DietaryChoice™

EATING BEHAVIOUR OBESITY AND HEALTH

- Satiety Feeling
- Bitter Taste Perception
- Sweet Taste Perception
- Sugar Consumption
- Fat Taste Perception
- Response to Fat Intake

POWERED BY fitgenes

Name: Sample Client

Kit: 0-000-000-0

Introduction

Thank you for choosing Fitgenes to assist in reviewing and managing potential issues regarding your diet and food preferences and choices along with weight management. Fitgenes is an Australian healthtech company using DNA-based reports to assist people improve their health, longevity and performance, by applying nutrigenetics and nutrigenomics evidence.

Nutrigenetics is the study of the impact of genetic variation on dietary responses, while nutrigenomics is a scientific discipline that studies how nutrients affect gene expression. This means that your genes are not your destiny: you can modify your genetic predisposition to certain conditions by making the right lifestyle choices.

THE BASICS OF DNA

The human genome consists of 23 pairs of chromosomes found in the cell nuclei, which contain genes and other non-coding sequences. Overall, it is estimated that each individual has approximately 30,000 genes. A gene is, essentially, a sequence of DNA that codes for a molecule with a function. As chromosomes come in pairs, each individual has two copies of each gene, one inherited from each parent.

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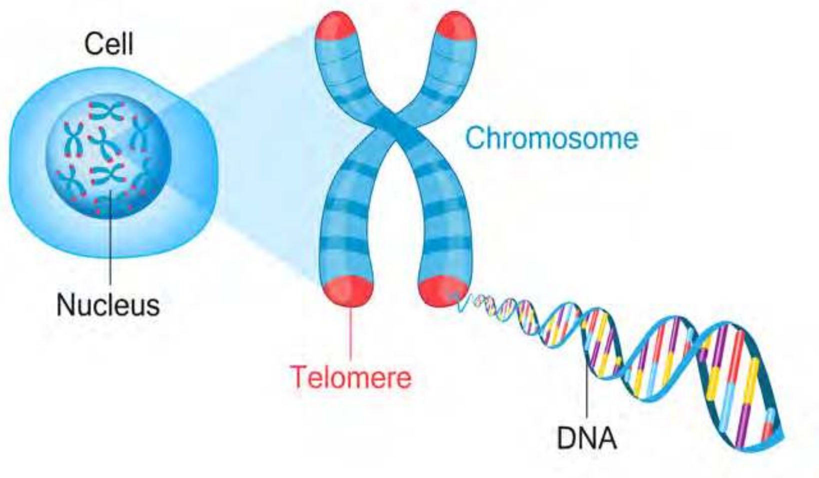


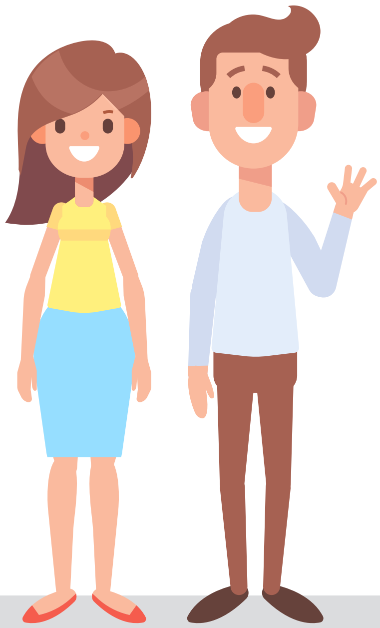
GENETICS OF EATING BEHAVIOUR AND LINK WITH OBESITY

Eating behaviour is a broad term that includes meal timing, amount of food intake, and food preferences, as well as eating-related disorders. A mix of factors, such as physiology, psychology, and social life, determine our eating behaviour. More recently, genetics is also being considered as an important factor affecting eating behaviour, since variants in genes involved in the neuroregulation of food intake, metabolism, or taste perception, have been shown to affect the way people eat.

