that eating more carbs is not healthy and can lead to body fat and weight gain, as well as diabetes. But the relationship is not that simple: many people who eat a high carbohydrate diet are not overweight and do not have diabetes, and, in fact, may have much lower levels of blood glucose. Several large epidemiological studies have shown that increased carb intake actually leads to a lower risk of diabetes and that, surprisingly, increased protein intake, increases the diabetes risk. The type of carbs you eat play a role: If you eat mostly processed carbs, you are likely to release greater amounts of insulin and this could affect your insulin resistance. The IRS1 gene in this category seems to influence insulin resistance and the body's response to carbs in the diet. One long term study found that people with a variant of this gene who ate a high carbohydrate, lower fat diet that consisted of high fiber, whole plant foods, as opposed to processed, lower fiber carbs, had greater insulin sensitivity—and low

Preferred Fruits - suggested serving size contains 15g of carbohydrates

Apple, unpeeled, 1 small (4 oz)

Apricots, fresh, 4 whole (5 1/2 oz)

Banana, small 1 (4 oz) Blackberries (3/4 c)

Blueberries (3/4 c)

Cantaloupe, small (1/3 melon or 1 c cubes)

Cherries, sweet, 12 fresh (3 oz)

Grapefruit, 1/2 large (11 oz)

Grapes, 17 small (3 oz)

Honeydew, 1 slice (10 oz or 1 c cubes)

Kiwi, one (3 1/2 oz)

Mango, small, 1/2 fruit (5 1/2 oz or 1/2 c)

Nectarine, 1 small (5 oz.)

Orange, 1 small (6 1/2 oz)

Papaya, 1/2 fruit (8 oz or 1 c cubes)

Peach, fresh, 1 medium (6 oz)

Pear, fresh, 1/2 large (4 oz)

Pineapple, fresh 3/4 c

Plums, 2 small (5 oz)

Raisins (2 T)

Raspberries (1 c)

Strawberries, whole berries (1 1/4c)

Tangerines, 2 small (8 oz)

Watermelon, 1 slice (13 1/2 oz or 1 1/4 c cubes)

Preferred Grains - 1/2 cup contains listed grams of carbohydrates

Couscous - 15g

Kamut - 26g

Quinoa - 28g

Barley - 22g

Oats - 15g

Amaranth - 23g

PROCESSED/LESS DESIRABLE CARBOHYDRATES

Less Desirable Starchy Vegetables

Mixed vegetables with corn or peas

Corn on the cob

Corn

Less Desirable Grains

Bread

Bagel

Pancake/Waffle

Cereal

Crackers

Rice

Pasta

Genetic Research

er levels of insulin and insulin resistance—and experienced greater weight loss compared to eating a lower carb, higher fat diet. Research also finds that variations of the FGF21 gene, which helps regulate carbohydrate intake and metabolism, influence how people lose weight in response to a high or low carbohydrate diet, with certain genotypes having a larger reduction in weight with a low carbohydrate diet and a lesser reduction in weight with a high carbohydrate diet. Our analysis of your genes investigated which genotype for this gene was present in your DNA. Your rating of either **LOW**, **NORMAL** or **ENHANCED** reflects whether your genotype included those genes that increase risk of reduced weight loss ability from a low carb, higher fat diet, , or if your genotype included those genes that responded more favorably to a lower carb diet.

Caffeine Metabolism

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a **SLOW** rate of caffeine metabolism. That means you do not have the liver enzymes to breakdown and metabolize caffeine at a normal rate, but rather it stays in your system for a prolonged period of time. Using caffeine before training or sporting events may not be beneficial for you, and caffeine may have detrimental effects on your health. It also puts you at risk for more serious side effects from the stimulant, including elevated blood pressure and heart attack risk.

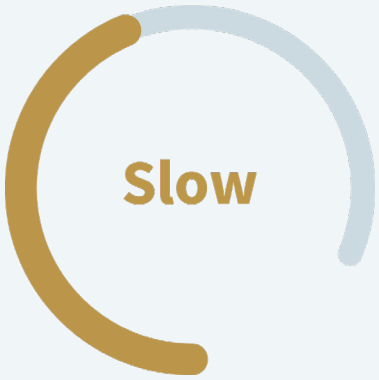
Research dating back to the '70s has consistently shown that caffeine can improve sports performance, particularly endurance performance, where the average improvement in exercise trials is about 24 percent in time to exhaustion and 3.1 percent in time to completion. It may also improve muscle power and endurance for power and sprint-based sports.

Caffeine primarily interacts with adenosine, a chemical in your central nervous system that regulates sleeping and waking. As adenosine accumulates, it inhibits nerve activity and causes drowsiness. Caffeine essentially blocks adenosine, preventing your nerve activity from slowing down, which increases alertness and brain activity and reduces tiredness, which benefits all sports performance. It also increases circulating epinephrine, the hormone responsible for your fight or flight response, which helps you feel physically and mentally keyed up to perform.

Caffeine use, however, does not benefit everyone equally. In one study of 35 trained male cyclists, caffeine decreased time on a 40 km time trial by nearly 4 minutes in those who had a favorable caffeine-metabolizing genotype, while those who were slow metabolizers improved their time by 1.3 minutes. Other exercise trials have reported that slow metabolizers saw no improvements, or in some case, had poorer outcomes than those of the same slow-metabolizing genotypes who didn't take caffeine.

More concerning is that caffeine can raise blood pressure and heart attack risk in slow caffeine metabolizers. Research published in the Journal of the American Medical Association (JAMA) has reported that for slow caffeine metabolizers, those who drank 2 to 3 cups of coffee a day had a 36 percent increased risk of heart attack, while those who drank 4 or more cups daily had a 64 percent increased risk.

As a slow caffeine metabolizer, you likely are already aware that you are sensitive to caffeine and are less likely to consume moderate to high amounts. If you choose to use caffeine as an ergogenic aid, keep the dose low—100 to 150 mg in the hours before training or competing—and be sure to keep tabs on your blood pressure if you use caffeine regularly.



Your genetic profile indicates that you are likely to have a Slow rate of caffeine metabolism.

This means you are not likely to benefit from the stimulant's ergogenic benefits as much as someone with a normal rate of caffeine metabolism and caffeine use may actually be detrimental to your health.

Related Gene / SNPs

AHR	RP11-10017.3 - 001
CYP1A1	AR1D3B

Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have significant associations with a person's ability to metabolize caffeine. Caffeine is well known and widely used as a legal stimulant. On the endurance front, caffeine increases the body's ability to use stored fat as fuel, which spares limited muscle glycogen (stored carbohydrate) stores. It also increases beta-endorphins to enhance feelings of wellness while also lowering your perceived exertion, so hard efforts feel easier. However, not everyone responds equally…or favorably. Some people suffer from negative caffeine side effects after one ill-timed cup of coffee, while others can drink several cups a day and feel fine. We now know this disparity is largely hereditary. Caffeine is rapidly absorbed into the bloodstream, with levels peaking after about 90 minutes and starting to drop off after about 3 to 4 hours. Caffeine eventually gets broken down in the liver by enzymes (Cytochrome P450 1A2, or CYP1A2) that metabolize the chemical. Depending on your genetic makeup, you will be able to metabolize caffeine at a normal rate, or your rate may be significantly slower. One study of 9,876 individuals found that variants in several genes were associated with slow caffeine metabolism (which was also associated with lower coffee consumption, indicating that people generally self regulate). Being a slow caffeine metabolizer means the caffeine stays in your system longer, which can have adverse effects such as increasing blood pressure and may increase the risk of heart attack. Slow metabolizers also do not enjoy the same level of ergogenic improvement as people who metabolize the drug normally. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **NORMAL** or **SLOW** reflects whether your genotype included those that carried a risk of adverse side effects in response to caffeine use or whether you are likely to benefit from using caffeine as an ergogenic aid.

Cholesterol Response To Dietary Fat

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a **NORMAL** cholesterol response to eating dietary fat. That means you may be less inclined to see significant changes in your cholesterol levels in response to a moderate or higher fat diet, which is in keeping with landmark studies, such as the Nurse's Health Study and the Health Professionals Follow Up Study, which found no link between overall percentage of calories from fat and heart disease. Not all fats are created equal, and it's wise to choose the healthiest types and minimize those that research shows may have negative health effects.

SUCCESS STRATEGIES

Unsaturated

Liquid at room temperature and generally considered heart healthy; found in plants like nuts, seeds, and vegetable oils and seafood. Focus your diet around these. Specific foods to include in your daily and/or weekly diet:

Olive oil — A study published in the journal Molecules reported that components of olive oil, including oleic acid and secoiridoids, protect your body on the cellular level and may help slow the aging process.

Fish — The new US Dietary Guidelines recommend eating 8 ounces per week to get healthy amounts of polyunsaturated omega-3 fatty acids, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), which fight inflammation and chronic disease.

Avocados — Animal research shows avocados may help lower inflammation, as well as improve cholesterol levels.

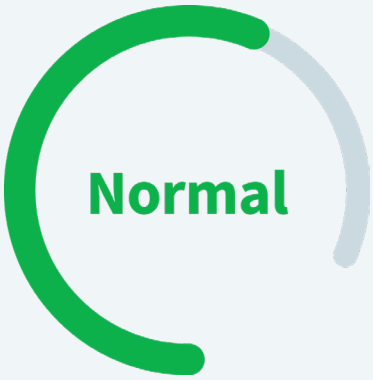
Tree nuts — According to a study in the British Journal of Nutrition, people who ate a daily one-ounce serving of nuts had a 50% lower rate of diabetes, a 30% reduction in heart disease and a nearly 50% lower incidence of stroke.

Saturated

Solid at room temperature and found in animal foods as well as coconut and palm oil; often deemed unhealthy for your heart, but research is equivocal, and some types may be beneficial. Best to limit them—especially those found in processed meats like sausage and lunch meats—to smaller doses.

Trans

Liquid fats made solid through a process called hydrogenation; found in fried foods, baked goods and processed snack foods. These were banned from the food supply in 2015 and manufacturers were given 3 years to eliminate them.



Your genetic profile indicates that you are likely to have a **Normal** cholesterol response to eating dietary fat

We recommend that you chose a diet that is low— about 15 percent of your total daily calories—in fat and saturated fat. Focus on eating beneficial fats as part of your daily fat intake.

Related Gene / SNPs

LIPC

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's blood lipid response to eating dietary fat. Little in the nutrition landscape has been as rife with controversy and confusion as dietary fat. For decades, the brightest brains in medical science have debated, studied and scrutinized the impact the fat we eat has on our health, specifically our cholesterol levels and subsequent cardiovascular health. The results are mixed and consensus is very hard to come by. It's possible that the situation is so confounded because individual responses are just that, individual. A growing body of gene research indicates that variations in your genetic code may impact how your body responds to a host of dietary factors, including fat.
In one study, researchers measured the total cholesterol, triglycerides, LDL cholesterol, HDL cholesterol levels, and genotype of 743 overweight men and women and then asked them to eat either a high fat (40 percent of daily calories) or a low-fat (20 percent of daily calories) diet for two years, when they would retest their lipid levels.
At the end of the study, the men and women who carried the A allele form of this gene were particularly sensitive to dietary fat in that when they ate a low fat diet, their total and LDL cholesterol levels dropped compared to their peers with other genotypes. Conversely, when they ate a higher fat diet, their total and LDL cholesterol levels rose. Other studies have pinned increases in protective HDL cholesterol with other variations of the LIPC gene.
Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NORMAL**, **SENSITIVE** or **HIGHLY SENSITIVE** reflects whether or not your genotypes included those that increased your blood lipid sensitivity to dietary fat.

Polyunsaturated Fatty Acid Tendency

WHAT YOUR GENES SAY ABOUT YOU:

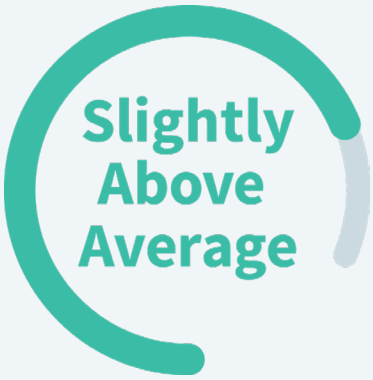
Our analysis indicates that your genetic profile exhibits characteristics that give you the likelihood of having **SLIGHTLY ABOVE AVERAGE** PUFA blood levels. Your genetic profile indicates that your body is likely efficient in converting and metabolizing the fatty acids you need. That's good news because there's a strong link between cardiovascular health and lower mortality and adequate levels of these essential fatty acids in the blood. It's still important to eat a PUFA-rich diet so you maintain healthy adequate levels of these protective essential fatty acids.

SUCCESS STRATEGIES

A tall and growing body of research indicates that the healthiest, longestliving people on the planet follow PUFA-rich diets such as the much-hailed Mediterranean diet, as well as the Japanese diet, which has recently been found to reduce the risk of mortality from all causes by 15 percent among those who follow it most closely. It appears especially good at decreasing risk for heart disease and stroke. Not surprisingly, the diet, which contains ample amounts of fish, soy foods and vegetables, is also rich in PUFAs.

The American Heart Association, along with PUFA research, supports a diet that gets about 5 to 10 percent of its energy from PUFAs like linoleic acid (LA) to reduce cardiovascular disease risk. You can maintain healthy levels by eating more nuts and seeds; swapping soy foods for animal protein at some meals and using olive, walnut and/or canola oil for drizzling on salads and side dishes. The US government also recommends increasing intake of foods rich in omega-3 fatty acids to balance omega-6/omega-3 fatty acids. Strive to eat 8 ounces of fish each week or increasing consumption of flaxseed, walnuts, Brussels sprouts or cauliflower or to improve levels of protective omega-3 fatty acids.

You should still avoid processed foods that are made with vegetable oils, as they not only tend to be low in nutritional value, but also PUFAs can be oxidized during processing, which may make them more harmful than healthful.



Your genetic profile indicates that you are likely to have a **Slightly Above Average** blood levels of PUFAs.

We recommend that you continue to eat PUFA-rich foods—especially in lieu of those that are high in saturated fats or simple carbohydrates—to maintain your PUFA blood levels, which can help lower your cholesterol and coronary artery and heart disease risk.

Related Gene / SNPs

FADS1-2

Genetic Research

The gene and its associated SNP that is included in this category has been shown in studies to have significant associations with a person's blood levels of polyunsaturated fatty acids (PUFAs).
Your body needs a certain amount of fat to perform all of its vital biological functions including produce certain hormones, absorb fat-soluble nutrients like vitamins A, D, E and K, and maintain your body temperature. Though your body is very good at storing fat, there are essential fatty acids, such as PUFAs, that need to be eaten in your diet to maintain healthy levels.
Polyunsaturated fats include omega-3 fatty acids and omega-6 fatty acids, are found in plants like nuts, seeds, and vegetable oils and seafood, and are generally considered heart healthy. Research shows a strong association between the levels of PUFAs in the blood and the status of a person's health. In a 16-year analysis of 2,700 older men and women, those with the highest omega-3 PUFA levels had a mortality rate 27 percent lower than those with the lowest levels. After age 65, those with the highest levels lived an average of 2.2 years longer than those with the lowest.
The level of these essential PUFAs in your bloodstream is largely determined by what you eat because your body cannot make its own. There is also some genetic influence to blood PUFA levels. Large scale meta-analysis gene studies have found a strong link between variations of the FADS1-2 genes and concentrations of PUFAs, particularly omega-3 fatty acid alpha-linolenic acid (ALA) and omega-6 fatty acid linoleic acid (LA), both of which have been linked to lower cholesterol levels and reduced risk for coronary artery and heart disease.
Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NORMAL**, **SLIGHTLY ABOVE AVERAGE** or **ABOVE AVERAGE** reflects the level of circulating PUFAs that are likely to be present in your blood.

Insulin Response To Dietary Fat

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a **NEUTRAL** insulin response to consuming dietary fat. That means you may experience more positive insulin sensitivity (and less insulin resistance) by eating a diet that is moderately higher in fat. The types of fat you choose still matter for insulin sensitivity and overall health, however, as do your carbohydrate choices.

SUCCESS STRATEGIES

The beauty of a moderate fat diet is that it is easy to do. You can pretty much eat what you want so long as you eat appropriate portions. That being said, research shows that unsaturated fats, particularly monounsaturated fats and polyunsaturated omega-3 fatty acids like those found in olive oil and fatty fish have a more positive influence on insulin response than saturated fats, like those found in meats (see Types of Fat in Cholesterol Response to Dietary Fat section for more on types of fats). So you would still be wise to skew your intake toward the healthier end of the fat spectrum. These swaps can help:

- Use olive oil instead of butter when cooking
- Eat fish or seafood at least twice a week
- Go meatless Monday (and maybe Tuesday); try bean and grain dishes and meat substitutes instead
- Choose dark chocolate, which contains healthy fats, for a sweet treat and/or dessert instead of sugary cakes and cookies.

Be choosy about your carbohydrates. Dietary fat has a lot of influence, but the carbs you eat are still very much key to maintaining healthy insulin response and blood sugar levels. A whole potato will always trump a potato chip in the health department. Avoid sugary, starchy refined carbohydrates, which can spike your insulin and set you up for insulin resistance overtime, and opt for slower digesting complex carbs. Good sources include whole plant foods such as fruits, vegetables, legumes, whole grains (such as brown rice, quinoa and oats), nuts and seeds.

Your genetic profile indicates that you are likely to have a **Neutral** insulin response to consuming dietary fat.

Following a more moderate fat diet that gets about 30% of its calories from fat will help you maintain healthy insulin sensitivity and blood sugar levels. Carbohydrates also play a major role in insulin response, so it is important to choose complex, healthier carbohydrates.

Related Gene / SNPs

FTO PPM1K

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's insulin response to eating dietary fat.

When most of us think insulin, we think sugar and carbs. However, dietary fat also drives insulin response and has long been vilified as contributing to insulin resistance and subsequent fat storage—especially deep in the abdomen where it wreaks havoc on metabolic health—and chronic conditions like diabetes and heart disease.

Low fat diets have been shown to help some people maintain healthy insulin sensitivity. As with many dietary interventions, however, they didn't and don't work for everyone. There are many reasons why, of course. The type of carbohydrates you replace fats with, how much protein you eat, how much you eat, how much you exercise and the type of fat you eat all factor into your insulin response. Research shows that there is a genetic component as well.

In a study published in The Journal of Nutrition, Boston-based researchers genotyped FTO (the gene associated with fat mass and obesity) variants among 743 overweight or obese men and women who were following either a high fat (40% of total calories) or a low fat (20% of total calories) diet for two years. In the end, regardless of how much weight they lost, those who carried certain FTO variations had less improvement in insulin sensitivity/resistance following a low fat diet than following a high fat diet—a finding that echoed an earlier European study, which also found risk allele carriers of FTO benefitted more from a high fat diet when it came to improving insulin resistance.

Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NEUTRAL**, **NOT SENSITIVE** or **SENSITIVE** reflects how your insulin sensitivity (a good thing, as it prevents/improves insulin resistance) responds when you consume dietary fat.

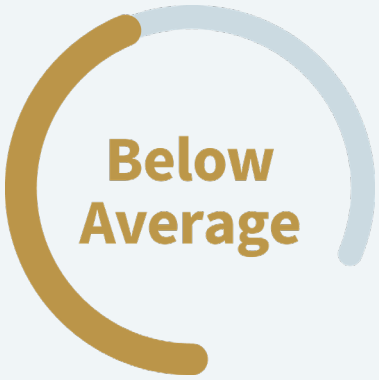
Vitamin B9 – Folate Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile is **BELOW AVERAGE**. Your score reflects the fact that your genotype showed a higher risk allele combination. This means you have a chance of having slightly reduced blood levels of folate. This suggests that you may be at risk for higher levels of homocysteine, which is a risk factor for heart disease, and your Vitamin B12 blood levels may be low.