Unhealthy eating behaviours, of which sometimes people are not aware, are directly linked to obesity, diabetes, and other chronic diseases, therefore it is important to identify and address them. These behaviours tend to run in families, and are likely to persist during adulthood if acquired during childhood.

In summary, it can be very helpful to discover your genetic predispositions to practise specific eating behaviours in order to improve not only your diet and fitness level but also your overall health.

Your Genetic Profile Report



In this report, you will identify key genes which may influence the way you eat and how this may relate to your risk of obesity, and therefore what areas you should target to assist you in maintaining a healthy diet and optimal body weight. In particular, we detail your genetic variants that influence your ability to control appetite, as well as your sugar cravings and perception of different tastes, with genotype-specific interventions. This information, combined with other assessments, can be used by an accredited health practitioner to design more personalised and targeted dietary recommendations.

In order to simplify the results, the genes tested as part of your personal profile have been grouped in the following categories:

1. **Satiety Feeling**
2. **Bitter Taste Perception**
3. **Sweet Taste Perception**
4. **Sugar Consumption**
5. **Fat Taste Perception**
6. **Response to Fat Intake**

For each gene or grouping, you can have three different results, as shown by the figure below.

Beneficial	Less Beneficial	Least Beneficial
One or both of the genes in the pair contributes to the normal healthy functioning of the gene product.	One of the genes in the pair is contributing to a situation that impairs the healthy functioning of the gene product.	Both of the genes in the pair are contributing to a situation that impairs healthy functioning of the gene product.

For categories that have multiple genes, your risk for a particular condition will be increased with the more orange (slightly increased) or red (further increased) results you have. Similarly, if you only have green results, your risk will not be increased based on the genes included in this report.

If you have any worry or concern about a particular category or result, or if there is anything you do not understand, we encourage you to speak to your health practitioner.

Scientific Note: when comparing results from Fitgenes with other sources, it is important to take into account whether testing was done
on the forward or reverse strand. For this reason, it is possible that results do not completely match, but they are still the same (C=G, A=T). Caution should be taking with complementary changes (C>G, A>T).

Disclaimer and limitations: all genes and variants presented in this report, with their corresponding implications for your health, have gone through extensive scientific iterature review. Nevertheless, genetic research is rapidly increasing, and our understanding of the information included in this report will increase over time, and so the content of future reports may vary from this one.

1 **SATIETY** Feeling

Some people feel full easily after eating small amounts of food, while others may eat more than necessary without feeling satisfied. This is due to individual differences in the feeling of satiety, which is defined as the feeling of fullness after eating. Lack of satiety after eating is one of the mechanisms through genetic predisposition is linked with weight gain risk in an environment rich with food. Poor appetite can also make gaining weight more difficult to those that are underweight.

The three best-known genes involved in the regulation of body weight through satiety control are: *LEPR* (makes the receptor for leptin, "the satiety hormone"), *MC4R* (most common gene involved in monogenic obesity), and *FTO* (known as "the fat gene").

Your Results

You are likely to feel unsatiated after eating normal amounts of food, and therefore you have higher risk of obesity in this regard (intermediate risk)

> Aim to increase satiety by consuming more foods rich in fibre and protein, water-rich foods (vegetables, salads, soups, etc), and avoid sugary foods and eating while watching TV or between meals. High protein/low carb and high fat diets suppress appetite better than low fat diets or caloric restriction. Yerba mate may help with weight balance by increasing fat burning and improving satiety. Aim for a "mindful eating" way of eating, that is, eat slowly, chew thoroughly, with smaller bites, and enjoy the meal

> Refer to the supplementary file for more tips on healthy eating patterns

2 **BITTER** Taste Perception

The way people perceive bitter substances has an effect of food preferences. People with a higher bitter-tasting ability (super-tasters and tasters) tend to be more sensitive to the taste of several foods (e.g. cruciferous vegetables, chilli peppers) and drinks (e.g. dark beer, coffee and tea), and therefore consume less of these . In fact, research has shown these individuals to have a lower vegetable intake in these individuals which can also have negative health consequences. Non-tasters, who are less sensitive to the bitter taste, have been reported to have an increased eating disinhibition and higher intake of high-fat and high-sugar foods, which therefore could cause an indirect impact on obesity risk.

Differences in taste perception are influenced by the *TAS2R38* gene, which is involved in determining our likes or dislikes of bitter and sweet tastes, and hence food preferences and, indirectly, obesity risk. In particular, the ability to perceive the bitter taste is determined by three variants in this gene.

TAS2R38 GENOTYPE

- SUPER-TASTERS
- TASTERS
- NON-TASTERS

Less obesity risk but need to monitor and ensure sufficient vegetable intake for many health reasons (SUPER-TASTERS, TASTERS)

Technical Note: since both super-tasters (those homozygous for the reference variant) and tasters (those heterozygous for the variant), are considered to have a high bitter-taste ability, there is no "Less Beneficial" result in this category

Your Results

You have normal bitter taste ability (taster)

> You are not at risk of obesity in this regard, but you may need to increase consumption of vegetables such as cabbage, spinach, and broccoli, and other healthy bitter foods and beverages, for your overall health. Although they may taste bitter, consider dressings and spices to increase palatability

> Refer to the supplementary file for a detailed list of bitter foods and beverages

3 SWEET Taste Perception

Sweetness is one of the basic tastes most commonly appreciated when consuming high-sugar foods, or other sweet chemical compounds such as aldehydes, ketones, and sugar alcohols. Not everyone perceives sweetness in the same way, as this perception is initiated when sweeteners interact with sweet taste receptor proteins, encoded by the *TAS1R2* and *TAS1R3* genes.

For this reason, genetic variants in these genes can affect sweet food choices and intake, impacting obesity risk, as well as proclivity to drink alcohol, as shown by gene-association studies. As a consequence of these genetic variants, people can be classified into "sweet-likers", which are those with a low sweet taste ability, or "sweet-dislikers", which are those who are too sensitive to the sweet taste due to their high sweet taste ability.

TAS1R2/3 GENOTYPE

HIGH SWEET TASTE PERCEPTION = SWEET-DISLIKERS

INTERMEDIATE SWEET TASTE PERCEPTION = SWEET-LIKERS

LOW SWEET TASTE PERCEPTION = SWEET-LIKERS

Your Results

You have low sweet taste ability (sweet-liker), and therefore higher risk of obesity in this regard (intermediate risk)

> Be mindful of your sweet food intake, and watch the amount of alcohol you are consuming. If you start consuming less sugar, you might eventually become more sensitive and therefore you could increase your sweet tasting ability
> Consider discussing with your practitioner about strategies to manage sweet taste
> Refer to the supplementary file for a detailed list of sweet foods highest in sugar to limit or avoid

4 **SUGAR** Consumption

Sugar provides a major number of calories with little nutritional benefit. Diets high in sugars, such as those found in sweetened soft drinks, candies, baked goods, or sugary cereals, are often associated with weight gain and other related chronic disorders (obesity, diabetes, cardiovascular disease, etc.).

Genetically, some people are more predisposed than others to prefer a diet with a high content of sugars, as it was shown by a study of the *GLUT2* gene. This gene, which is considered a sweet taste gene (but is not a taste receptor), mediates the movement of glucose in and out of the cells, and and seems to have a role as a glucose sensor in the brain. As a consequence, people with certain variants of this gene are more likely to be overweight due to a higher sugar intake **regardless of their sweet taste perception** which was discussed in the previous section.