SUCCESS STRATEGIES

- Since you may be at risk of having lower levels of folate, you may want to discuss with your physician whether you should get a blood test to check for folate-related conditions including anemia, as well Vitamin B12 and homocysteine status. Your genes only predict your risk, but a blood test can give you concrete information about your body levels of this nutrient.
- All women should ensure they get enough folate in their diet. Because you are at a risk of having lower levels, you may want to eat even greater amounts of folate. You will get folate that is added to whole grains in cereals and breads, but you should also eat natural food sources of folate. The foods highest in folate include legumes, fruits and vegetables, especially greens.
- Some of the folate in food is diminished with heat from cooking or oxidation during storage. To minimize potential losses, eat plant foods at every meal to make sure you get enough, eat fresh produce quickly after purchase, and incorporate some raw plant foods into your meals.
- You can also supplement your diet with folate. However, since low levels of Vitamin B12 can mask anemia if folate is taken, it is a good idea to supplement with both Vitamin B12 and folate.
- Smoking can also decrease folate levels. You may need to consume more if you smoke — or better yet, quit smoking!



Your genetic profile indicates that your response is **Below Average**

This suggests that you may have a chance of having slightly-reduced levels of folate. You may want to ask your doctor to take a blood test to assess your levels of serum folate, Vitamin B12 and homocysteine. If your levels are low, getting enough by eating plant foods every day and supplementing with folate may be beneficial.

Related Gene / SNPs

MTHFR

Genetic Research

This gene and its associated SNPs have been shown to have significant associations with a person's folate, or vitamin B9, status. Folate plays many important roles in the body, including acting as a coenzyme in DNA creation and in energy metabolism reactions. Folate also plays a role in biochemical processes that affect the metabolism of an amino acid, homocysteine. One SNP associated with this gene is associated with enzyme activity that can lead to higher levels of homocysteine. Since homocysteine is a risk factor for heart disease, high levels may be of concern. In child-bearing women, getting sufficient amounts of folate is important because low levels can lead to neural tube birth defects. As a public health measure, grains are fortified with folate to ensure that women of childbearing age get enough. Low levels of folate can also lead to anemia.
In studies on this gene, people who carried the most unfavorable pairs of genes, or alleles, had only a 10%-20% efficiency at processing folate. And those with the below average allele had a 60% efficiency at processing folate. People with more of the unfavorable alleles are more likely to have high homocysteine and low Vitamin B12 levels. Poor ability to process folate may be fairly common: Around 53% of women appear to have these unfavorable genotypes.

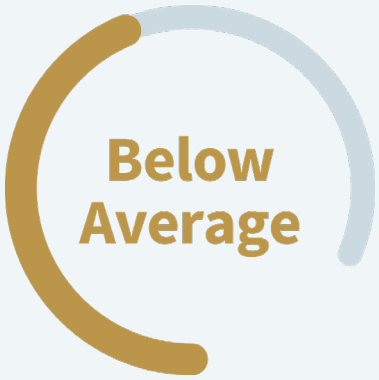
Vitamin A Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a **BELOW AVERAGE** ability to process Vitamin A from a beta-carotene supplement compared to others with a different genotype. Your score reflects the fact that, for the gene investigated, your genotype showed some of the allele combinations that resulted in less beta-carotene in supplement form being converted into Vitamin A as reflected in a blood test. This means that if you take high doses of a beta-carotene supplement, your ability to convert the nutrient into an active form of Vitamin A may be reduced compared to someone with a different genotype.

SUCCESS STRATEGIES

- You may want to request a blood test assessing your levels of Vitamin A from your doctor.
- Vitamin A is needed for good vision. Needs may increase in women who are pregnant or lactating. If your levels are low or your body is deficient, vision and other aspects of health can be affected. You may want to increase your intake of beta-carotene and Vitamin A-rich foods, and perhaps take Vitamin A supplements.
- If you do take a supplement, make sure not to exceed recommended levels of supplemental beta-carotene or Vitamin A, as toxicity can occur.
- Be aware that some medications, alcohol or health conditions may interact with Vitamin A supplements and cause adverse effects. Discuss supplementation with your doctor.



Your genetic profile indicates that your response is **Below Average**

This suggests that your ability to convert high doses of beta-carotene from a supplement into an active form of Vitamin A may be reduced. You may want to get a blood test to assess your blood levels of Vitamin A, and, if your levels are low, then consume more beta-carotene and Vitamin A-rich foods, or possibly take low-dose supplements if you are deficient.

Related Gene / SNPs

BCMO1

Genetic Research

The gene and its associated SNPs that are included in this category have been shown to have statistically significant associations with a person's blood levels of Vitamin A. Vitamin A promotes good vision, is involved in protein synthesis that affects skin and membrane tissues, and helps support reproduction and growth. The nutrient is found in plant foods in its precursor forms such as beta-carotene. Beta-carotene is converted by the body into different active forms of Vitamin A: retinol, retinal and retinoic acid. Animal foods, such as meat and dairy, provide the retinol form of Vitamin A.
It is rare to over-consume beta-carotene in plant foods to reach toxic levels. However, it is possible to consume toxic levels of Vitamin A from organ meats or fortified foods. Pregnant women are advised to eat liver no more than once every two weeks. Vitamin A in the form of beta-carotene is found in foods such as vegetables, especially leafy greens like spinach and orange foods such as carrots, sweet potatoes, apricots, mango and cantaloupe, as well as in the retinol form in dairy and in organ meats like liver.

Vitamin B6 Tendency

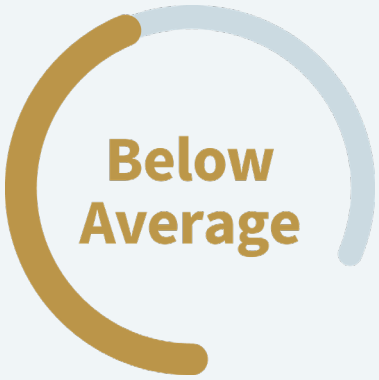
WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile response is **BELOW AVERAGE.** Your score reflects the fact that your genotype showed an unfavorable allele combination. This means that there is a risk that your blood levels of Vitamin B6 may be slightly lower than normal. Keep in mind that increased risk does not mean that your blood levels are low. You can only know this by requesting a blood test from your physician or other healthcare provider.

SUCCESS STRATEGIES

Since you are at risk for having lower levels of Vitamin B6 in your blood, make sure you get adequate amounts of this nutrient in your diet. Keep a food log using a dietary app to monitor how much Vitamin B6 you consume.

You may wish to ask your doctor for a blood test. If your blood tests show low levels, obtain more of this nutrient from foods or take a Vitamin B6 supplement. Be sure to avoid high doses of a supplement, as they can cause nerve damage.



Your genetic profile indicates that your response is **Below Average**

You may want to get a blood test to check your levels of Vitamin B6. Eat enough Vitamin B6-rich foods and consider supplementing if you are low.

Related Gene / SNPs

NBPF3

Genetic Research

The gene and its associated SNPs included in this category have been shown to have statistically significant associations with a person's blood levels of Vitamin B6. In one large study, people who carried the most unfavorable pairs of genes, or alleles had lower levels of Vitamin B6. Vitamin B6 is important for nerve cell function, energy metabolism and the production of hormones, such as serotonin and epinephrine. Low levels of B6 are also linked to higher levels of homocysteine, which increases heart disease risk. B6 is found in many foods including grains, legumes, vegetables, milk, eggs, fish, lean meat and flour products.

Vitamin B12 Tendency

WHAT YOUR GENES SAY ABOUT YOU:

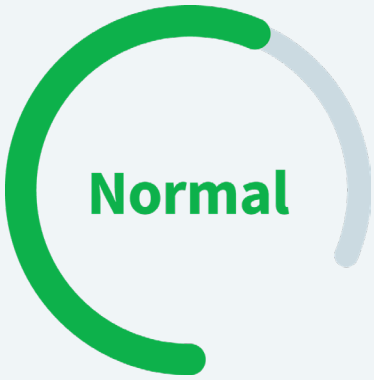
Our analysis indicates that your genetic profile is **NORMAL**. Your score reflects the fact that your genotype showed few, if any, of the unfavorable allele combinations. This suggests that, as long as you consume a healthy diet that includes Vitamin B12, you are likely to have normal blood levels of vitamin B12. Keep in mind, however, that vitamin B12 deficiencies can develop with some health conditions. Also, aging can result in poorer absorption of vitamin B12 from foods.

If you follow a plant-based vegan diet that does not include fortified foods, levels also can become low.

SUCCESS STRATEGIES

Getting a nutrient analysis of what you eat can give you an indication of how much of a nutrient you are consuming. Do periodic checks of your estimated vitamin B12 intake with a food log using a dietary app.

To assess how well nutrients in your foods are absorbed, it is a good idea to get periodic testing of your blood levels of vitamin B12. If absorption is impaired, your blood levels may be low and you may wish to supplement with B12.



Your genetic profile indicates that your response is **Normal**

This suggests that your blood levels of Vitamin B12 are likely to be normal.

Related Gene / SNPs

FUT2

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's blood levels of Vitamin B12. In one large study, those women who carried the most unfavorable pairs of genes, or alleles, had slightly lower levels of Vitamin B12 compared to others with more favorable genotypes. However, they were not deficient: their levels were still in the normal range, just on the low end. Around 70% of people have genotypes that suggest they may be at risk for having blood levels of B12 that are at the lower end of the normal range. There are several reasons why blood levels of B12 can be low. Some people do not get enough in their diet and so they are simply not getting enough of the nutrient. Some other people get enough, but do not absorb it efficiently. A small percentage of people over 50 or those who have had gastrointestinal surgery or GI disorders such as Crohn's disease may also have reduced abilities to absorb it. Research also indicates that around 30% of people have genotypes that suggest they may be predisposed to having higher than normal levels of vitamin B12. Their levels are not excessive, just on the high end of the normal range. Vitamin B12 is important for many processes in the body, including red blood cell formation, neurological function and cognitive performance. Deficiencies of B12 can cause pernicious anemia, and is also associated with high levels of homocysteine, which may impair arteries and increase risk of heart disease. There is some evidence that subclinical symptoms may be associated with being in the low end of the normal range. Vitamin B12 is produced by microorganisms found in soil and water, and in both the guts of animals and humans. In the modern world, highly-sanitized food processing systems have eliminated many naturally occurring sources of Vitamin B12-providing bacteria in plant products. Vitamin B12 is typically obtained from animal foods such as meat, or fortified foods such as dairy and plant milks. Certain mushrooms and seaweed may provide some Vitamin B12, but are not considered to be reliable sources.

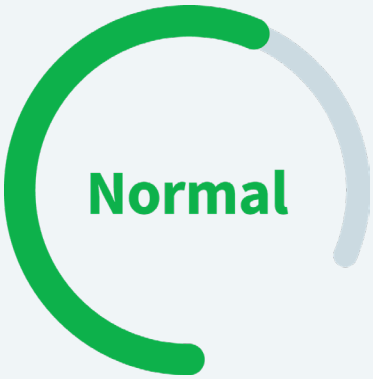
Vitamin C Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile suggests that you are likely to have **NORMAL** levels of Vitamin C. Your score reflects the fact that for the gene investigated, your genotype did not show the unfavorable allele combinations. This means that if you consume enough Vitamin C in the foods you eat, blood levels of L-ascorbic acid should be in the normal range. If you smoke, however, you may deplete some of your Vitamin C and may need more.

SUCCESS STRATEGIES

- To ensure your body gets the Vitamin C it needs, make sure to include a wide variety of plant foods, including citrus in your diet.
- If you wish to supplement with Vitamin C, avoid very high doses because they can cause diarrhea and gastrointestinal distress.



Your genetic profile indicates that your response is **Normal**

If you eat enough Vitamin C-rich foods, you should have normal levels in your blood.

Related Gene / SNPs

SLC23A1

Genetic Research

The gene and associated SNP included in this category has been shown to have statistically significant associations with a person's blood levels of L-ascorbic acid, or Vitamin C. Those people who carried more unfavorable pairs of genes, or alleles, were more likely to have lower blood levels of the nutrient. Vitamin C is a nutrient that has many functions in the body, including acting as an antioxidant, and is needed for skin and membrane tissues. Low levels have also been associated with diseases such as heart disease and cancer. Vitamin C also helps with the absorption of iron. The nutrient must be obtained from foods since the human body cannot make its own, as some other animals can. Vitamin C can be found in citrus fruits, but is also in many fruits, vegetables and legumes.

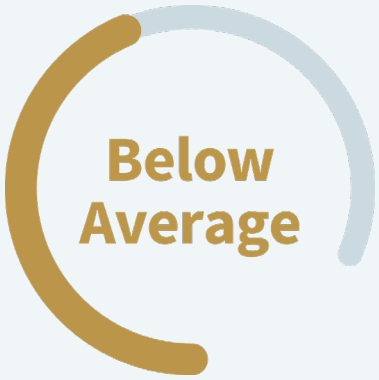
Vitamin D Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic response is **BELOW AVERAGE**. Your score reflects the fact that for the genes investigated, your genotype showed some of the unfavorable allele combinations. This means you have a risk of having low levels of Vitamin D. You will not know your actual levels, however, unless you obtain a blood test.

SUCCESS STRATEGIES

- Get tested! Even though you may be at risk of having low Vitamin D levels, you will not know if you do unless you get a blood test from your doctor.
- Expose yourself to the sun on most days of the week for at least 10 to 15 minutes (30 to 50 minutes if you have naturally dark skin). Spend more time outdoors in winter months, or if you live in northern latitudes.
- If you are deficient in Vitamin D, do a nutrient analysis to determine how much Vitamin D you consume, then eat more foods that contain Vitamin D.
- If you are low, you may wish to take a Vitamin D supplement. Avoid overly-high doses, unless by prescription through your doctor, as they may cause adverse effects.



Your genetic profile indicates that your response is **Below Average**

so your levels of Vitamin D may be low and possibly deficient. Get your blood tested for Vitamin D. If your levels are low, increase your sun exposure and add more Vitamin D-rich foods or supplements.

Related Gene / SNPs

GC NADSYN1 CYP2R1

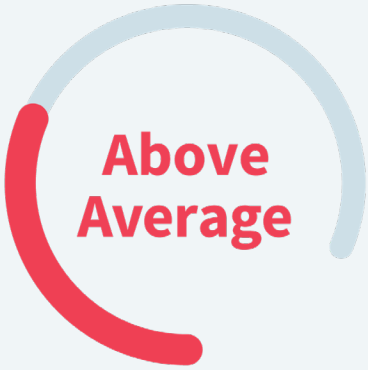
Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have statistically significant associations with a person's blood levels of Vitamin D (which is actually a hormone). One study found that several SNPs linked to low levels of Vitamin D were from genes that may play a role in the Vitamin D conversion and delivery process. Those people who carried unfavorable pairs of genes, or alleles, had a higher risk of low levels of Vitamin D, and those who carried several unfavorable SNPs had a much higher chance of being deficient in Vitamin D.
Vitamin D has been proven in research to be crucial for bone health. Low levels of Vitamin D have been associated with a variety of health conditions, including heart disease, diabetes, depression and cancer.
A blood test from your doctor can determine your blood levels of Vitamin D. Vitamin D is primarily produced by the body from exposure to ultraviolet rays from sunlight, and this is considered to be the optimal source since Vitamin D generated by the body lasts longer in the body than Vitamin D taken in supplement form. Your levels are likely to be higher if you live in the southern latitudes and during the summer. However, it is not uncommon for people with lots of exposure to the sun to still have low levels of Vitamin D. In general, only 10 to 15 minutes of sun exposure to bare skin per day during the summer months is needed for a Caucasian to produce the Vitamin D he or she needs. Darker skinned people will need to spend 2-5 times more time in the sun. Since Vitamin D is stored in the body, stores can be built up during warmer months and may compensate for less sun exposure during winter months.
Vitamin D can be obtained through foods such as oily fish and egg yolks, as well as fortified dairy and plant milks, and fortified cereals. Vitamin D can also be taken in supplements. If you test low and choose to take a Vitamin D supplement, be careful of taking higher doses because there can be adverse effects.

Iron Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to have **ABOVE AVERAGE** blood iron levels, a condition known as hemochromatosis, or iron overload from too much iron absorption and storage. That may be a cause for concern as high iron levels have been linked to a wide array of diseases including heart disease, cancer, diabetes, infections, arthritis and neurodegenerative disorders. In one study published in the journal Circulation, scientists found that men with genetic mutations that cause slightly elevated iron levels had a 2.3 fold increase in heart attack risk. Other research has found that women carrying the same high iron absorption and storage genetic predisposition were also at a higher risk for heart disease. Older adults, particularly Caucasians, should be particularly mindful of this genetic predisposition, as research shows they may already be at risk for storing excessive amounts of iron. Among the 1,106 white adults ages 67 to 96 in the Framingham Heart Study, 13 percent had high iron stores.



Your genetic profile indicates that you are likely to have Above Average blood iron levels – a hereditary condition called hemochromatosis.

This can be cause for concern because iron overload is hard on your organs and has been linked to a long list of chronic conditions and diseases. It's important to pay attention to your iron levels and iron intake, especially if you eat a lot of foods, such as meat, poultry and fish, that are rich in easily absorbed heme iron.

SUCCESS STRATEGIES

Even mild forms of hemochromatosis can be harmful, especially long term. Your physician can screen your iron levels with a series of blood tests that measure your hemoglobin and hematocrit levels, as well as your serum iron (the amount of iron in your blood); serum ferritin (the amount of the protein that helps store iron), and transferrin levels (total iron-binding capacity. Your doctor can work with you on strategies, such as chelation therapy, to keep your iron levels in check. Here are some diet and lifestyle modifications that may help as well.

Lean toward meatless meals. Animal foods are not only some of the best sources of iron, but also contain the most easily absorbed type of iron— heme iron. Plant foods, on the other hand, contain non-heme iron, which is less bioavailable in the body. If you're genetically predisposed to iron overload, eat meat more sparingly.

Avoid ironware. Cast iron pots and pans leech a lot of the mineral into your food as you cook. Choose other types of non-iron based cookware instead.

Give blood. Donating blood not only helps save other lives, it could help improve your health and extend yours if you are prone to high levels of iron. Becoming a regular blood donor can be an easy way to lower and control your levels of iron. If you have high iron, talk to your doctor about this option.

Related Gene / SNPs

TRF2 HFE TMPRSS6

Genetic Research

The genes and their associated SNPs included in this category have been shown to have significant associations with a person's blood iron levels.
Iron is a well-known essential nutrient that most of us associate with energy. That's because along with regulating cell growth and other metabolic functions, iron is vital for producing hemoglobin, a protein your red blood cells use to deliver oxygen throughout your body. Without enough oxygen, all your metabolic functions suffer. On the flip side, too much iron is toxic and can be equally, if not more damaging than having too little and may cause organ damage and raise your risk for diabetes, heart attack, neuro-degenerative conditions like Alzheimer's and cancer. Many factors influence your iron levels including diet, gender, age, and activity level. In premenopausal women, the primary cause of iron deficiency is heavy menstrual bleeding as blood loss means iron loss. High levels of physical activity— especially if it's particularly long and/or strenuous also may lead to a decline in iron levels, especially in women. Vegans and vegetarians also may be at risk for low iron levels, as the iron in plant-based foods (non-heme iron) is harder for the body to absorb than iron from animal sources (heme iron). Older adults, again especially women, generally need less iron to maintain healthy stores than men.
Your genes also may play a role, particularly in the tendency for above normal iron levels. Research has found that certain gene mutations may impact how much iron your body absorbs and recycles, creating borderline or high levels of iron in circulation. At the extreme end is a genetic disorder called hemochromatosis, which occurs in about 10 percent of white people of Northern European ancestry. People with this condition absorb three to four times as much iron from food as those without these genetic mutations. Other mutations can leave you susceptible to a more mild form of hemochromatosis, leading to accumulating slightly higher than average stores of iron.
Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **NORMAL** or **ABOVE AVERAGE** reflects whether your genotype included those alleles that were found to lead to a tendency of having normal or high levels of this essential mineral.

Magnesium Tendency

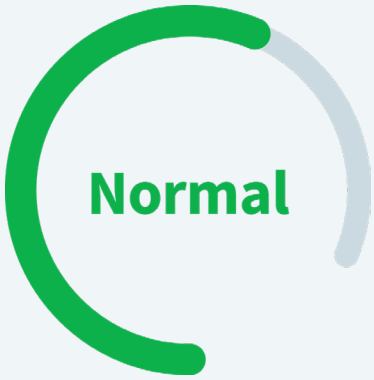
WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to have a **NORMAL** blood magnesium level. That's good news because magnesium plays an essential role in hundreds of biochemical processes including regulating blood sugar, blood pressure, muscle contraction and heart rhythm. As we age, our body's ability to absorb magnesium decreases, so it's important to eat plenty of magnesium-rich foods to maintain healthy levels of this essential mineral.

SUCCESS STRATEGIES

Maintain healthy blood magnesium levels by including magnesium-rich foods in your daily diet. Good sources include dark leafy greens, nuts and seeds, fatty fish, avocado, beans, whole grains, yogurt, soy foods and bananas. If you like dark chocolate, you're in luck. One 2-ounce chunk delivers about a quarter of your daily needs. Drink alcohol and coffee in moderation, as both of those can lower magnesium levels by blocking absorption and increasing excretion. Also, skip the soda. Sugary sodas are also linked to lowered magnesium levels.

Though too much magnesium from your diet doesn't pose a problem because your kidneys simply eliminate it in your urine, it is possible to overdo it from supplements and other sources. Overuse of laxatives or antacids can lead to high levels, which can cause diarrhea, nausea and abdominal cramping.



Your genetic profile indicates that you are likely to have **Normal** blood levels of magnesium.

You can maintain those healthy blood levels of this essential mineral by eating plenty of magnesium-rich foods and avoiding those that deplete it.

Related Gene / SNPs

MUC1 SHROOM3 TRPM6

DCDC5 ATP2B1 MDS1

Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have significant associations with a person's blood magnesium levels. Magnesium doesn't get much attention in mainstream nutrition circles, but it should. The mineral plays a critical role in blood sugar control, muscle contractions and heart rhythm and is involved in more than 300 biochemical reactions in your body. Some medical experts have recently dubbed magnesium deficiency the "invisible deficiency" because it's very difficult to pinpoint as the most common symptoms such as fatigue and muscle cramping are common side effects of many conditions. It's also very common. Studies show that only about a quarter of US adults get the 320 mg (women) to 420 mg (men) they need. Though only about 1 percent of your magnesium is found in your blood, low serum magnesium levels have been associated with multiple chronic diseases such as diabetes, heart disease and high blood pressure. Though low magnesium is generally a condition that occurs over time due to habitually low magnesium intake, high intakes of alcohol, soda and caffeine, and/or taking medications that interfere with its absorption can also cause levels to dip. There's also a genetic influence. Research shows that serum magnesium concentrations are about 27 % heritable. In one study of 15,366 men and women, researchers identified six gene variations that were associated with blood magnesium levels. These findings echoed those of another study that found these gene associations in both Caucasian and African American populations. The effects were most pronounced in postmenopausal women and/or people with low insulin levels.
Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **BELOW AVERAGE**, **NORMAL** or **ABOVE AVERAGE** reflects whether your genotype included those that carried a risk of having low levels of this essential mineral or whether you were likely to have adequate levels.

Zinc Tendency

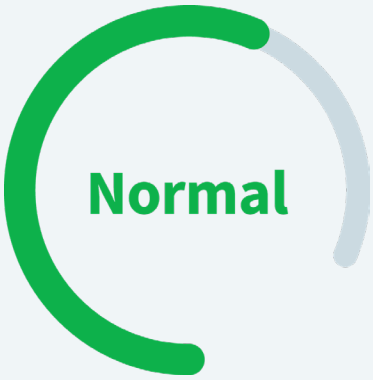
WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you the likelihood of having **NORMAL** blood zinc levels. That's good news because adequate levels of zinc help keep your immunity strong and can help protect you from both acute diseases like colds and infections as well as chronic conditions like heart disease and diabetes. Remember that genetics play just one role in your blood level zinc status and its still important to get enough of this essential mineral in your daily diet, especially if you're among the groups, like older adults and vegetarians, who may have a tendency to have a lower than adequate daily zinc intake.

SUCCESS STRATEGIES

Since our bodies don't store zinc, we need to eat adequate amounts in our diet every day. Most Americans do. However, a sizable percentage of the population falls short. National nutritional surveys show that up to 45 percent of adults over the age of 60 fall below the recommended amount. Vegetarians and vegans are also at risk for marginal amounts because zinc found in plant foods is harder for the body to absorb. In fact, some experts recommend that vegetarians aim to get 50% more zinc than the recommended dietary allowance to ensure their body gets the amounts it needs. For meat eaters, getting adequate amounts of zinc is easy, especially if you also like shellfish. Just three ounces of oysters delivers 74 mg, far and away more than any other food source. Other zinc-rich foods include lobster, crab, pork and chicken (dark meat especially). Zinc is also found in yogurt, baked beans, cashews, oatmeal, milk, kidney beans, almonds, chickpeas and fortified.

If you eat little or no meat, consider taking a multivitamin as a form of insurance for days when your diet may fall short. Getting zinc in a multivitamin is preferable to taking it alone, as too much zinc on its own can cause copper levels to drop. Multivitamins contain the right balance of both.



Your genetic profile indicates that you are likely to have **Normal** blood levels of zinc.

We recommend eating a diet rich in foods that are good sources of this essential mineral to continue getting the minimum 8 to 11 mg of zinc you need each day to maintain the zinc blood levels you need for strong immunity and healthy cellular function.

Related Gene / SNPs

CA1 PPCDC LINC01420

Genetic Research

The genes and their associated SNPs that are included in this category have all been shown to have significant associations with a person's blood levels of zinc.
Zinc is an essential trace element that plays a key role in immune function, protein synthesis, wound healing, insulin function, reproduction, thyroid function, blood clotting, growth, taste, vision and smell. After iron, it's the most common mineral in the body and is found in every cell.
You don't need much zinc to perform all these functions. The recommended dietary allowance for adults is just 8 mg (women) to 11 mg (men). But you do need zinc in your daily diet because the body doesn't store it.
Zinc deficiency hinders immune function and has been associated with cardiovascular disease and diabetes.
Though outright deficiency is uncommon in industrialized countries like America, there is evidence that relative zinc deficiency and marginal zinc levels may be somewhat common among certain populations, particularly among older people as well as vegetarians, since red meat and poultry provide the majority of zinc in the American diet and zinc from plant sources is slightly harder for the body to absorb. Taking too much zinc, which can happen when people supplement the mineral—a popular practice for staving off cold infections—can cause toxicity, which results in nausea, vomiting, GI distress, loss of appetite and headaches.
Genetics can influence a person's zinc blood levels. In one widespread analysis of more than 12,000 adults, genetic variations accounted for 8 percent of the variation in blood zinc levels. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **NORMAL** or **ABOVE AVERAGE** reflects the zinc lev-els that are likely to be present in your blood..

Calcium Tendency

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to have **NORMAL** blood levels of calcium. That means you likely have adequate circulating calcium in your bloodstream so your body doesn't have to leech it from your bones to maintain healthy cellular function. You should continue getting 1,000 mg (men) to 1,200 mg (women) of calcium a day through a vitamin and mineral-rich diet

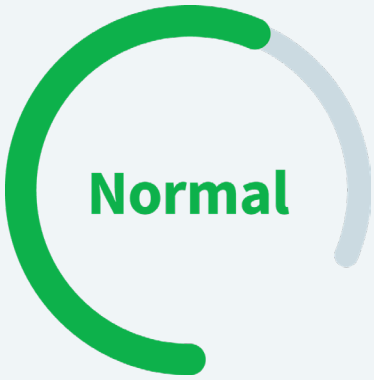
SUCCESS STRATEGIES

Our bodies become less adept at absorbing calcium as we age, so it's important to continue eating a diet that is rich in this essential mineral as well as to perform healthy lifestyle practices to keep your skeleton strong.

Consume more calcium. Some food sources of calcium are dairy, canned fish like salmon and sardines, tofu, almonds and fortified alternative milk products., as well as collard greens, kale and spinach.

Skip supplements. Calcium supplements have been the topic of considerable controversy in recent years. Some research finds that they are not useful for preventing fractures and may be linked to increase risk for heart disease. You can get plenty of calcium in your diet and your genotype does not call for additional amounts.

Stay active. Be sure to get regular "impact" exercise like jogging, tennis, or strength training. Your bones need some stress to get the signal to grow. Every time you load or add resistance to your bones, they release calcium into your blood. That calcium is then circulated and sent back to your bones which then grow and become stronger. So these activities help keep them strong. Strength training two or three days a week has also been shown in studies to help build and maintain bone density.



Your genetic profile indicates that you are inclined to have **Normal** blood levels of calcium.

Continue eating a healthy diet and maximize your skeletal health with bone-building lifestyle and exercise habits.

Related Gene / SNPs

CARS
DGKD
LINC00709
CASR
LOC105370176
GCKR
CYP24A1

Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have significant associations with a person's blood calcium levels. Calcium is the most plentiful mineral in the human body and is used by nearly every cell in the body. It's well known that the mineral is essential for maintaining skeletal and dental health, as your bones and teeth are where the lion's share of calcium is stored. Calcium also is required for nerve function, muscle contraction, hormone release and heart health. Your body keeps the amount of calcium circulating in your bloodstream within a certain range to allow all your specific cells to have what they need to perform their jobs. When those levels dip below that range, your body pulls what it needs from your skeleton. Over time that leads to weakened bones. Your calcium levels are influenced by your diet, how well your intestines absorb the calcium you take in, levels of phosphate in the body, your vitamin D levels and by levels of certain hormones like parathyroid hormone, calcitonin and estrogen. Emerging research also shows that your genotype may influence blood calcium levels. In one very large study of 39,400 men and women, researchers found variations in these genes had a significant impact on blood calcium levels, which echoes findings from previous animal research as well as a study of 1,747 twins that estimated heritability to be 33 percent for blood serum calcium levels. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **NORMAL** or **BELOW AVERAGE** reflects whether or not your genotypes included those that increased your risk for low blood calcium levels.

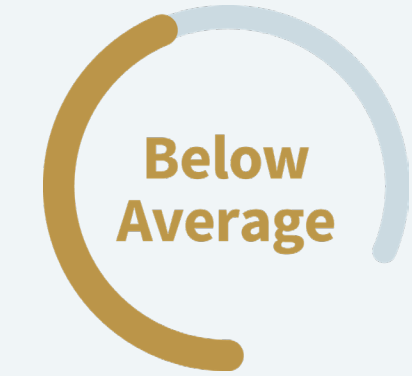
HDL Response To Cardio

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits a genotype that is rated **BELOW AVERAGE** for HDL response to cardio exercise. Your score reflects the fact that your genotype showed the 'unfavorable' gene combinations. This means that you are likely to see a boost in HDL levels from exercise, but it may be a small improvement.

SUCCESS STRATEGIES

- Aim to perform cardio exercise at least 5 to 7 days per week for 300 minutes or more.
- You may benefit from keeping other cholesterol levels, such as LDL, low. Reducing your intake of saturated fat may help, especially if your genotype was rated High Sensitivity to Fat.
- What you eat is crucial to help normalize all of your cholesterol levels. A diet high in fiber-filled plant foods, low in saturated animal fats and low in sugar & simple carbohydrates will help lower your total cholesterol, LDL cholesterol and triglyceride values. Incorporate more beans, nuts, fruits and vegetables into your diet, as all have been shown to improve cholesterol.



Your genetic profile indicates that your HDL response to cardio is **Below Average**

Aim to burn at least 1,500 to 2,000 calories per week by exercising at least 5 days per week. Perform longer cardio sessions and/or work at higher intensities. Keep other cholesterol levels in check by eating plenty of beans, nuts and other plant foods.

Related Gene / SNPs

APOE

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's HDL cholesterol response to cardio exercise. HDL is a protein particle in the blood that carries cholesterol to the liver, helping to clear it from the blood. Excess cholesterol lingering in the blood can contribute to plaque that causes heart disease. So having higher levels of HDL is beneficial—which is why it's considered "good" cholesterol. Even one session of cardio exercise can boost HDL, and regular exercisers tend to have higher HDL. This gene plays a role in the HDL response to cardio. One large study had men and women exercise for 30 to 50 minutes, 3 times a week for 5 months. Those people with the more ''favorable'' genotype experienced greater than average boosts to their HDL levels. Those with the 'unfavorable' genotype showed a decreased response: smaller increases in HDL. Our analysis investigated which genotype for this gene was present in your DNA. Your rating of either **ENHANCED**, **NORMAL** or **BELOW AVERAGE** reflects whether your genotypes included those that carried a risk of an enhanced or reduced HDL response to cardio exercise.

Glucose Response To Cardio

WHAT YOUR GENES SAY ABOUT YOU:

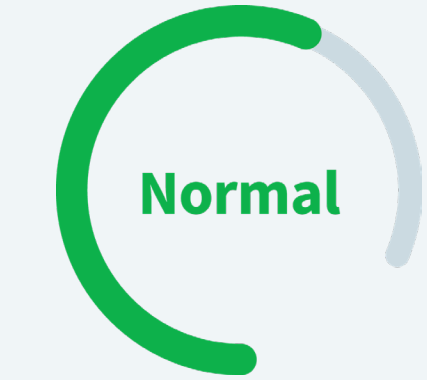
Our analysis indicates that your genetic profile exhibits a **NORMAL** glucose response to cardio exercise. Your score reflects the fact that your genotype showed the 'unfavorable' gene combinations. This means that you are likely to experience smaller decreases in glucose from doing cardio exercise at least 2 to 3 times per week.

SUCCESS STRATEGIES

Increasing the amount and intensity of exercise you do will help to improve your glucose regulation. Perform cardio on five or more days a week.

And rather than just performing moderate-intensity workouts, after you are fit enough to push a little harder, include more high-intensity minutes into your cardio workouts. Aim to work at an intensity level that leaves you slightly breathless and that feels 'hard.' After a few minutes, recover by continuing to move at an easier pace. Then pick up the intensity for a harder interval, again followed by an easier recovery interval.

- Incorporate resistance training to enhance your blood glucose response.
- What you eat also affects your blood glucose level. Increase the amount of fiber you eat by eating more whole plant foods at every meal. But make sure that these foods are unprocessed so that you obtain more nutrients and experience a lower glycemic response from the food.



Your genetic profile indicates that your glucose response to cardio is Normal

You are likely to experience minimal decreases in blood glucose from cardio exercise. However, you can boost your response by exercising 4 or more days per week, by working out at higher intensities and by adding resistance training to your routine.

Related Gene / SNPs

PPARG

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's glucose response to cardio exercise. Glucose is one of the body's main sources of energy and it comes from the breakdown of carbohydrates in the diet. Brain and nerve cells, as well as red blood cells, exclusively use glucose for energy. That's why blood glucose is maintained at constant levels—so that all the cells in the body that need it can access it. If blood glucose levels rise and stay high, eventually insulin resistance and diabetes can develop. Exercise helps regulate blood glucose levels because every session of exercise uses glucose in the muscle for energy, and the blood glucose supply is then tapped into to replenish the muscle reserves.This gene seems to play a role in the glucose response to cardio and appears to be a reliable indicator of whether exercise will have beneficial effects on insulin resistance. Several studies involved a variety of individuals, both diabetics and non-diabetics, performing regular cardio for 2 to 3 days per week for up to 5 months. Those people with the more 'favorable' genotype experienced greater-than average clearance of blood glucose. Those with the 'unfavorable' genotype showed a decreased response, or smaller drop in glucose levels. People with this genotype also had a decreased weight-loss ability—they loss less weight compared to people with different genotypes.
Our analysis investigated which genotype for this gene was present in your DNA. Your rating of either **ENHANCED** or **NORMAL** reflects whether your genotypes included those that carried a risk of an enhanced or reduced glucose response to cardio exercise.

Insulin Sensitivity Response To Cardio

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits an **ENHANCED** insulin sensitivity to cardio exercise. Your score reflects the fact that your genotype showed the 'favorable' gene combinations. This suggests that you are likely to see beneficial improvements to your insulin sensitivity if you exercise regularly.

SUCCESS STRATEGIES

- The more often you exercise, the greater the benefits. For optimal insulin response, perform cardio exercise at least three to four times a week and stick to it.
- Strength training can also improve insulin sensitivity, so include some form of resistance training, targeting all the major muscle groups as part of your weekly routine.

Your genetic profile indicates that your insulin sensitivity response to cardio is **Enhanced**

Performing 3 or more days of cardio per week should improve your glucose uptake. You can optimize these effects by working out more than three days per week and including resistance training in your workouts.

Related Gene / SNPs

LIPC

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's insulin sensitivity in response to cardio exercise. Insulin is a hormone that plays a crucial role in delivering glucose, a form of sugar, in the blood to cells in the body that use it for energy. In a healthy person, cells are sensitive to this action of insulin and blood glucose levels are kept in their optimal range. If insulin sensitivity declines, a person may become insulin resistant. This keeps blood glucose levels high and diabetes can develop.
Even one session of exercise can improve insulin sensitivity. Exercise also helps keep blood glucose levels low because exercising muscles can absorb glucose without needing insulin to do so. Exercise over time can prevent diabetes—and it can help those who already have it.
This gene seems to play a role in the insulin sensitivity response to cardio. One large study had men and women perform cardio exercise at a moderate- to- high intensity for 30 to 50 minutes, 3 times a week. Those people with the more 'favorable' genotype experienced greater than average improvements in their insulin sensitivity. Those with the 'unfavorable' genotype were less likely to improve their insulin sensitivity by exercise.
Our analysis investigated which genotype for this gene was present in your DNA. Your rating of either **ENHANCED**, **NORMAL** or **BELOW AVERAGE** reflects whether your genotypes included those that carried a risk of an enhanced or reduced insulin sensitivity response to cardio exercise.

Triglyceride Response To Cardio

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a **BELOW AVERAGE** triglyceride response to cardiovascular exercise. That means you are less likely to see your levels of these harmful blood fats drop (and in some people they tick upward) in response to regular aerobic exercise training. While that is discouraging, it doesn't mean you should stop or not start exercising. You may need to employ other exercise intensities and other lifestyle and/or medical interventions to bring your triglyceride levels into a healthy range if they are elevated.

SUCCESS STRATEGIES

Everybody should aim for at least 150 minutes of physical activity a week for good general health. People who are genetically less inclined to see improved blood fat levels from regular cardio can benefit from taking other healthy lifestyle measures, as well.