Technical Note: while the previous section focused on the perception of sweet taste with an indirect link to sweet consumption, this section focuses on a gene directly associated with sugar consumption. Both sections should be considered when looking at the predisposition to consume different types of sweets and obesity risk

Your Results

You are not likely to prefer a high-sugar diet

> Although your genes are not making you crave sugar, you should always watch your sugar intake for health reasons
> Refer to the supplementary file for a detailed list foods that can fight sugar cravings

5 FAT Taste Perception

Fats are one of the main three macronutrients, and therefore essential part of our diet and necessary for overall good health. There are different types of fats (saturated fats, monounsaturated fats, polyunsaturated fats, and trans fats), and not all of them are equally healthy.

With trans fats increasing LDL cholesterol levels and trans fats increasing total cholesterol levels, increased consumption of this type of fats can contribute towards cardiovascular and other health issues, while trans fats can particularly contribute towards inflammatory health issues. On the other hand, unsaturated fats have diverse health benefits, such as improving total blood cholesterol levels and cardiovascular health, and reducing inflammation.

It has been reported that texture, olfaction, and oral irritation contribute to the rewarding effect of fatty foods. In particular, research shows that people can detect fatty acids *via* specialised sensors on the tongue, such as the CD36 receptor, which is a fatty acid transporter. A genetic variant in this gene has been shown to affect fat taste perception, and thus influence fat intake. It is worth mentioning that the association between fat taste perception and obesity risk is not clear yet. The relationship between fat metabolism and obesity will be better explained in the next section.

Your Results

You have low fat taste perception, and therefore higher risk of obesity in this regard (intermediate risk)

↓

> Monitor and consider the amount and type of fat you are consuming. In particular, you should limit intake of trans fats and eat saturated fats in moderation, not only for weight management but also for many health reasons

> Refer to the supplementary file for more information on recommended amounts of different types of fats and dietary sources

6 **RESPONSE** to Fat Intake

The *PPARγ* gene has a central role in adipogenesis, the process by which preadipocytes get differentiated into lipocytes and fat cells, and is highly expressed in adipose tissue (fat). As a consequence, this gene has been extensively studied in the context of obesity.

In particular, the *PPARγ* gene is important in fat metabolism, as it affects how our body stores and breaks down the fats that we eat, and genetic variation has been associated with obesity risk depending on the type of fat intake.

SATURATED FATS →

UNSATURATED FATS →

PPARγ GENOTYPE →

Your Results

You have normal PPARγ activity

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> Although up to recommended amounts of saturated fats do not seem to increase your obesity risk based on your genotype, it is generally advised to increase unsaturated fat intake and limit saturated fat intake for many health reasons

> Refer to the supplementary file for more information on recommended amounts of different types of fat and dietary sources

YOUR Genetic Profile Report: Summary

This report has been designed to identify your genetic variants associated with your eating behavior and obesity risk. Through genotype-specific interventions, you can find out how to maintain a healthy diet and optimal body weight by making the right nutrition and lifestyle choices (this can be assisted by an accredited practitioner).

We provide you with more information about each of these categories in the Supplementary File **(see also a separate section on predisposition to drink alcohol based on different sections of this and the FoodChoice™ Genetic Profiles),** and we encourage you to speak to your health practitioner if you have any concern about a particular category.

Results for Kit Id 0-000-000-0

Category	Gene (variant)	Your Result	Meaning
Satiety Feeling	LEPR-1 (rs1137101)	AA	You are likely to feel unsatiated after eating normal amounts of food, and therefore you have higher risk of obesity in this regard (intermediate risk)
	MC4R (rs12970134)	GG	
	FTO (rs9939609)	AA	
Bitter Taste Perception	TAS2R38-1 (rs713598)	CG	You have normal bitter taste ability (taster)
	TAS2R38-2 (rs1726866)	TC	
	TAS2R38-3 (rs10246939)	CT	
Sweet Taste Perception	TAS1R2 (rs12033832)	AG	You have low sweet taste ability (sweet-liker), and therefore higher risk of obesity in this regard (intermediate risk)
	TAS1R3 (rs307355)	CC	
Sugar Consumption	GLUT2 (rs5400)	CC	You are not likely to prefer a high-sugar diet
Fat Taste Perception	CD36 (rs1761667)	GA	You have low fat taste perception, and therefore higher risk of obesity in this regard (intermediate risk)
Response to Fat Intake	PPARγ (rs1801282)	CC	You have normal PPARγ activity