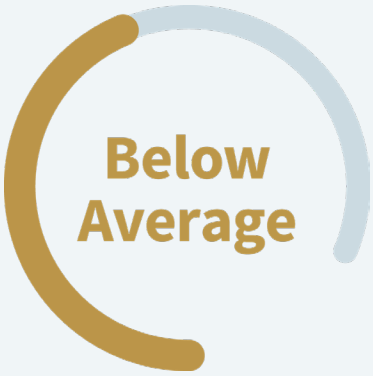
Step it up. The American Heart Association currently recommends at least 150 minutes per week of moderate exercise like walking, swimming and biking at a pace where you can easily converse, or 75 minutes a week of vigorous exercise where you're exerting yourself enough to be breathing harder and can only speak in short sentences—or a combination of both. Some research suggests that vigorous exercise may do a better job of clearing blood fats and lowering triglyceride levels than moderate activity. Include short 5 to 10 minute bursts of harder paced effort into your regular workouts, or devote two sessions a week to vigorous activity.

Lose weight. If you are overweight, losing even just 5 to 10 pounds can help lower triglyceride levels, according to research.

Eat more healthy fats. The type of fat you eat can greatly impact your triglyceride levels. Omega-3 fatty acids like those found in fatty fish like salmon and mackerel are particularly beneficial. Eat fish at least twice a week. Also opt for foods rich in heart healthy monounsaturated fats and polyunsaturated omega-3 fatty acids like olive oil, nuts, and avocado over meats and foods high in saturated fats whenever possible.

Limit sugary and refined foods. Simple carbs like foods made with white flour and sugar are known to raise triglyceride levels.

Watch your alcohol intake. Too much alcohol taxes your liver and can lead to high triglyceride levels. If your levels are high, stick to one drink a day or eliminate alcohol entirely.



Your genetic profile indicates that you have a **Below Average** triglyceride response to regular cardiovascular exercise

If a blood test shows your triglyceride levels are elevated, we recommend that you continue getting at least 150 minutes a day of physical activity a week for good general health and employ other exercise, lifestyle and/or medical interventions to reduce them to healthy levels.

Related Gene / SNPs

CYYR1 GLT8D2 RBFOX1 ZNF385D

Genetic Research

The genes and associated SNPs in this category have been shown to have significant associations with a person's triglyceride level response to cardiovascular exercise. Triglycerides are a type of fat that your body uses for energy. You store them in your fat cells and they circulate in your bloodstream. When you have more triglycerides than you're burning, you end up with elevated levels, which are harmful to your body and can cause hardening of the arteries and heart disease. A simple blood test can tell you your levels, which should fall into a healthy range:
Normal is less than 150 mg/dl.
Borderline-high is 150 to 199.
High is 200 to 499.
Very high is 500 or higher.
Regular aerobic exercise is one of the most effective methods for lowering triglycerides, since your body breaks down fat to fuel activities like walking, biking and swimming. Research shows that, on average, exercise training helps reduce triglyceride levels between 4 to 38 mg/dL. As that range indicates, however, there is a lot of individual variation in how well any given person's triglyceride levels improve from a standard exercise program. It's become clear that genetics play a large role in that regard.
In fact, in a study of 478 men and women who were put on a 20-week endurance training program, variations of these four genes statistically explained 100% of the genetic effect of triglycerides' response to cardiovascular exercise. The good news is that, on average, triglyceride levels decreased over the course of the study. However, those with more favorable genetic variations enjoyed greater reductions while those with higher risk variations actually saw increased levels.
Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **BELOW AVERAGE**, **NORMAL** or **ABOVE AVERAGE** reflects whether your genotype carried more or less favorable variations for lowering your triglyceride levels through cardiovascular exercise. This knowledge can help you create a more effective exercise plan to improve your heart health.

Intrinsic Motivation To Exercise

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you **MORE LIKELY** to be intrinsically motivated to train. That means you are more likely to derive pleasure from participating in your sport or activity without much need for external reward. That means you are more likely to consistently stick to a routine and spend more time engaged in your activity, which in turn can make it easier to reap other rewards and performance benefits.

SUCCESS STRATEGIES

Athletes who are intrinsically oriented tend to face fewer ups and downs in their motivation. They also tend to be less stressed when they hit training obstacles and have less anxiety over "losing" or disappointing outcomes, like missing a podium position or failing to hit a set goal. Generally speaking, they exercise longer and more often, because they find activity itself rewarding.

Being intrinsically motivated to exercise makes getting regular physical activity easier, but it doesn't mean you're immune to boredom or falling into a rut. These strategies will help keep your routine fresh and rewarding.

Challenge yourself. Maximize your exercise enjoyment by challenging yourself with new fitness goals on a regular basis. If you regularly run 10Ks, aim for a half or even full marathon. If you're into CrossFit, compete in a local competition. New challenges can add fuel to your intrinsic motivation to keep moving and keep you from falling into a training rut.

Pay it forward. Use your exercise motivation for greater good (and be even more motivated to train, especially during times when it's harder to get going like cold, wet weather seasons) by signing up for a run, bike ride, or triathlon that benefits a charity of your choice. There are also apps that will donate money to your favorite charity for every step you take.

Your genetic profile indicates that you are **More Likely** to have intrinsic motivation to exercise.

You will be more inclined to maintain an exercise and training routine without the need for external motivation or rewards. Be sure to build time into your schedule to fit the training you want to do.

Related Gene / SNPs

BDNF

Genetic Research

The gene and associated SNP included in this category has been shown to have significant associations with a person's intrinsic motivation to train.

Athletes participate and compete in their sports for a variety of reasons and each of us has our own personal motivations. Athletes who are intrinsically motivated are inclined to participate in a sport for internal reasons. They run marathons because they love to run. They push themselves because they are driven to see how good they can be. They enjoy the process of training with the outcome being secondary. Those who are not intrinsically motivated tend to be extrinsically motivated, or participate for external reasons, such as winning competitions, impressing peers, or in some cases material rewards like trophies, medals, and even cash and scholarships.

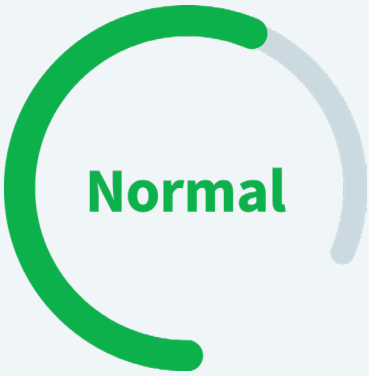
Intrinsic motivation may be embedded in your genes. In one study, researchers collected DNA samples from a group of healthy adult men and women then observed the group while they performed a 30-minute treadmill workout. After the half hour session was up, the exercisers were told that they had completed the session and they could either begin a cool down or could keep going if they wanted. Those with at least one copy of the met allele for the val66met polymorphism were more than 2 ½ times likely to keep going than their peers with a val/val genotype.

Our analysis investigated which genotype for this gene was present in your DNA. Your rating of either **MORE LIKELY** or **LESS LIKELY** reflects whether your genotypes included those that carried a risk for being low in intrinsic motivation or for being likely to be high in intrinsic motivation. Knowing that you're genetically more or less inclined to be intrinsically motivated can help you establish strategies that may help ensure your success.

Impulse Control & Taste Preference

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you an **NORMAL** level of impulse control and risk for consuming high calorie foods as you age. That means that though you still need to be mindful of what and when and how much you're eating, you are not at an increased risk for increased impulsivity, particularly around rich, tempting foods.



Your genetic profile indicates that you will likely have a Normal level of impulse control and increased risk of consuming excess high calorie foods as you age.

You'll be even less likely to succumb to the lure of high fat sweets and snacks and to eat impulsively by following some simple mindful eating strategies.

SUCCESS STRATEGIES

Even people with good impulse control can slip into mindless eating, especially in social situations where Cornell University Food and Brand Lab research finds pretty much everyone eats about 44 to 76 percent more than they would alone. Likewise, nearly all of us have certain foods we find impossible to resist. We recommend that everyone employ a few healthful, mindful eating strategies.

Snack first; then stand clear of the food. Since social situations are when nearly everyone eats (and overeats) impulsively, set yourself up for success by having a light, but fiber-rich and filling snack like an apple and natural peanut butter before you leave the house. It'll be far easier to resist picking at all the finger foods at the party or event. Also, position yourself away from the food table, so you won't mindlessly nibble while you socialize.

Stash it out of sight. Store treats, sweets and high calorie snacks in the least convenient space in your kitchen cupboards. It's harder to impulsively eat when food is out of sight. If you know there's a certain food, like BBQ potato chips, that you cannot resist, don't keep them in the house. Enjoy them as an occasional treat when you go out, instead. Ditto for candy jars. In one study people who kept candy in sight (and arm's reach) weighed about 15 pounds more than those who didn't.

Avoid distracted eating. People who eat while watching TV consume 28 percent more food, according to a study out of the Cornell University Food and Brand Lab. Focus on your food to be aware of what and how much you're eating. You'll enjoy it more, too.

Portion it out. If you want a snack or sweet, dish out a portion and put the rest away. Eating straight from the box, bag or container makes it challenging to not over-indulge, even for people with high impulse control. Research shows people eating out of large containers eat more than 50 percent more than those eating the same snacks in reasonably sized containers.

Keep healthy foods on hand. Keep plenty of baby carrots, pepper strips, apples, clementines, and other healthy snacks in sight and easily accessible when you feel like reaching for some food.

Related Gene / SNPs

FTO

Genetic Research

The gene and associated SNPs included in this category have been shown to have significant associations with a person's impulsivity and taste preference for fatty foods as they age. Impulse control, especially in the presence of an abundance of calorie-dense, fatty foods is essential for maintaining a healthy, portion-controlled diet. So called "mindless" eating or eating just because its there, is a common problem in our society where food is present everywhere you turn. Even small things, such as the size of the food container and being around others can lure you into impulse eating. Fatty rich foods are also easy to overeat once you start eating them because they stimulate powerful pleasure centers in your brain. While some people are aware of their impulsivity, many people eat and overeat impulsively without being aware of it, especially in social situations, when eating out and when food is readily available, like during meetings or other functions where cookies and pastries are out for the taking. Though we tend to think of resisting impulsive eating as an act of "willpower," it takes a good deal of mindfulness to avoid slipping into impulse eating behavior and there also appears to be a genetic component underlying some of this behavior. Results from the Baltimore Longitudinal Study of Aging (BLSA) indicate that people who carry a risk allele of the FTO gene are not only at a 67% higher risk for becoming obese, but also for having reduced activity in the region of the brain that dictates impulse control and taste preference, leaving them more susceptible to consume—and overeat—high calorie, fatty foods, which of course is likely an underlying factor behind their being overweight. Our analysis investigated which genotype was present in your DNA. Your rating of

NORMAL, **SLIGHTLY BELOW AVERAGE**, or **BELOW AVERAGE** indicates your level of impulse control and your relative risk for consuming high calorie foods as you age.

Power / Endurance Potential

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to have **HIGHER POWER** response to strength and power training.. You are likely to enjoy significant power gains in response to strength training. Your genes may help you exceed in sports where power plays a pivotal role, such as sprinting; ball sports such as baseball, football, tennis, and golf; track racing, competitive lifting, and CrossFit types of activities. You can capitalize on your genotype by prioritizing strength and power workouts in your exercise regimen.

Power related sports involve faster, more forceful bursts of activity for a shorter time. Typical power sports are mixed martial arts, hockey, football, baseball, and CrossFit.

Whether you tend to be power or endurance oriented largely depends on your muscle fiber composition. Generally speaking, muscle fibers can be broken into two types: type I (slow twitch) and type II (fast twitch). Type I use oxygen for fuel, fire slowly, provide continuous energy, and have high endurance. Type II rely on anaerobic metabolism for fuel, fire rapidly, and are quicker to fatigue. Fast twitch fibers can further be broken down into type IIa, which are intermediate or hybrid fast twitch fibers in that they use both aerobic and anaerobic metabolism almost equally and type IIb, which are purely anaerobic and produce the highest rate of contraction for quick, powerful bursts of activity. They also fatigue very quickly.

Literature shows that healthy, sedentary people tend to have a 50/50 split of type I and type II fibers. Power athletes are estimated to have up to 80 percent type II fibers. Likewise, elite marathoners may have 80 percent type I fibers. Your DNA largely determines your personal combination. While you can train and make adaptations to muscle fiber size and shape and, to a small extent type, research shows genetic predisposition accounts for greater than 60 percent with only about a third being influenced by training and nutrition.

SUCCESS STRATEGIES

Your genetic inclination to be positively responsive to power training gives you an advantage for using training to get strong and fast for power-oriented sports and activities. That also means, of course, that you're less likely to excel in endurance-based sports like distance running, long distance cycling, and 70.3 or Ironman level triathlon. Which isn't to say you won't be successful in those endeavors, but may be less likely than other endurance-oriented genotypes to compete at an elite level.

Do some heavy lifting. Research indicates that athletes with your genotype see optimal gains in response to high intensity, low repetition type strength training. Try performing multiple sets of low weight such as 5 sets of 3 to 4 reps of close to your max weight with generous amounts of recovery (about 4 minutes) between sets. When you're comfortable with that, shake it up and lift closer to your max by performing 10 sets of 2 repetitions. This type of lifting stimulates your neural drive, improves your intramuscular coordination (so the fibers in any given muscle work better in concert to generate force), stimulates growth hormone production, and generates myofibrillar hypertrophy, which means your muscle fibers become denser and stronger—all of

Your genetic profile indicates that you are likely to have **Higher Power** response to strength training than other genotypes

That means you are more likely to improve your power in response to strength training and excel in sports that are power based.

Related Gene / SNPs

ACTN3	AGT	IL-6
NOS3	ACE	FTO
IGF1	GNB3	IL6-174

which plays to the strengths of your genotype and will help you excel in power-based athletic endeavors.

Be explosive. The definition of power is work divided by time. The more work you can do in a short amount of time, the more powerful you are. You can think of it as taking your strength and applying speed, such as what you do when you sprint, swing a bat to knock a ball out of the park, and clean and jerk a heavy bar. To maximize your genetic tendency to build power, include explosive types of training like Olympic style lifts and CrossFit into your training. Explosive workouts train your fast-twitch muscles to fire powerfully and quickly.

HIIT it. It may be tempting to forgo cardiovascular exercise completely, and if you're training for power-based sports, you don't need much. (Obviously if you're looking to do a mud run or Spartan challenge type of event, you'll need to increase your cardio training to build endurance to complete the distance of the event). By practicing high intensity interval training (HIIT), you can take advantage of your genotype and get the best of both worlds. Intense intervals tap into and condition your type II, turbo fibers, which you have in abundance. Because your heart rate stays elevated you get cardiovascular fitness benefits.

In one head-to-head comparison, Canadian researchers found that cyclists who performed 30-minute sprint sessions three days a week that included six 30-second max efforts with 4 minutes rest reaped nearly identical fitness gains to a group who pedaled moderately 90 minutes to two hours three days a week. In a similar study, the same research team found that high-intensity sprint training also doubled time to exhaustion during a threshold test. Since your genotype is one that is more responsive to power-based exercise, HIIT is an efficient way to improve your cardiovascular fitness.

A good example of HIIT is tabatas. They're super short, but very demanding. You can do them while running, cycling, or on exercise equipment like an elliptical. To do them, warm up for 5 to 10 minutes. Then go as hard as possible (you're going for maximum power output) for 20 seconds. Recover at an easy pace for 10 seconds. Repeat 6 to 8 times. Rest 4 to 5 minutes. If you are accustomed to interval training repeat for another set or two. If you're new to intervals, stick to one set. Cool down for 5 to 10 minutes.

Rest and recover. Because your genotype rewards high intensity training it can be tempting to hit it hard every time you hit the gym or perform your activity of choice. Resist the urge. Remember that your body repairs and makes its metabolic adaptations when you rest and recover. Take a couple of days off from hard training each week. Support your training and recovery with a healthful diet, good lifestyle habits, and quality sleep. Consider incorporating yoga into your routine for cross training and recovery. It will help you maintain muscle and joint mobility, which improves performance and helps prevent injury.

Genetic Research

The genes and associated SNPs included in this category have been shown to have significant associations with a person's endurance and/or power potential, or how likely you are to have a positive response to aerobic endurance and/or power training, which in turn may help determine the activities at which you will be most successful. A meta-analysis of 35 articles published between 2008 and 2016 that analyzed the DNA of 19,852 people identified nine genetic variations that have significant associations with being a power athlete. Other research has found that a specific allele of the ACE gene is heavily represented in endurance athletes like elite long distance cyclists and is beneficial for endurance, rather than power-related sports. Knowledge of your genetic makeup can help you hone your training for the optimum outcome. In a study published in Biology of Sport, researchers tested the power and endurance levels of 28 athletes from different sports and 39 soccer players. All the athletes underwent genetic testing and then were assigned to a training protocol that either matched their DNA analysis or did not match their DNA analysis. After 8 weeks, they retested the athletes' aerobic fitness and explosive power. Those who were in the DNAmatched training group performed significantly better than those who were not. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **HIGHER ENDURANCE**, **EQUAL ENDURANCE/POWER**, or **HIGHER POWER**, reflects whether your genotypes included those that carried the likelihood of being more responsive to endurance training; equally responsive to endurance and power training, or more responsive to power training.

VO2 Max

WHAT YOUR GENES SAY ABOUT YOU:

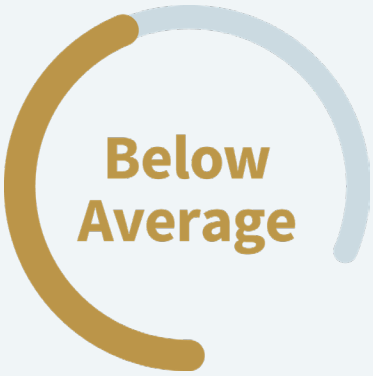
Our analysis indicates that your genetic profile exhibits a **BELOW AVERAGE** fitness response to high-intensity exercise. That means you may experience lesser gains in your VO2 Max from high intensity workouts as someone with a more favorable genotype. That doesn't mean you can't benefit from cardiovascular training, however. You can still improve your fitness and performance. But you will likely see greater gains from longer, moderate intensity workouts. You may also benefit from resistance training workouts that improve your muscular power, efficiency, and endurance.

Your muscles need oxygenated blood to generate fuel. The more work you ask them to do, the more fuel—and oxygen-rich blood—they need. As you start to exercise, your heart rate and your breathing increases and keeps increasing as the intensity rises, so you can send more and more oxygenated blood to your working muscles. Keep pushing and you'll reach a point where your body can't use any more—your system is tapped out. Your heart is pumping all it can and your muscles are using all they can. That is your VO2 Max, the scientific name for the measure of your oxygen capacity —how much oxygen-rich blood your heart can pump and how much your muscles can use per minute, which is expressed in ml/kg/min.

VO2 Max is influenced by your genes, but also by your size, gender and, because it naturally diminishes overtime, age. For example, a sedentary woman in her 30s or 40s may have a VO2 Max of about 26 ml/kg/min while an athletic woman of the same age will have VO2 Max closer to 56 ml/kg/ min. A 50-year-old man in fair condition may have a VO2 Max of 30, while his cross country ski-racing friend has one of 55 ml/kg/min.

Some people appear more inclined to respond to higher intensity efforts while others respond to lower intensity efforts. In one study, researchers from Queen's University in Kingston, Ontario, and the University of Ottawa measured VO2 Max in a group of "non-responders." They then split the group in half and had one group perform classic endurance style moderate intensity training for three weeks, while the other half performed Tabata style, very high intensity interval training (HIIT) style workouts over the same period. After three weeks, they measured their VO2 Max levels, waited several months, and then brought the volunteers back to do another three week training block, this time doing the opposite style training as before. In the end, about a third of the group had little response to endurance style training; a third had little response to HIIT training, but no one failed to respond at all and generally if they didn't respond to one type of training, they had a good response to the other style of training.

In a similar study, researchers had sedentary men and women begin a cardiovascular training routine that included up to 50 minutes of cardio machines, like spin bikes and treadmills, 3 to 4 days a week for 5 to 6 months. Those with an "unfavorable" fitness response to cardio genotype experienced smaller gains in their cardiovascular fitness from the training. However, they also were less able to perform high intensity efforts, suggesting that their optimal fitness response may be better achieved at a lower intensity of exercise.



Your genetic profile indicates that your fitness response to moderate-to-high-intensity cardio is Below Average

Though your genotype might limit your absolute VO2 Max improvements in response to high-intensity exercise, you can still improve your cardiovascular endurance by performing longer, moderate intensity workouts and by including resistance training in your regimen.

Related Gene / SNPs

AMPD1 APOE

You'll generally hit your VO2 Max upper limit within a year of consistent training. It's important to note that even among elite athletes, there is a wide variation in VO2 Max values and that just because you've hit your VO2 Max ceiling doesn't mean that you can't continue to improve your athletic performance. Raising your lactate threshold—being able to perform at a higher percentage of your VO2 Max before fatiguing—and improving your efficiency and economy (which allows you to save energy while cranking out a high pace) can help you make measurable gains regardless of absolute VO2 Max.

SUCCESS STRATEGIES

The good news is that even if your genotype doesn't respond optimally to a steady diet of high intensity workouts, you can still make gains and see results through an exercise routine that prioritizes longer endurance workouts. Skew your training to prioritize zone 2 and 3 workouts.

It's also important to realize that a high VO2 Max isn't necessarily a benchmark for success in longer endurance activities. Elite marathon runners tend to have lower VO2 Max values than short or middle-distance runners because the maximal amount of oxygen you can deliver becomes less important when you're performing for long durations at sub-maximum intensities. You may excel at longer endurance events and, of course, non-endurance events that don't require a high VO2 Max.

Also consider including resistance training to improve your muscular strength and economy, which can give you a large performance boost regardless of your VO2 Max. Research has found that endurance athletes like runners, cyclists, and triathletes who swap some cardiovascular training time for resistance training like CrossFit and plyometrics improve their performance in time trials and other cycling, running, and multisport events, despite having slightly lower total training hours.

Genetic Research

The genes and associated SNPs included in this category have been shown to have significant associations with a person's cardiovascular fitness response to moderate-to-high intensity exercise. VO2 Max is generally considered the best indicator of aerobic fitness and endurance potential. Factors that impact it are how strong and efficient your heart is, how well developed your capillary system is to deliver blood into your muscles, and the size and number of the energy-producing furnaces known as mitochondria in your muscle cells. All of these factors—and in turn your VO2 Max—improve with moderate to high intensity training. People who are active will have a higher VO2 Max than their sedentary peers. It is also influenced by your size, gender and, because it naturally diminishes overtime, age. How much you can improve your VO2 Max depends upon myriad factors, including your current fitness level and the intensity of your training. Research finds that sedentary people who start training at about 75 percent of their max for at least 30 minutes 3 times a week can increase their VO2 Max an average of 15 to 20 percent over six months, but the range of response is large. Some people make enormous gains, while others make very few. The reason, we now know, is in your genes. We've also learned that, contrary to what was thought previously, there are very few actual exercise "nonresponders." It's more a matter of to what type of cardiovascular intensity your body best responds. Our analysis investigated which genotype for these genes was present in your DNA. Your rating of **NORMAL**, **BELOW AVERAGE** or **LOW** reflects whether your genotypes included those that carried a risk of reduced cardiovascular fitness response from moderate-to-higher intensity exercise.

Exercise Heart Rate Response

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a likely **SLIGHTLY ABOVE AVERAGE** heart rate response to exercise. That means you are likely to experience a small to moderate decrease in your exercise heart rate with training. That does not limit your ability to make measurable fitness gains or mean that you will experience sub-par performance with training. Even small heart rate improvements are meaningful and heart rate is only one factor in exercise performance and success.

SUCCESS STRATEGIES

Athletes often prize a low resting, and subsequent lower exercising, heart rate as a sign of superior fitness. Though a decrease in beats per minute (bpm) is a sign of improved cardiovascular conditioning and a lower resting heart rate can be an indicator of good fitness, it is only part of a larger picture when it comes to performance. These strategies can help maximize your training with regards to your genetic inclination for a more moderate heart rate training response.

Know your numbers. Healthy adults have an average resting heart rate (RHR) of 60 to 80 bpm; RHR may be 100 bpm in sedentary adults and lower than 60 bpm for active adults. Because women are smaller, their average heart rate is up to 10 bpm higher.

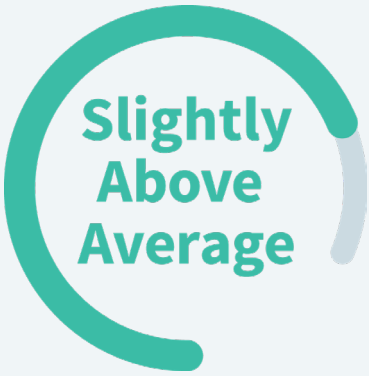
The first step is determining your current resting heart rate, because if you don't know where you're starting, you can't measure your progress. If you've been training for more than a few weeks, you may have already achieved a lower resting and exercising heart rate and will not see further declines. Keep in mind that research shows that if you naturally have a lower heart rate, you will not see as dramatic a decrease as someone who has a naturally higher heart rate might.

It's best to measure your resting heart rate first thing in the morning. You should be fully recovered from any recent hard training or racing, as that can elevate your morning heart rate. If you need to use the bathroom, do that first, so you're fully relaxed. Put on your heart rate monitor and measure for about a minute, noting your lowest heart rate number. If you don't have a heart rate monitor you can simply use a timer and place your fingertips on your pulse and count beats for a minute.

If you've just started training, check again in three to four weeks (again being sure you're fully recovered) to note any changes.

Consider your exercise intensities. Lower intensity exercise doesn't have as much of an impact on your resting and exercise heart rate as high intensity exercise. Research shows that one hour a week of high intensity aerobic training lowered resting heart rate more effectively than lower intensity bouts.

Practice other heart healthy behaviors. Exercise isn't the only thing that impacts your resting and exercising heart rate. Dehydration thickens your blood and raises your heart rate, so staying



Your genetic profile indicates that you are likely to experience a **Slightly Above Average** heart rate response to exercise.

You are likely to experience a small to moderate decrease in exercise heart rate with training. Though larger decreases may be advantageous, heart rate is only one measurement of fitness and performance potential.

Related Gene / SNPs

CREB1

hydrated is key. Caffeine can make it higher, so sensible caffeine use will help keep a too high heart rate in check. Exercising in extreme temperatures will raise it. Your heart rate will be higher at high altitudes, especially if you're not acclimated.

Make it part of the larger picture. Resting heart rate is only one piece of your athletic portrait. Your training partner with a resting heart rate of 32 bpm may win a fitness contest on paper, but in the real world, you could still be stronger and faster and get to the finish line first. Training your strengths can help minimize any limitations.

Genetic Research

The gene and associated SNP included in this category have been shown to have significant associations with a person's exercise heart rate response. Your heart's primary job is to keep your blood circulating, sending blood into the lungs to pick up fresh oxygen and then pumping out that oxygenated blood into the rest of the body so your cells can function. When you exercise, your heart pumps faster to keep your working muscles fueled.
As you become more fit, your body becomes more efficient at using oxygen so your heart rate doesn't have to rise as dramatically when you exercise. It also becomes lower when you are at rest. Having a lower resting heart rate doesn't only indicate better heart health, but also, because your heart can pump more oxygenated blood with fewer beats per minute, you have greater endurance and exercise capacity. Your genetics have a considerable influence over how dramatically your exercise heart rate responds to endurance training.
The HERITAGE Family Study of 472 men and women from 99 nuclear families found that after 20 weeks of endurance training, the average decrease in heart rate during steady state aerobic exercise (60% of VO2 Max) was 11.3 beats per minute (bpm), but there was a large range among individuals, from a decrease of 42 bpm to an increase of 12 bpm. Variations in the CREB1 SNP were strongly associated with heart rate response to exercise, explaining about 20 percent of the variance in heart rate response.
Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NORMAL**, **SLIGHTLY ABOVE AVERAGE**, or **ABOVE AVERAGE** reflects whether your genotypes included those that make you more likely to have a small, small to moderate, or moderate decrease in exercise heart rate with training.

Exercise Stroke Volume

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to have a **NORMAL** stroke volume response to exercise. That means you are likely to experience a typical increase in stroke volume in response to exercise training.

SUCCESS STRATEGIES

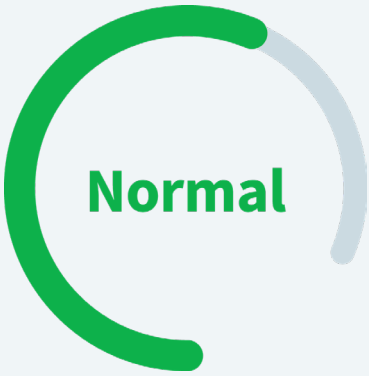
Untrained people have a stroke volume of about 50 to 70 ml/beat at rest, which increases to 110 to 130 ml/beat during high intensity efforts. Exercise makes your heart muscle bigger and stronger, so you have a greater stroke volume. The resting stroke volume in elite athletes averages 90 to 110 ml/beat (which is why their resting heart rate is also so low), which increases to as much as 150 to 220 ml/ beat during high intensity exercise, according to research.

Your stroke volume response is also sport dependent. Swimmers generally see a smaller increase in stroke volume response than runners or cyclists; exercising heart rate is typically lower during swimming as well, because the supine position prevents blood from pooling in the lower extremities and there's less need for increased heart rate and stroke volume to meet the body's needs.

Increasing stroke volume is believed to be more efficient than increasing heart rate during exercise, as you can do more work at a lower heart rate with a higher stroke volume. That said, once you reach a certain intensity, your stroke volume plateaus and your heart rate increases to meet your increasing exercise demands.

Your genetic tendency to have an average stroke volume response to exercise training does not mean you cannot perform at a high level or successfully compete against someone with a larger stroke volume response, though you may need to work harder at a given heart rate.

You can minimize any disadvantages by training your sport-specific skills; developing muscular power and efficiency and other fitness elements not solely dependent on cardiovascular efficiency. It's also important that you maintain optimum hydration status, as dehydration diminishes blood volume, which can exacerbate the impact of a genetically lower stroke volume.



Your genetic profile indicates that you are likely to experience a **Normal** stroke volume response to exercise training.

A greater stroke volume response is advantageous as you can pump out more blood at a lower heart rate. However, stroke volume response is only one factor in exercise performance and success.

Related Gene / SNPs

KIF5B

Genetic Research

The gene and associated SNP included in this category have been shown to have significant associations with a person's exercise stroke volume response.
There are two ways for your heart to get more oxygen-rich blood to your exercising muscles: pump faster (heart rate response) and pump out a greater volume of blood with every beat. The latter is your stroke volume response, the amount of blood ejected per beat from your left ventricle, as measured in ml/beat. Stroke volume increases as your exercise intensity rises. How much your stroke volume improves with exercise is also largely hereditary. The HERITAGE Family Study of 483 men and women from 99 nuclear families found that after 20 weeks of endurance training, the average increase in stroke volume during steady state aerobic exercise (60% of VO2 Max) was 3.9 ml/beat. But there was a large range of stroke volume response among individuals, ranging from a decrease of 41 ml/beat to an increase of 45 ml/beat. Variations in the KIF5B SNP were strongly associated with stroke volume response to exercise, explaining nearly 30 percent of the variance. Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NORMAL** or **ABOVE AVERAGE** reflects whether your genotype included those that make you likely to have an average or above average stroke volume response to regular exercise training.

Systemic Inflammation

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a likelihood of having **NORMAL** systemic inflammation levels. That means your CRP levels are likely to fall in a normal range. That's good news because chronically elevated inflammation levels take a toll on your organs and pave the way for diseases like diabetes and heart disease. Of course, genes are only one factor in systemic inflammation. You still need to follow a balanced diet, train intelligently, and maintain a healthy weight.

SUCCESS STRATEGIES

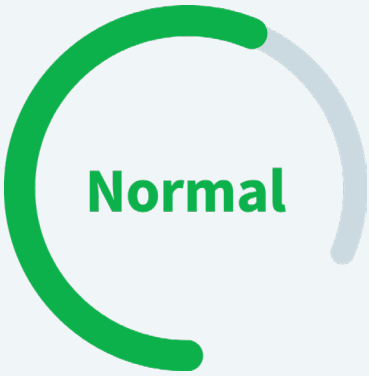
Normal CRP levels vary from laboratory to laboratory, but generally there are no or very low levels of CRP detectable in the blood. According to the American Heart Association, you are at a low risk for developing heart disease if your CRP levels are less than 1.0 mg/L; your risk is considered average if your levels are between 1.0 mg/L and 3.0 mg/L, and your risk is high if your levels are higher than 3.0mg/L. Simple, healthy lifestyle practices go a long way in keeping systemic inflammation levels in a low, healthy range. Maintaining a healthy weight is one of the best ways to keep systemic inflammation in check, since carrying excess fat, especially metabolically active abdominal fat, can induce chronic low-grade inflammation.

The good news for you as an active person is that regular physical activity, which can help you maintain a healthy weight, is one of the best "anti-inflammatories" there is. Regular exercise has been shown to reduce inflammation by up to 60 percent. In a 10-year study of nearly 4,300 men and women, British researchers found that those who got 2 ½ hours of moderate exercise a week had significantly lower CRP levels than those who were less physically active. Those who began exercising regularly during the study had lower inflammation levels by the end.

It's important to note that exercise often causes some degree of inflammation. A long, hard and/or intense training session is a form of stress that initiates an inflammatory response, which is part of the adaptation process that generates muscle and makes you stronger and fitter as your body rebuilds. If you constantly train hard without adequate rest, such as doing high intensity CrossFit workouts every single day or training for long endurance events like marathons, ultras, and long distance triathlons, you raise your risk for chronic inflammation. Also, research suggests that sporadic intense exercising, such as being a "weekend warrior," can increase inflammation and weaken immunity, rather than bolster it.

Your favorable genotype may help protect you from chronic inflammation that can result from too much intense exercise without adequate rest and inconsistent training, but you should still aim to follow healthy, consistent training practices that include a mix of high intensity training days interspersed with adequate recovery days. Avoid slogging through workouts when you're feeling fatigued.

Eating a Mediterranean-style diet that is rich in inflammation-lowering polyunsaturated omega-3 fatty acids also helps keep CRP levels low. Build your diet around plant foods and eat lots of vegetables and fruits with moderate amounts of lean protein and healthy fats. Avoid eating fried



Your genetic profile indicates that you are inclined to have Normal systemic inflammation levels.

You can maximize the beneficial effects of your genes by eating an anti-inflammatory diet and training consistently, including rest and recovery days after strenuous workouts, competitions and races, and training blocks.

Related Gene / SNPs

CRP APOC1 HNF1A

foods, fast foods, and foods that are high in sugar, as they can raise inflammation. If you drink, do so in moderation. Too much is bad for you, but research shows that moderate amounts, such as a drink a day, lowers your CRP levels more than totally abstaining. It's not a reason to start drinking, of course. But good news for those who enjoy alcohol in moderation.

Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have significant associations with a person's systemic inflammation levels. That's low-level inflammation we don't see, which left unchecked, can damage our blood vessels and lead to many serious chronic diseases like heart disease, diabetes, stroke, neurodegenerative diseases like Alzheimer's, and some cancers. Chronic inflammation also hinders recovery from exercise and training and harms performance. Doctors use C-reactive protein (CRP) levels as a general marker of systemic inflammation. CRP is a protein found in your blood plasma that binds to the surface of dead or dying cells and certain bacteria to clear them from your body. When there's a lot of cellular damage to clean up, CRP levels rise. Unsurprisingly, high CRP levels have been linked to a higher risk of mortality. There are many culprits behind systemic inflammation, including autoimmune diseases, being overweight (especially if you carry your excess fat in your abdomen, where it is most metabolically active), poor fitness, a diet that is high in sugar and other inflammatory foods, sleep deprivation, as well as exposure to secondhand smoke and other pollutants. CRP is also significantly influenced by genetics. Researchers estimate that the heritability of CRP levels is up to 40 percent. In a recent genome wide association analysis of more than 82,700 men and women, scientists identified a half a dozen genetic variations that were significantly associated with CRP levels. When they ranked the study participants according to their at-risk CRP genetic makeup, those in the highest gene score group had an average CRP level that was more than double the average level of those in the lowest gene score group. Our analysis investigated which genotype for this gene was present in your DNA. Your rating of **NORMAL**, **ABOVE AVERAGE** reflect whether or not your genotype include those that increase your risk for elevated systemic inflammation levels.

Injury Risk

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that give you a likelihood of having an **ABOVE AVERAGE** fracture risk and a below average bone mineral density. That is concerning because weak bones not only leave you vulnerable to stress fractures and breaks, but also can be crippling and life-threatening later in life. As someone who is genetically inclined to have below average bone density, it's important to practice bone-building nutrition, exercise, and lifestyle habits.

SUCCESS STRATEGIES

As an active person, you're already on the right path to building a strong skeleton. But it's essential that you eat a diet that supports your activity level and encourages bone development. Your lifestyle habits and even certain medications can contribute to bone loss. So it's important to practice bone-building behaviors and avoid those (like smoking, which you likely already avoid) that can diminish your bone density.

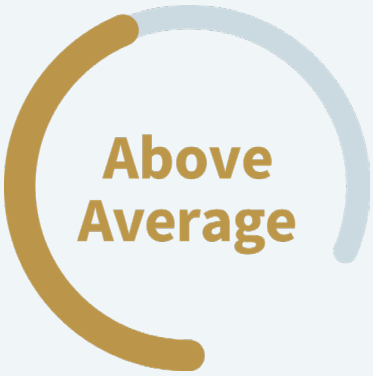
Get all the calcium and vitamin D you need. Low calcium intake puts you at risk for low bone mineral density, as your bones are made mostly from this essential mineral. Men 70 years old and younger and women 50 years old and younger need 1,000 milligrams a day; men 71 years old and older and women 51 years old and older need 1,200 milligrams a day of calcium. You can get adequate calcium from dairy products like yogurt and cheese, sardines and salmon with bones, dark leafy vegetables, and tofu. Vitamin D assists in calcium absorption and bone formation. You get vitamin D through exposure to the sun and you can get it from fortified dairy products, eggs (with the yolks), and saltwater fish. Men and women 50 years old and younger need 400 to 800 IUs a day; men and women 51 years old and older need 800 to 1,000 IUs a day. Almost 70 percent of Americans don't meet all their vitamin D needs. You can ensure you get enough by taking a supplement of 400 to 800 IUs.

Prioritize protein. Active adults need more protein, which not only helps you build and maintain skeletal muscle, but also helps build your skeleton, as well. It's especially important to take in enough protein to fuel your training recovery, which in turn helps you maintain bone mineral density and testosterone, and for women can prevent menstrual cycle dysfunction, which can lead to significant bone loss. Aim for 30 to 40 grams per meal to help maintain muscle and bone integrity.

[IF FEMALE] **See your doctor if you stop menstruating and are not menopausal**. Irregular periods are a symptom of hormonal disruption that can cause bone loss. Amenorrheic athletes have up to a 30 percent lower bone mineral density as normally menstruating athletes. If your periods become irregular or you stop menstruating, see your doctor.