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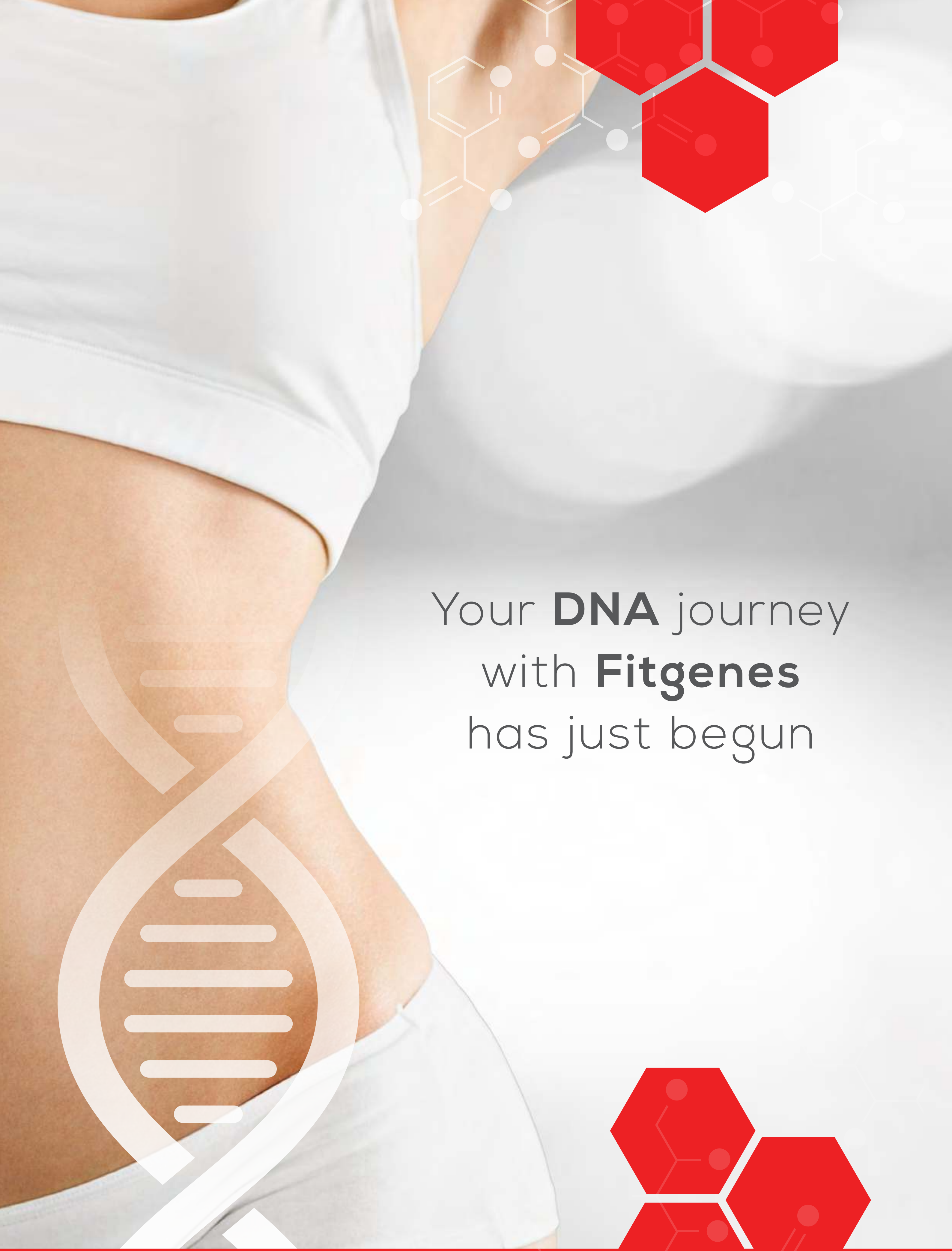