Train your core. Your spine is one of the most vulnerable spots for bone loss. Do core training, such as push-ups, pull ups, and planks year round.

Add impact and high intensity exercise. Impact exercise like walking, running, racquet sports,



Your genetic profile indicates that you are inclined to have **Above Average** fracture risk.

You can minimize the potentially detrimental effects of your genes by eating, exercising, and practicing lifestyle habits that contribute to strong, healthy bone density.

Related Gene / SNPs

SPTBN1	MEPE	SLC25A13
LRPF	C18 OR F19	MBL2/ DKK1

and jumping drills like plyometrics put healthy stress on your bones and encourage bone development. If you primarily practice non-impact sports like cycling and swimming, incorporate some impact cross training into your schedule. You may also build bone with low-impact exercise by adding high intensity, which research suggests may put enough tension on bones to help promote development.

Make muscle. Strong muscles and strong bones go hand in hand. Your muscles put healthy tension on your bones and encourage bone formation. Strength training is essential, especially once you hit your 40s, when muscle mass may naturally decline. It's also important to strength train those body parts that you don't use in your typical activity. Bone density is "site specific", meaning that you build more bone in the places that have the most muscle mass and that you work the hardest. Research has found that strength training can improve bone density by about 1 percent a year, according to the National Osteoporosis Foundation.

Be cautious about bone-robbing medications. Certain medications such as corticosteroids, aluminum containing antacids, antidepressants, and proton pump inhibitors can contribute to bone loss. Talk to your doctor if you need to be on them for any length of time.

Go easy on alcohol. Heavy drinking can compromise bone integrity and lead to bone loss. If you drink alcohol, keep your consumption moderate: one drink a day for women, two for men.

Consider getting a bone scan. If you're concerned about the status of your bone health, make an appointment to get a bone scan. It's quick and easy and will let you know what, if any, actions you should be taking.

Genetic Research

The genes and their associated SNPs in this category have been shown to have significant associations with a person's bone mineral density and risk of fracture. Strong bones are essential for good health and longevity as well as to support your active lifestyle and avoid injuries like stress fractures and breaks. Throughout your life, your body is constantly breaking down old bone (in a process called resorption) and laying down new bone. You reach peak bone density at about age 30, after which you may start breaking down bone faster than you make it. If this loss remains unchecked, you can end up with dangerously thin bones that increase your risk of fracture. Because of hormonal reasons and the fact that they have thinner bones to begin with, women are at particular risk for thinning bones and osteoporosis (a disease where bones are porous and prone to breaks), especially after menopause. Twins and family research reveals that up to 85 percent of the variance in bone mineral density (BMD) is determined by genetics. The largest meta-analysis of 17 genome-wide association studies found that certain genetic scores were highly associated with BMD and fracture risk. The only way to know for certain that you have healthy or low BMD is to have a bone density test, called a dual energy x-ray absorptiometry or DXA scan, which measures bone density in your hip and spine. Other screenings, such as the kinds that measure bone density in your lower arm wrist, finger, or heel, also can identify thinning bones. Our analysis investigated which genotype was present in your DNA. Your rating of **NORMAL**, **ABOVE AVERAGE**, or **WELL ABOVE AVERAGE** reflects whether or not your genotype includes those that increase your risk for low bone mineral density and bone fracture.

Sleep Duration

WHAT YOUR GENES SAY ABOUT YOU:

Our analysis indicates that your genetic profile exhibits characteristics that make you likely to get an **NORMAL** amount of sleep per night. That's good news because adequate sleep protects your health and improves your mood and general daytime functioning. It's important to keep in mind, however, that the majority of factors that influence sleep duration are not genetic. So even if you have a genetic predisposition for average sleep, you must still practice good sleep hygiene to ensure that you get sufficient rest and reap the many health benefits associated with regularly getting a good night's sleep.

SUCCESS STRATEGIES

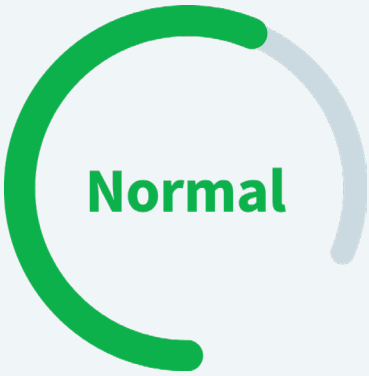
Sleep has a powerful effect on health. So it bodes well for your general well being that you are genetically inclined to get an average amount of sleep per night. Remember, however, that average is sometimes shy of enough depending on your personal needs. Be sure to practice good sleep hygiene to ensure you get the proper amount of restorative sleep you need.

Keep caffeine intake to healthy limits. Regardless of your genetic makeup, too much caffeine can wreck your sleep. Caffeine works by binding to your brain's nerve receptors, speeding them up, which triggers your pituitary glands to secrete adrenaline. Hence the energy buzz. The half-life of caffeine is about six hours, so if your last mug is at 4 p.m., by 10 p.m., you still have a shot of espresso's worth flowing through your system, which research shows can reduce your sleep by an hour. Have your last cup at before 4, so you can wind down and fall asleep more easily.

Nix the nightcaps. A glass of wine, beer or your favorite spirit may make you feel drowsy initially, but too much alcohol close to bedtime disrupts your sleep architecture. Alcohol within an hour of bedtime lengthens your non-REM sleep and shortens your REM sleep during the first half of the night, so you are in more wakeful territory longer. As your liver clears the ethanol from your bloodstream, your body can go into a bit of withdrawal during the second half of the night, making you restless and more likely to toss and turn. Drink moderately and avoid alcohol an hour or two before bedtime.

Reduce your light exposure. Bathing yourself in artificial light—whether from light bulbs or screens—in the evening suppresses your melatonin—a hormone produced in the pineal gland of the brain that is critical for your natural sleep-wake cycle—so your body temperature doesn't dip and your body doesn't get the signals that it is time to start the stages of sleep. Your smartphone or tablet also emit blue wavelength light, which has been shown to be especially harmful to circadian rhythm function. Dim the lights and shut down all electronics 30 minutes before you want to be asleep. Also consider downloading a blue light-filtering app if you must be on your device at night.

Create a comfy sleep environment. Humans sleep best in cool, dark, quiet conditions. Set your thermostat to between 60 and 67 degrees for the optimum ambient sleeping temperature. Consider black out curtains if outside light enters your bedroom. Earplugs or white noise machines can block out disruptive noise.



Your genetic profile indicates that you may be likely to get a **Normal** amount of sleep per night.

Since the average American sleeps just 6.8 hours of sleep a night, that's good news. Because many lifestyle, diet, and behavior factors impact your sleep duration, you'll be more likely to maximize your genetic potential and to consistently get the recommended 7 to 8 hours of restorative sleep each night if you implement habits that are conducive to good sleep.

Related Gene / SNPs

ABCC9 LOC101927400 DRD2

Quiet your mind. Problem-solving beta brain waves aren't conducive to deep sleep. If your brain races with worries at night, consider keeping a bedside journal to jot down your concerns with notes to address them the following day. Mind calming practices such as repeating mantras and meditation also can calm beta brain wave activity so you can drift into slower alpha, theta, and deep sleep delta wave activity.

Genetic Research

The genes and their associated SNPs that are included in this category have been shown to have significant associations with sleep duration.
Sleep is essential for physical and psychological health. Research shows that sleep plays a critical role in immunity, metabolism, learning, memory and a host of vital functions. Getting too little sleep (6 hours or less) doesn't just make you feel drowsy and irritable during the day, but also has been linked with an increased risk for heart disease, diabetes, poor cognitive function, getting sick and weight gain. Research shows that adults sleeping 5 or fewer hours a night have 55% greater odds of becoming obese. Research also shows that Americans currently average 6.8 hours of sleep a night, with 26 percent averaging 6 hours or less and 14 percent averaging 5 hours or less. Many factors, including age, gender, lifestyle, diet, caffeine and alcohol consumption, occupation, light exposure and general health influence how much (or little) sleep we get each night. Your genes may also play a role in sleep duration. Studies show the inheritability of sleep duration to be anywhere between 9 and 44 percent. Variations in the genes, or alleles, listed above have been shown to influence sleep duration, with each allele increasing or decreasing sleep by 3 to 4 minutes. Compared to other factors, genes may not move the needle on sleep in a giant way, but even small amounts of additional sleep if you are typically a short sleeper can improve your well-being. Consider that research shows just a 10-minute nap is sufficient for significantly improving alertness and cognitive performance for more than two hours, and just three minutes of stage 2 sleep (the stage where we drift off and become less aware of our surroundings) has recuperative benefits and you'll appreciate how key every minute of sleep is to your well-being. Trending your sleep duration in a healthy direction may also set the stage for improved sleep hygiene and better sleep duration long term, which may trigger a cascade of further genetic outcomes. One British study

Genetic Research

reported that there are approximately 500 genes that are affected by sleep duration. When volunteers who typically slept 7 ½ hours shaved an hour off their nightly rest, the genes associated with inflammation, immune response, stress, diabetes and risk of cancer became more active. The opposite occurred when the volunteers who typically slept 6 ½ hours added an hour of sleep. Our analysis investigated which genotype of each of these 5 genes was present in your DNA. Your rating of **NORMAL**, **BELOW AVERAGE**, or **ABOVE AVERAGE** reflects whether your genotypes include those that carried a risk of reduced healthy sleep duration.

WEIGHT LOSS TENDENCY

Hum Hered. 2013;75(2-4):160-74. doi: 10.1159/000353181. Epub 2013 Sep 27.

Human cardiovascular disease IBC chip-wide association with weight loss and weight regain in the look AHEAD trial

http://www.ncbi.nlm.nih.gov/pubmed/?term=24081232

McCaffery JM, Papandonatos GD, Huggins GS, Peter I, Erar B, Kahn SE, Knowler WC, Lipkin EW, Kitabchi AE, Wagenknecht LE, Wing RR; Genetic Subgroup of Look AHEAD; Look AHEAD Research Group.

Diabetes. 2012 Nov;61(11):3005-11. doi: 10.2337/db11-1799. Epub 2012 Aug 13.

FTO genotype and 2-year change in body composition and fat distribution in response to weight-loss diets

http://www.ncbi.nlm.nih.gov/pubmed/?term=22891219

Zhang X, Qi Q, Zhang C, Smith SR, Hu FB, Sacks FM, Bray GA, Qi L.

Int J Obes (Lond). 2013 Dec;37(12):1545-52. doi: 10.1038/ijo.2013.54. Epub 2013 Apr 3.

FTO predicts weight regain in the Look AHEAD clinical trial

http://www.ncbi.nlm.nih.gov/pubmed/?term=23628854

McCaffery JM1, Papandonatos GD, Huggins GS, Peter I, Kahn SE, Knowler WC, Hudnall GE, Lipkin EW, Kitabchi AE, Wagenknecht LE, Wing RR; Genetic Subgroup of Look AHEAD; Look AHEAD Research Group.

Diabetes. 2010 Mar;59(3):747-50. doi: 10.2337/db09-1050. Epub 2009 Dec 22.

Gene variants of TCF7L2 influence weight loss and body composition during lifestyle intervention in a population at risk for type 2 diabetes

http://www.ncbi.nlm.nih.gov/pubmed/?term=20028944

Haupt A, Thamer C, Heni M, Ketterer C, Machann J, Schick F, Machicao F, Stefan N, Claussen CD, Häring HU, Fritsche A, Staiger H.

Am J Clin Nutr. 2012 Nov;96(5):1129-36. doi: 10.3945/ajcn.112.038125. Epub 2012 Oct 3.

TCF7L2 genetic variants modulate the effect of dietary fat intake on changes in body composition during a weight-loss intervention

http://www.ncbi.nlm.nih.gov/pubmed/?term=23034957

Mattei J, Qi Q, Hu FB, Sacks FM, Qi L.

Am J Clin Nutr. 2014 Feb;99(2):392-9. doi: 10.3945/ajcn.113.072066. Epub 2013 Dec 11

Variants in glucose- and circadian rhythm-related genes affect the response of energy expenditure to weight-loss diets

http://www.ncbi.nlm.nih.gov/pubmed/?term=24335056

Mirzaei K, Xu M, Qi Q, de Jonge L, Bray GA, Sacks F, Qi L.

Obesity (Silver Spring). 2009 Oct;17(10):1924-31. doi: 10.1038/oby.2009.199. Epub 2009 Jun 18.

PPARG genotype accounts for part of individual variation in body weight reduction in response to calorie restriction

https://www.ncbi.nlm.nih.gov/pubmed/19543210

Matsuo T, Nakata Y, Katayama Y, Iemitsu M, Maeda S, Okura T, Kim MK, Ohkubo H, Hotta K, T.

Diabetes Care. 2012 Feb;35(2):363-6. doi: 10.2337/dc11-1328. Epub 2011 Dec 16.

Genetic predictors of weight loss and weight regain after intensive lifestyle modification, metformin treatment, or standard care in the Diabetes Prevention Program

http://www.ncbi.nlm.nih.gov/pubmed/?term=22179955

Delahanty LM, Pan Q, Jablonski KA, Watson KE, McCaffery JM, Shuldiner A, Kahn SE, Knowler WC, Florez JC, Franks PW; Diabetes Prevention Program Research Group.

Diabetes. 2002 Aug;51(8):2581-6.

Association of the Pro12Ala polymorphism in the PPAR-gamma2 gene with 3-year incidence of type 2 diabetes and body weight change in the Finnish Diabetes Prevention Study

http://www.ncbi.nlm.nih.gov/pubmed/?term=12145174

Lindi VI, Uusitupa MI, Lindström J, Louheranta A, Eriksson JG, Valle TT, Hämäläinen H, Ilanne-Parikka P, Keinänen-Kiukaanniemi S, Laakso M, Tuomilehto J; Finnish Diabetes Prevention Study.

Clin Genet. 2003 Feb;63(2):109-16.

The PPAR-gamma P12A polymorphism modulates the relationship between dietary fat intake and components of the metabolic syndrome

http://www.ncbi.nlm.nih.gov/pubmed/?term=12145174

Robitaille J, Després JP, Pérusse L, Vohl MC.

Clin Genet. 2003 Feb;63(2):109-16.

Interaction between a peroxisome proliferator-activated receptor gamma gene polymorphism and dietary fat intake in relation to body mass

http://www.ncbi.nlm.nih.gov/pubmed/?term=14506127

Memisoglu A, Hu FB, Hankinson SE, Manson JE, De Vivo I, Willett WC, Hunter DJ.

Obesity (Silver Spring). 2009 Oct;17(10):1924-31. doi: 10.1038/oby.2009.199. Epub 2009 Jun 18.

PPARG genotype accounts for part of individual variation in body weight reduction in response to calorie restriction.

https://www.ncbi.nlm.nih.gov/pubmed/19543210

Matsuo T, Nakata Y, Katayama Y, Iemitsu M, Maeda S, Okura T, Kim MK, Ohkubo H, Hotta K, Tanaka K.

FAT LOSS RESPONSE TO CARDIO

J Appl Physiol (1985). 2001 Sep;91(3):1334-40.

Evidence of LPL gene-exercise interaction for body fat and LPL activity : the HERITAGE Family Study.

http://www.ncbi.nlm.nih.gov/pubmed/11509533

Garenc C, Pérusse L, Bergeron J, Gagnon J, Chagnon YC, Borecki IB, Leon AS, Skinner JS, Wilmore JH, Rao DC, Bouchard C.

Obes Res. 2003 May;11(5):612-8.

Effects of beta2-adrenergic receptor gene variants on adiposity: the HERITAGE Family Study.

http://www.ncbi.nlm.nih.gov/pubmed/12740450

Garenc C, Pérusse L, Chagnon YC, Rankinen T, Gagnon J, Borecki IB, Leon AS, Skinner JS, Wilmore JH, Rao DC, Bouchard C; HERITAGE Family Study.

BODY COMPOSITION RESPONSE TO STRENGTH TRAINING

International Journal of Obesity (2015) 39, 1371–1375; doi:10.1038/ijo.2015.78; published online 26 May 2015

High genetic risk individuals benefit less from resistance exercise intervention

http://www.nature.com/ijo/journal/v39/n9/abs/ijo201578a.html

Y C Klimentidis, J W Bea, T Lohman, P-S Hsieh, S Going and Z Chen

PROTEIN UTILIZATION

Int J Obes (Lond). Author manuscript; available in PMC 2018 Aug 28.

Gut-microbiome related LCT genotype and 2-year changes in body composition and fat distribution: the POUNDS Lost Trial

https://europepmc.org/articles/PMC6109621;jsessionid=0B22A0CC55E5A80BEDB6A2D70A2B7F1C

Yoriko Heianza, Dianjianyi Sun, Wenjie Ma, Yan Zheng, Catherine M. Champagne, George A. Bray, Frank M. Sacks, and Lu Qi

FAT UTILIZATION

Diabetes Care. 2012 Feb;35(2):363-6. doi: 10.2337/dc11-1328. Epub 2011 Dec 16.

Genetic predictors of weight loss and weight regain after intensive lifestyle modification, metformin treatment, or standard care in the Diabetes Prevention Program

http://www.ncbi.nlm.nih.gov/pubmed/?term=23628854

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Diabetes. 2002 Aug;51(8):2581-6.

Association of the Pro12Ala polymorphism in the PPAR-gamma2 gene with 3-year incidence of type 2 diabetes and body weight change in the Finnish Diabetes Prevention Study

http://www.ncbi.nlm.nih.gov/pubmed/?term=12145174

Lindi VI, Uusitupa MI, Lindström J, Louheranta A, Eriksson JG, Valle TT, Hämäläinen H, Ilanne-Parikka P, Keinänen-Kiukaanniemi S, Laakso M, Tuomilehto J; Finnish Diabetes Prevention Study.

Clin Genet. 2003 Feb;63(2):109-16.

The PPAR-gamma P12A polymorphism modulates the relationship between dietary fat intake and components of the metabolic syndrome

http://www.ncbi.nlm.nih.gov/pubmed/?term=12630956

Robitaille J, Després JP, Pérusse L, Vohl MC.

Hum Mol Genet. 2003 Nov 15;12(22):2923-9. Epub 2003 Sep 23.

Interaction between a per oxisome proliferator-activated receptor gamma gene polymorphism and dietary fat intake in relation to body mass.

http://www.ncbi.nlm.nih.gov/pubmed/?term=14506127

Memisoglu A, Hu FB, Hankinson SE, Manson JE, De Vivo I, Willett WC, Hunter DJ.

Am J Clin Nutr. 2012 Nov;96(5):1129-36. doi: 10.3945/ajcn.112.038125. Epub 2012 Oct 3.

TCF7L2 genetic variants modulate the effect of dietary fat intake on changes in body composition during a weight-loss intervention.

http://www.ncbi.nlm.nih.gov/pubmed/?term=23034957

Mattei J, Qi Q, Hu FB, Sacks FM, Qi L.

Circulation. 2006 May 2;113(17):2062-70. Epub 2006 Apr 24.

Dietary intake of n-6 fatty acids modulates effect of apolipoprotein A5 gene on plasma fasting triglycerides, remnant lipoprotein concentrations, and lipoprotein particle size: the Framingham Heart Study.

http://www.ncbi.nlm.nih.gov/pubmed/?term=16636175

Lai CQ, Corella D, Demissie S, Cupples LA, Adiconis X, Zhu Y, Parnell LD, Tucker KL, Ordovas JM.

Clin Genet. 2005 Aug;68(2):152-4.

A polymorphism in the apolipoprotein A5 gene is associated with weight loss after short-term diet.

http://www.ncbi.nlm.nih.gov/pubmed/?term=15996212

Aberle J, Evans D, Beil FU, Seedorf U.

J Mol Med (Berl). 2007 Feb;85(2):119-28. Epub 2007 Jan 9.

APOA5 gene variation modulates the effects of dietary fat intake on body mass index and obesity risk in the Framingham Heart Study.

http://www.ncbi.nlm.nih.gov/pubmed/?term=17211608

Corella D, Lai CQ, Demissie S, Cupples LA, Manning AK, Tucker KL, Ordovas JM.

J Nutr. 2011 Mar;141(3):380-5. doi: 10.3945/jn.110.130344. Epub 2011 Jan 5.

APOA5 gene variation interacts with dietary fat intake to modulate obesity and circulating triglycerides in a Mediterranean population.

http://www.ncbi.nlm.nih.gov/pubmed/?term=21209257

Sánchez-Moreno C, Ordovás JM, Smith CE, Baraza JC, Lee YC, Garaulet M.

Circulation. 2013 Mar 26;127(12):1283-9. doi: 10.1161/CIRCULATIONAHA.112.000586. Epub 2013 Feb 27.

Variants in glucose- and circadian rhythm-r elated genes affect the response of energy expenditure to weight-loss diets: the POUNDS LOST Trial.

http://www.ncbi.nlm.nih.gov/pubmed/?term=24335056

Mirzaei K, Xu M, Qi Q, de Jonge L, Bray GA, Sacks F, Qi L.

Am J Clin Nutr. 2014 Feb;99(2):392-9. doi: 10.3945/ajcn.113.072066. Epub 2013 Dec 11.

Genetic determinant for amino acid metabolites and changes in body weight and insulin resistance in response to weight-loss diets: the Preventing Overweight Using Novel Dietary Strategies (POUNDS L OST trial.

http://www.ncbi.nlm.nih.gov/pubmed/?term=23446828

Xu M, Qi Q, Liang J, Bray GA, Hu FB, Sacks FM, Qi L.

CARB UTILIZATION

Diabetes Care. 2016 Nov;39(11):1909-1914. Epub 2016 Aug 31.

Macronutrient Intake-Associated FGF21 Genotype Modifies Effects of Weight-Loss Diets on 2-Year Changes of Central Adiposity and Body Composition: The POUNDS Lost Trial

https://www.ncbi.nlm.nih.gov/pubmed/27581055

Heianza Y, Ma W, Huang T, Wang T, Zheng Y, Smith SR, Bray GA, Sacks FM, Qi L.

Hum Mol Genet. 2013 May 1;22(9):1895-902. doi: 10.1093/hmg/ddt032. Epub 2013 Jan 30.

Novel locus including FGF21 is associated with dietary macronutrient intake.

https://www.ncbi.nlm.nih.gov/pubmed/23372041

Chu AY, Workalemahu T, Paynter NP, Rose LM, Giulianini F, Tanaka T, Ngwa JS; CHARGE Nutrition Working Group, Qi Q, Curhan GC, Rimm EB, Hunter DJ, Pasquale LR, Ridker PM, Hu FB, Chasman DI, Qi L; DietGen Consortium.

Am J Clin Nutr. 2013 Jun;97(6):1395-402. doi: 10.3945/ajcn.112.052183. Epub 2013 May 1.

Genome-wide meta-analysis of observational studies shows common genetic variants associated with macronutrient intake.

https://www.ncbi.nlm.nih.gov/pubmed/23636237

Tanaka T1, Ngwa JS, van Rooij FJ, Zillikens MC, Wojczynski MK, Frazier-Wood AC, Houston DK, Kanoni S, Lemaitre RN, Luan J, Mikkilä V, Renstrom F, Sonestedt E, Zhao JH, Chu AY, Qi L, Chasman DI, de Oliveira Otto MC, Dhurandhar EJ, Feitosa MF, Johansson I, Khaw KT, Lohman KK, Manichaikul A, McKeown NM, Mozaffarian D, Singleton A, Stirrups K, Viikari J, Ye Z, Bandinelli S, Barroso I, Deloukas P, Forouhi NG, Hofman A, Liu Y, Lyytikäinen LP, North KE, Dimitriou M, Hallmans G, Kähönen M, Langenberg C, Ordovas JM, Uitterlinden AG, Hu FB, Kalafati IP, Raitakari O, Franco OH, Johnson A, Emilsson V, Schrack JA, Semba RD, Siscovick DS, Arnett DK, Borecki IB, Franks PW, Kritchevsky SB, Lehtimäki T, Loos RJ, Orho-Melander M, Rotter JI, Wareham NJ, Witteman JC, Ferrucci L, Dedoussis G, Cupples LA, Nettleton JA.

Cell Rep. 2018 Apr 10;23(2):327-336. doi: 10.1016/j.celrep.2018.03.070

A Common Allele in FGF21 Associated with Sugar Intake Is Associated with Body Shape, Lower Total Body-Fat Percentage, and Higher Blood Pressure

https://www.ncbi.nlm.nih.gov/pubmed/29641994

Frayling TM, Beaumont RN, Jones SE, Yaghootkar H, Tuke MA, Ruth KS, Casanova F, West B, Locke J, Sharp S, Ji Y, Thompson W, Harrison J, Etheridge AS, Gallins PJ, Jima D, Wright F, Zhou Y, Innocenti F, Lindgren CM, Grarup N, Murray A, Freathy RM, Weedon MN, Tyrrell J, Wood AR.

CAFFEINE METABOLISM

Hum Mol Genet. 2016 Dec 15;25(24):5472-5482. doi: 10.1093/hmg/ddw334.

Genome-wide association study of caffeine metabolites provides new insights to caffeine metabolism and dietary caffeine-consumption behavior.

https://www.ncbi.nlm.nih.gov/pubmed/27702941

Cornelis MC, Kacprowski T, Menni C, Gustafsson S, Pivin E, Adamski J Artati A, Eap CB, Ehret G, Friedrich N, Ganna A, Guessous I Homuth G, Lind L, Magnusson PK, Mangino M, Pedersen NL, Pietzner M, Suhre K, Völzke H; Swiss Kidney Project on Genes in Hypertension (SKIPOGH) team, Bochud M, Spector TD, Grabe HJ, Ingelsson E.

CHOLESTEROL RESPONSE TO DIETARY FAT

J Nutr. 2015 Jun;145(6):1289-94. doi: 10.3945/jn.115.212514. Epub 2015 Apr 29.

Dietary fat intake modifies the effect of a common variant in the LIPC gene on changes in serum lipid concentrations during a long-term weight-loss intervention trial

https://www.ncbi.nlm.nih.gov/pubmed/?term=25926410

Xu M, Ng SS, Bray GA, Ryan DH, Sacks FM, Ning G, Qi L6

POLYUNATURATED FATTY ACID LEVELS

PLoS Genet. 2009 Jan;5(1):e1000338. doi: 10.1371/journal.pgen.1000338. Epub 2009 Jan 16.

Genome-wide association study of plasma polyunsaturated fatty acids in the InCHIANTI Study

https://www.ncbi.nlm.nih.gov/pubmed/19148276

Tanaka T1, Shen J, Abecasis GR, Kisialiou A, Ordovas JM, Guralnik JM, Singleton A, Bandinelli S, Cherubini A, Arnett D, Tsai MY, Ferrucci L.

Circ Cardiovasc Genet. 2014 Jun;7(3):321-31. doi: 10.1161/CIRCGENETICS.113.000208. Epub 2014 May 13.

Genome-wide association study of plasma N6 polyunsaturated fatty acids within the cohorts for heart and aging research in genomic epidemiology consortium

https://www.ncbi.nlm.nih.gov/pubmed/24823311

Guan W, Steffen BT, Lemaitre RN, Wu JH, Tanaka T, Manichaikul A, Foy M, Rich SS, Wang L, Nettleton JA, Tang W, Gu X, Bandinelli S, King IB, McKnight B, Psaty BM, Siscovick D, Djousse L, Ida Chen YD, Ferrucci L, Fornage M, Mozafarrian D, Tsai MY, Steffen LM.

Hum Mol Genet. 2006 Jun 1;15(11):1745-56. Epub 2006 May 2.

Common genetic variants of the FADS1 FADS2 gene cluster and their reconstructed haplotypes are associated with the fatty acid composition in phospholipids

https://www.ncbi.nlm.nih.gov/pubmed/16670158

Schaeffer L1, Gohlke H, Mûller M, Heid IM, Palmer LJ, Kompauer I, Demmelmair H, Illig T, Koletzko B, Heinrich J.

INSULIN RESPONSE TO DIETARY FAT

J Nutr. 2015 May;145(5):977-82. doi: 10.3945/jn.115.210005. Epub 2015 Mar 11.

Dietary fat modifies the effects of FTO genotype on changes in insulin sensitivity

https://www.ncbi.nlm.nih.gov/pubmed/?term=25761503

Zheng Y1, Huang T1, Zhang X2, Rood J3, Bray GA3, Sacks FM1, Qi L4.

VITAMIN B9 – FOLATE TENDENCY

Proc Nutr Soc. 2014 Feb;73(1):47-56. doi: 10.1017/S0029665113003613. Epub 2013 Oct 17.

MTHFR 677TT genotype and disease risk: is there a modulating role for B-vitamins?

http://www.ncbi.nlm.nih.gov/pubmed/?term=24131523

Reilly R, McNulty H1, Pentieva K, Strain JJ, Ward M.

VITAMIN A TENDENCY

FASEB J. 2009 Apr;23(4):1041-53. doi: 10.1096/fj.08-121962. Epub 2008 Dec 22.

Two common single nucleotide polymorphisms in the gene encoding beta-carotene 15,15'-monoxygenase alter beta-carotene metabolism in female volunteers.

http://www.ncbi.nlm.nih.gov/pubmed/?term=19103647

Leung WC, Hessel S, Méplan C, Flint J, Oberhauser V, Tourniaire F, Hesketh JE, von Lintig J, Lietz G.

VITAMIN B6 TENDENCY

Am J Hum Genet. 2009 Apr;84(4):477-82. doi: 10.1016/j.ajhg.2009.02.011. Epub 2009 Mar 19.

Genome-wide association study of vitamin B6, vitamin B12, folate, and homocysteine blood concentrations.

http://www.ncbi.nlm.nih.gov/pubmed/?term=19303062

Tanaka T, Scheet P, Giusti B, Bandinelli S, Piras MG, Usala G, Lai S, Mulas A, Corsi AM, Vestrini A, So i F, Gori AM, Abbate R, Guralnik J, Singleton A, Abecasis GR, Schlessinger D, Uda M, Ferrucci L.

VITAMIN B12 TENDENCY

Nat Genet. 2008 Oct;40(10):1160-2. doi: 10.1038/ng.210. Epub 2008 Sep 7.

Common variants of FUT2 are associated with plasma vitamin B12 levels.

http://www.ncbi.nlm.nih.gov/pubmed/?term=18776911

Hazra A, Kraft P, Selhub J, Giovannucci EL, Thomas G, Hoover RN, Chanock SJ, Hunter DJ.

VITAMIN C TENDENCY

Am J Clin Nutr. 2010 Aug;92(2):375-82. doi: 10.3945/ajcn.2010.29438. Epub 2010 Jun 2.

Genetic variation at the SLC23A1 locus is associated with cir culating concentrations of L-ascorbic acid (vitamin C : evidence from 5 independent studies with >15,000 participants.

http://www.ncbi.nlm.nih.gov/pubmed/?term=20519558

Timpson NJ, Forouhi NG, Brion MJ, Harbord RM, Cook DG, Johnson P, McConnachie A, Morris RW, Rodriguez S, Luan J, Ebrahim S, Padmanabhan S, Watt G, Bruckdorfer KR, Wareham NJ, Whincup PH, Chanock S, Sattar N, Lawlor DA, Davey Smith G.

VITAMIN D TENDENCY

Lancet. 2010 Jul 17;376(9736):180-8. doi: 10.1016/S0140-6736(10)60588-0. Epub 2010 Jun 10.

Common genetic determinants of vitamin D insufficiency: a genome-wide association study.

http://www.ncbi.nlm.nih.gov/pubmed/?term=20541252

Wang TJ, Zhang F, Richards JB, Kestenbaum B, van Meurs JB, Berry D, Kiel DP, Streeten EA, Ohlsson C, Koller DL, Peltonen L, Cooper JD, O'Reilly PF, Houston DK, Glazer NL, Vandenput L, Peacock M, Shi J, Rivadeneira F, McCarthy MI, Anneli P, de Boer IH, Mangino M, Kato B, Smyth DJ, Booth SL, Jacques PF, Burke GL, Goodarzi M, Cheung CL, Wolf M, Rice K, Goltzman D, Hidiroglou N, Ladouceur M, Wareham NJ, Hocking LJ, Hart D, Arden NK, Cooper C, Malik S, Fraser WD, Hartikainen AL, Zhai G, Macdonald HM, Forouhi NG, Loos RJ, Reid DM, Hakim A, Dennison E, Liu Y, Power C, Stevens HE, Jaana L, Vasan RS, Soranzo N, Bojunga J, Psaty BM, Lorentzon M, Foroud T, Harris TB, Hofman A, Jansson JO, Cauley JA, Uitterlinden AG, Gibson Q, Järvelin MR, Karasik D, Siscovick DS, Econs MJ, Kritchevsky SB, Florez JC, Todd JA, Dupuis J, Hyppönen E, Spector TD.

IRON TENDENCY

Hum Mol Genet. 2011 Mar 15;20(6):1232-40. doi: 10.1093/hmg/ddq552. Epub 2010 Dec 28.

Identification of a common variant in the TFR2 gene implicated in the physiological regulation of serum iron levels

https://www.ncbi.nlm.nih.gov/pubmed/212089373

Pichler I, Minelli C, Sanna S, Tanaka T, Schwienbacher C, Naitza S, Porcu E, Pattaro C, Busonero F, Zanon A, Maschio A, Melville SA, Grazia Piras M, Longo DL, Guralnik J, Hernandez D, Bandinelli S, Aigner E, Murphy AT, Wroblewski V, Marroni F, Theurl I, Gnewuch C, Schadt E, Mitterer M, Schlessinger D, Ferrucci L, Witcher DR, Hicks AA, Weiss G, Uda M, Pramstaller PP.

Blood. 2010 Jan 7;115(1):94-6. doi: 10.1182/blood-2009-07-232496. Epub 2009 Oct 30.

A genome-wide association analysis of serum iron concentrations

https://www.ncbi.nlm.nih.gov/pubmed/19880490

Tanaka T, Roy CN, Yao W, Matteini A, Semba RD, Arking D, Walston JD, Fried LP, Singleton A, Guralnik J, Abecasis GR, Bandinelli S, Longo DL, Ferrucci L.

Nat Genet. 2009 Nov;41(11):1173-5. doi: 10.1038/ng.456. Epub 2009 Oct 11.

Common variants in TMPRSS6 are associated with iron status and erythrocyte volume

https://www.ncbi.nlm.nih.gov/pubmed/19820699

Benyamin B1, Ferreira MA, Willemsen G, Gordon S, Middelberg RP, McEvoy BP, Hottenga JJ, Henders AK, Campbell MJ, Wallace L, Frazer IH, Heath AC, de Geus EJ, Nyholt DR, Visscher PM, Penninx BW, Boomsma DI, Martin NG, Montgomery GW, Whitfield JB.

Haematologica. 2009 Jun;94(6):840-9. doi: 10.3324/haematol.2008.001867. Epub 2009 Apr 18.

Matriptase-2 (TMPRSS6): A Proteolytic Regulator Of Iron Homeostasis

https://www.ncbi.nlm.nih.gov/pubmed/19377077

Ramsay AJ, Hooper JD, Folgueras AR, Velasco G, López-Otín C.

Nat Genet. 2008 May;40(5):569-71. doi: 10.1038/ng.130. Epub 2008 Apr 13.

Mutations in TMPRSS6 cause iron-refractory iron deficiency anemia (IRIDA)

https://www.ncbi.nlm.nih.gov/pubmed/18408718

Finberg KE, Heeney MM, Campagna DR, Aydinok Y, Pearson HA, Hartman KR, Mayo MM, Samuel SM, Strouse JJ, Markianos K, Andrews NC, Fleming MD.

Science. 2008 May 23;320(5879):1088-92. doi: 10.1126/science.1157121. Epub 2008 May 1.

The Serine Protease TMPRSS6 Is Required to Sense Iron Deficiency

https://www.ncbi.nlm.nih.gov/pubmed/18451267

Du X, She E, Gelbart T, Truksa J, Lee P, Xia Y, Khovananth K, Mudd S, Mann N, Moresco EM, Beutler E, Beutler B.

Cell Metab. 2008 Dec;8(6):502-11. doi: 10.1016/j.cmet.2008.09.012. Epub 2008 Oct 30.

The serine protease matriptase-2 (TMPRSS6) inhibits hepcidin activation by cleaving membrane hemojuvelin.

https://www.ncbi.nlm.nih.gov/pubmed/18976966

Silvestri L, Pagani A, Nai A, De Domenico I, Kaplan J, Camaschella C.

Nat Genet. 2004 Jan;36(1):77-82. Epub 2003 Nov 30.

Mutations in HFE2 cause iron overload in chromosome 1q–linked juvenile hemochromatosis

https://www.ncbi.nlm.nih.gov/pubmed/14647275

Papanikolaou G, Samuels ME, Ludwig EH, MacDonald ML, Franchini PL, Dubé MP, Andres L, MacFarlane J, Sakellaropoulos N, Politou M, Nemeth E, Thompson J, Risler JK, Zaborowska C, Babakaiff R, Radomski CC, Pape TD, Davidas O, Christakis J, Brissot P, Lockitch G, Ganz T, Hayden MR, Goldberg YP.

MAGNESIUM TENDENCY

PLoS Genet. 2010 Aug 5;6(8). pii: e1001045. doi: 10.1371/journal.pgen.1001045.

Genome-wide association studies of serum magnesium, potassium, and sodium concentrations identify six loci influencing serum magnesium levels

https://www.ncbi.nlm.nih.gov/pubmed/?term=20700443

Meyer TE, Verwoert GC, Hwang SJ, Glazer NL, Smith AV, van Rooij FJ, Ehret GB, Boerwinkle E, Felix JF, Leak TS, Harris TB, Yang Q, Dehghan A, Aspelund T, Katz R, Homuth G, Kocher T, Rettig R, Ried JS, Gieger C, Prucha H, Pfeufer A, Meitinger T, Coresh J, Hofman A, Sarnak MJ, Chen YD, Uitterlinden AG, Chakravarti A, Psaty BM, van Duijn CM, Kao WH, Witteman JC, Gudnason V, Siscovick DS, Fox CS, Köttgen A; Genetic Factors for Osteoporosis Consortium; Meta Analysis of Glucose and Insulin Related Traits Consortium.

BMC Genet. 2015 May 29;16:56. doi: 10.1186/s12863-015-0219-7.

Genetic loci for serum magnesium among African-Americans and gene-environment interaction at MUC1 and TRPM6 in European-Americans

https://www.ncbi.nlm.nih.gov/pubmed/?term=26058915

Tin A, Köttgen A, Folsom AR, Maruthur NM, Tajuddin SM, Nalls MA, Evans MK, Zonderman AB, Friedrich CA, Boerwinkle E, Coresh J, Kao WH

SELENIUM TENDENCY / ZINC TENDENCY

Hum Mol Genet. 2013 Oct 1;22(19):3998-4006. doi: 10.1093/hmg/ddt239. Epub 2013 May 29.

Genome-wide association study identifies loci affecting blood copper, selenium and zinc

https://www.ncbi.nlm.nih.gov/pubmed/?term=23720494

Evans DM, Zhu G, Dy V, Heath AC, Madden PA, Kemp JP, McMahon G, St Pourcain B, Timpson NJ, Golding J, Lawlor DA, Steer C, Montgomery GW, Martin NG, Smith GD, Whitfield JB.

CALCIUM TENDENCY

PLoS Genet. 2013;9(9):e1003796. doi: 10.1371/journal.pgen.1003796. Epub 2013 Sep 19.

Meta-analysis of genome-wide association studies identifies six new loci for serum calcium concentrations

https://www.ncbi.nlm.nih.gov/pubmed/?term=24068962

O'Seaghdha CM, Wu H, Yang Q, Kapur K, Guessous I, Zuber AM, Köttgen A, Stoudmann C, Teumer A, Kutalik Z, Mangino M, Dehghan A, Zhang W, Eiriksdottir G, Li G, Tanaka T, Portas L, Lopez LM, Hayward C, Lohman K, Matsuda K, Padmanabhan S, Firsov D, Sorice R, Ulivi S, Brockhaus AC, Kleber ME, Mahajan A, Ernst FD, Gudnason V, Launer LJ, Mace A, Boerwinckle E, Arking DE, Tanikawa C, Nakamura Y, Brown MJ, Gaspoz JM, Theler JM, Siscovick DS, Psaty BM, Bergmann S, Vollenweider P, Vitart V, Wright AF, Zemunik T, Boban M, Kolcic I, Navarro P, Brown EM, Estrada K, Ding J, Harris TB, Bandinelli S, Hernandez D, Singleton AB, Girotto G, Ruggiero D, d'Adamo AP, Robino A, Meitinger T, Meisinger C, Davies G, Starr JM, Chambers JC, Boehm BO, Winkelmann BR, Huang J, Murgia F, Wild SH, Campbell H, Morris AP, Franco OH, Hofman A, Uitterlinden AG, Rivadeneira F, Völker U, Hannemann A, Biffar R, Hoffmann W, Shin SY, Lescuyer P, Henry H, Schurmann C; SUNLIGHT Consortium; GEFOS Consortium, Munroe PB, Gasparini P, Pirastu N, Ciullo M, Gieger C, März W, Lind L, Spector TD, Smith AV, Rudan I, Wilson JF, Polasek O, Deary IJ, Pirastu M, Ferrucci L, Liu Y, Kestenbaum B, Kooner JS, Witteman JC, Nauck M, Kao WH, Wallaschofski H, Bonny O, Fox CS, Bochud M.

HDL RESPONSE TO CARDIO

Metabolism. 2004 Jan;53(1):108-16.

Association of apolipoprotein E polymorphism with blood lipids and maximal oxygen uptake in the sedentary state and after exercise training in the HERI TAGE family study.

http://www.ncbi.nlm.nih.gov/pubmed/14681851

Leon AS, Togashi K, Rankinen T, Després JP, Rao DC, Skinner JS, Wilmore JH, Bouchard C.

GLUCOSE RESPONSE TO CARDIO

Am J Physiol Endocrinol Metab. 2005 Jun;288(6):E1168-78. Epub 2005 Feb 1.

Influence of Pro12Ala peroxisome proliferator-activated receptor gamma2 polymorphism on glucose response to exercise training in type 2 diabetes.

http://www.ncbi.nlm.nih.gov/pubmed/15986237

Adamo KB, Sigal RJ, Williams K, Kenny G, Prud'homme D, Tesson F.

Diabetologia. 2010 Apr;53(4):679-89. doi: 10.1007/s00125-009-1630-2. Epub 2009 Dec 31.

Improvements in glucose homeostasis in response to regular exercise are influenced by the PPARG Pro12Ala variant: results from the HERITAGE Family Study.

http://www.ncbi.nlm.nih.gov/pubmed/20043145

Ruchat SM, Rankinen T, Weisnagel SJ, Rice T, Rao DC, Bergman RN, Bouchard C, Pérusse L.

Metabolism. 2003 Feb;52(2):209-12.

PPARgamma gene polymorphism is associated with exercise-mediated changes of insulin resistance in healthy men.

www.ncbi.nlm.nih.gov/pubmed/12601634

Kahara T, Takamura T, Hayakawa T, Nagai Y, Yamaguchi H, Katsuki T, Katsuki K, Katsuki M, Kobayashi K.

INSULIN SENSITIVITY RESPONSE TO CARDIO

Am J Physiol Endocrinol Metab. 2005 Jun;288(6):E1168-78. Epub 2005 Feb 1.

Endurance training-induced changes in insulin sensitivity and gene expression.

http://www.ncbi.nlm.nih.gov/pubmed/15687108

Teran-Garcia M, Rankinen T, Koza RA, Rao DC, Bouchard C.

Diabetes. 2005 Jul;54(7):2251-5.

Hepatic lipase gene variant -514C>T is associated with lipoprotein and insulin sensitivity response to regular exercise: the HERITAGE Family Study.

http://www.ncbi.nlm.nih.gov/pubmed/15983229

Teran-Garcia M, Santoro N, Rankinen T, Bergeron J, Rice T, Leon AS, Rao DC, Skinner JS, Bergman RN, Després JP, Bouchard C; HERITAGE Family Study.

TESTOSTERONE LEVELS

PLoS Genet. 2011 Oct;7(10):e1002313. doi: 10.1371/journal.pgen.1002313. Epub 2011 Oct 6.

Genetic determinants of serum testosterone concentrations in men.

https://www.ncbi.nlm.nih.gov/pubmed/?term=21998597

Ohlsson C, Wallaschofski H, Lunetta KL, Stolk L, Perry JR, Koster A, Petersen AK, Eriksson J, Lehtimäki T, Huhtaniemi IT, Hammond GL, Maggio M, Coviello AD; EMAS Study Group, Ferrucci L, Heier M, Hofman A, Holliday KL, Jansson JO, Kähönen M, Karasik D, Karlsson MK, Kiel DP, Liu Y, Ljunggren O, Lorentzon M, Lyytikäinen LP, Meitinger T, Mellström D, Melzer D, Miljkovic I, Nauck M, Nilsson M, Penninx B, Pye SR, Vasan RS, Reincke M, Rivadeneira F, Tajar A, Teumer A, Uitterlinden AG, Ulloor J, Viikari J, Völker U, Völzke H, Wichmann HE, Wu TS, Zhuang WV, Ziv E, Wu FC, Raitakari O, Eriksson A, Bidlingmaier M, Harris TB, Murray A, de Jong FH, Murabito JM, Bhasin S, Vandenput L, Haring R.

TRIGLYCERIDE RESPONSE TO CARDIO

Br J Sports Med. 2015 Dec;49(23):1524-31. doi: 10.1136/bjsports-2015-095179. Epub 2015 Oct 21.

Genomic and transcriptomic predictors of triglyceride response to regular exercise

https://www.ncbi.nlm.nih.gov/pubmed/?term=26491034

Sarzynski MA, Davidsen PK, Sung YJ, Hesselink MK, Schrauwen P, Rice TK, Rao DC, Falciani F, Bouchard C

INTRINSIC MOTIVATION TO EXERCISE

J Behav Med. 2014 Dec;37(6):1180-92. doi: 10.1007/s10865-014-9567-4. Epub 2014 May 8.

What keeps a body moving? The brain-derived neurotrophic factor val66met polymorphism and intrinsic motivation to exercise in humans

https://www.ncbi.nlm.nih.gov/pubmed/?term=24805993

Caldwell Hooper AE1, Bryan AD, Hagger MS.

IMPULSE CONTROL & TASTE PREFERENCE WITH AGING

Mol Psychiatry. 2015 Feb;20(1):133-39. doi: 10.1038/mp.2014.49. Epub 2014 May 27.

FTO genotype and aging: pleiotropic longitudinal effects on adiposity, brain function, impulsivity and diet

https://www.ncbi.nlm.nih.gov/pubmed/?term=24863145

Chuang YF, Tanaka T, Beason-Held LL, An Y, Terracciano A, Sutin AR, Kraut M, Singleton AB, Resnick SM, Thambisetty M

POWER / ENDURANCE POTENTIAL

J Sci Med Sport. 2018 Feb;21(2):213-220. doi: 10.1016/j.jsams.2017.06.012. Epub 2017 Jun 21.

Nine genetic polymorphisms associated with power athlete status - A Meta-Analysis.

https://www.ncbi.nlm.nih.gov/pubmed/?term=28666769

Weyerstraß J, Stewart K, Wesselius A, Zeegers M.

VO2 MAX

Physiol Genomics. 2003 Jul 7;14(2):161-6.

Associations between cardiorespiratory responses to exercise and the C34T AMPD1 gene polymorphism in the HERITAGE Family Study.

https://www.ncbi.nlm.nih.gov/pubmed/12783984

Rico-Sanz J, Rankinen T, Joanisse DR, Leon AS, Skinner JS, Wilmore JH, Rao DC, Bouchard C; HERITAGE Family study.

Article number: 16015 (2017) doi:10.1038/ncomms16015

Large-scale GWAS identifies multiple loci for hand grip strength providing biological insights into muscular fitness

https://www.nature.com/articles/ncomms16015

Sara M. Willems, Daniel J. Wright, Robert A. Scott

Metabolism. 2004 Jan;53(1):108-16.

Association of apolipoprotein E polymorphism with blood lipids and maximal oxygen uptake in the sedentary state and after exercise training in the HERITAGE family study.

https://www.ncbi.nlm.nih.gov/pubmed/14681851

Leon AS, Togashi K, Rankinen T, Després JP, Rao DC, Skinner JS, Wilmore JH, Bouchard C.

EXERCISE HEART RATE RESPONSE

Circ Cardiovasc Genet. 2010 Jun;3(3):294-9. doi: 10.1161/CIRCGENETICS.109.925644. Epub 2010 Apr 20.

CREB1 is a strong genetic predictor of the variation in exercise heart rate response to regular exercise: the HERITAGE Family Study.

https://www.ncbi.nlm.nih.gov/pubmed/20407090

Rankinen T1, Argyropoulos G, Rice T, Rao DC, Bouchard C.

EXERCISE STROKE VOLUME RESPONSE

Physiol Genomics. 2009 Jan 8;36(2):79-88. doi: 10.1152/physiolgenomics.00003.2008. Epub 2008 Nov 4.

KIF5B gene sequence variation and response of cardiac stroke volume to regular exercise.

https://www.ncbi.nlm.nih.gov/pubmed/18984674

Argyropoulos G, Stütz AM, Ilnytska O, Rice T, Teran-Garcia M, Rao DC, Bouchard C, Rankinen T.

SYSTEMIC INFLAMMATION

Circulation. 2011 Feb 22;123(7):731-8. doi: 10.1161/CIRCULATIONAHA.110.948570. Epub 2011 Feb 7.

Meta-analysis of genome-wide association studies in >80 000 subjects identifies multiple loci for C-reactive protein levels.

https://www.ncbi.nlm.nih.gov/pubmed/?term=21300955

Dehghan A, Dupuis J, Barbalic M, Bis JC, Eiriksdottir G, Lu C, Pellikka N, Wallaschofski H, Kettunen J, Henneman P, Baumert J, Strachan DP, Fuchsberger C, Vitart V, Wilson JF, Paré G, Naitza S, Rudock ME, Surakka I, de Geus EJ, Alizadeh BZ, Guralnik J, Shuldiner A, Tanaka T, Zee RY, Schnabel RB, Nambi V, Kavousi M, Ripatti S, Nauck M, Smith NL, Smith AV, Sundvall J, Scheet P, Liu Y, Ruokonen A, Rose LM, Larson MG, Hoogeveen RC, Freimer NB, Teumer A, Tracy RP, Launer LJ, Buring JE, Yamamoto JF, Folsom AR, Sijbrands EJ, Pankow J, Elliott P, Keaney JF, Sun W, Sarin AP, Fontes JD, Badola S, Astor BC, Hofman A, Pouta A, Werdan K, Greiser KH, Kuss O, Meyer zu Schwabedissen HE, Thiery J, Jamshidi Y, Nolte IM, Soranzo N, Spector TD, Völzke H, Parker AN, Aspelund T, Bates D, Young L, Tsui K, Siscovick DS, Guo X, Rotter JI, Uda M, Schlessinger D, Rudan I, Hicks AA, Penninx BW, Thorand B, Gieger C, Coresh J, Willemsen G, Harris TB, Uitterlinden AG, Järvelin MR, Rice K, Radke D, Salomaa V, Willems van Dijk K, Boerwinkle E, Vasan RS, Ferrucci L, Gibson QD, Bandinelli S, Snieder H, Boomsma DI, Xiao X, Campbell H, Hayward C, Pramstaller PP, van Duijn CM, Peltonen L, Psaty BM, Gudnason V, Ridker PM, Homuth G, Koenig W, Ballantyne CM, Witteman JC, Benjamin EJ, Perola M, Chasman DI.

INJURY RISK

Nat Genet. 2012 Apr 15;44(5):491-501. doi: 10.1038/ng.2249.

Genome-wide meta-analysis identifies 56 bone mineral density loci and reveals 14 loci associated with risk of fracture.

https://www.ncbi.nlm.nih.gov/pubmed/?term=22504420

Estrada K, Styrkarsdottir U, Evangelou E, Hsu YH, Duncan EL, Ntzani EE, Oei L, Albagha OM, Amin N, Kemp JP, Koller DL, Li G, Liu CT, Minster RL, Moayyeri A, Vandenput L, Willner D, Xiao SM, Yerges-Armstrong LM, Zheng HF, Alonso N, Eriksson J, Kammerer CM, Kaptoge SK, Leo PJ, Thorleifsson G, Wilson SG, Wilson JF, Aalto V, Alen M, Aragaki AK, Aspelund T, Center JR, Dailiana Z, Duggan DJ, Garcia M, Garcia-Giralt N, Giroux S, Hallmans G, Hocking LJ, Husted LB, Jameson KA, Khusainova R, Kim GS, Kooperberg C, Koromila T, Kruk M, Laaksonen M, Lacroix AZ, Lee SH, Leung PC, Lewis JR, Masi L, Mencej-Bedrac S, Nguyen TV, Nogues X, Patel MS, Prezelj J, Rose LM, Scollen S, Siggeirsdottir K, Smith AV, Svensson O, Trompet S, Trummer O, van Schoor NM, Woo J, Zhu K, Balcells S, Brandi ML, Buckley BM, Cheng S, Christiansen C, Cooper C, Dedoussis G, Ford I, Frost M, Goltzman D, González-Macías J, Kähönen M, Karlsson M, Khusnutdinova E, Koh JM, Kollia P, Langdahl BL, Leslie WD, Lips P, Ljunggren Ö, Lorenc RS, Marc J, Mellström D, Obermayer-Pietsch B, Olmos JM, Pettersson-Kymmer U, Reid DM, Riancho JA, Ridker PM, Rousseau F, Slagboom PE, Tang NL, Urreizti R, Van Hul W, Viikari J, Zarrabeitia MT, Aulchenko YS, Castano-Betancourt M, Grundberg E, Herrera L, Ingvarsson T, Johannsdottir H, Kwan T, Li R, Luben R, Medina-Gómez C, Palsson ST, Reppe S, Rotter JI, Sigurdsson G, van Meurs JB, Verlaan D, Williams FM, Wood AR, Zhou Y, Gautvik KM, Pastinen T, Raychaudhuri S, Cauley JA, Chasman DI, Clark GR, Cummings SR, Danoy P, Dennison EM, Eastell R, Eisman JA, Gudnason V, Hofman A, Jackson RD, Jones G, Jukema JW, Khaw KT, Lehtimäki T, Liu Y, Lorentzon M, McCloskey E, Mitchell BD, Nandakumar K, Nicholson GC, Oostra BA, Peacock M, Pols HA, Prince RL, Raitakari O, Reid IR, Robbins J, Sambrook PN, Sham PC, Shuldiner AR, Tylavsky FA, van Duijn CM, Wareham NJ, Cupples LA, Econs MJ, Evans DM, Harris TB, Kung AW, Psaty BM, Reeve J, Spector TD, Streeten EA, Zillikens MC, Thorsteinsdottir U, Ohlsson C, Karasik D, Richards JB, Brown MA, Stefansson K, Uitterlinden AG, Ralston SH, Ioannidis JP, Kiel DP, Rivadeneira F.

SLEEP DURATION

Mol Psychiatry. 2013 Jan;18(1):122-32. doi: 10.1038/mp.2011.142. Epub 2011 Nov 22.

A K(ATP) channel gene effect on sleep duration: from genome-wide association studies to function in Drosophila

https://www.ncbi.nlm.nih.gov/pubmed/?term=22105623

Allebrandt KV1, Amin N, Müller-Myhsok B, Esko T, Teder-Laving M, Azevedo RV, Hayward C, van Mill J, Vogelzangs N, Green EW, Melville SA, Lichtner P, Wichmann HE, Oostra BA, Janssens AC, Campbell H, Wilson JF, Hicks AA, Pramstaller PP, Dogas Z, Rudan I, Merrow M, Penninx B, Kyriacou CP, Metspalu A, van Duijn CM, Meitinger T, Roenneberg T.

Mol Psychiatry. 2015 Oct;20(10):1232-9. doi: 10.1038/mp.2014.133. Epub 2014 Dec 2.

Novel loci associated with usual sleep duration: the CHARGE Consortium Genome-Wide Association Study

https://www.ncbi.nlm.nih.gov/pubmed/?term=25469926

Gottlieb DJ, Hek K, Chen TH, Watson NF, Eiriksdottir G, Byrne EM, Cornelis M, Warby SC, Bandinelli S, Cherkas L, Evans DS, Grabe HJ, Lahti J, Li M Lehtimäki T Lumley T, Marciante KD, Pérusse L, Psaty BM, Robbins J, Tranah GJ, Vink JM Wilk JB Stafford JM, Bellis C, Biffar R, Bouchard C, Cade B Curhan GC, Eriksson JG, Ewert R Ferrucci L, Fülöp T, Gehrman PR, Goodloe R, Harris TB, Heath AC, Hernandez D, Hofman A, Hottenga JJ Hunter DJ, Jensen MK Johnson AD, Kähönen M, Kao L, Kraft P, Larkin EK, Lauderdale DS, Luik A, Medici M, Montgomery GW, Palotie A, Patel SR, Pistis G, Porcu E, Quaye L, Raitakari O, Redline S, Rimm EB, Rotter JI, Smith AV, Spector TD, Teumer A, Uitterlinden AG, Vohl MC, Widen E, Willemsen G, Young T, Zhang X, Liu Y, Blangero J, Boomsma DI, Gudnason V, Hu F, Mangino M, Martin NG, O'Connor GT, Stone KL, Tanaka T, Viikari J, Gharib SA, Punjabi NM, Räikkönen K, Völzke H, Mignot E, Tiemeier H.

Hum Mol Genet. 2016 Jan 1;25(1):167-79. doi: 10.1093/hmg/ddv434. Epub 2015 Oct 13.

Common variants in DRD2 are associated with sleep duration: the CARe consortium

https://www.ncbi.nlm.nih.gov/pubmed/?term=26464489

Cade BE, Gottlieb DJ, Lauderdale DS, Bennett DA, Buchman AS, Buxbaum SG, De Jager PL, Evans DS, Fülöp T, Gharib SA, Johnson WC, Kim H, Larkin EK, Lee SK, Lim AS, Punjabi NM, Shin C, Stone KL, Tranah GJ, Weng J, Yaffe K, Zee PC, Patel SR, Zhu X, Redline S, Saxena R.