Your **DNA** journey
with **Fitgenes**
has just begun

Supplementary File

Satiety Feeling
Bitter Taste Perception
Sweet Taste Perception and Sugar Consumption
Fat Taste Perception and Response to Fat Intake
Additional: Alcohol Consumption

Satiety Feeling

Here, you can find some tips on healthy diet patterns to avoid eating more than recommended so that you can keep a stable weight:

- Do not eat until fullness. It is recommended to leave some room in your stomach for water and expansion of gas, for digestion.

- Increase consumption of foods rich in fibre and protein and water-rich foods (vegetables, salads, soups, etc), particularly if you are likely to not feel satiated after eating. These will make you feel full more easily. Diets rich in fats are also very satiating.

- Set the meals that you are going to have every day (e.g. breakfast, lunch, dinner/supper), and do not skip any, or you will be hungrier in the next meal.

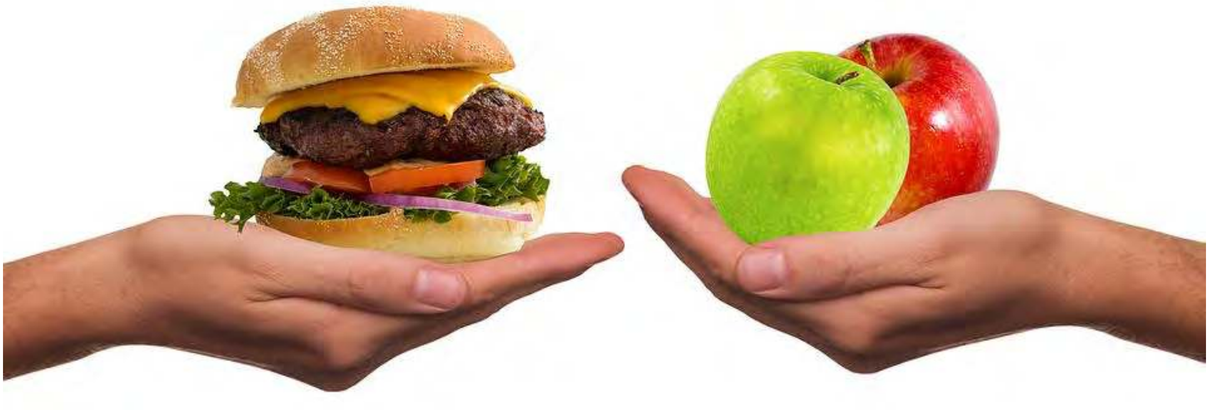
- Avoid snacking between meals. If you are going to do it, try to choose healthy foods, such as fruits, celery and carrot sticks.

- Avoid eating while watching TV. This will probably make you eat more than recommended, or make you associate this activity with eating.

- Do not eat too fast or while standing up, or when you are feeling stressed or anxious. This will also make you eat more than recommended.

- Keep a food diary to help you identify unhealthy habits you might have.

While the genes included in this section are mostly associated with an increased risk of obesity through lack of satiety after eating, it is also possible that a decreased appetite is contributing to difficulty gaining weight for those that are underweight. Discuss with your practitioner about strategies to increase appetite and achieve a healthy weight.



Bitter Taste Perception

In this table, you can find a list of bitter foods and drinks that might taste different depending on your genotype. Remember that those people with a higher bitter taste ability (super-tasters and tasters) tend to eat a lower amount of bitter foods and bitter drinks and have a lower risk of obesity, which is considered beneficial in this genetic profile. **However, some of these are healthy and their amount should be monitored in the diet, especially if not consumed enough.**

Bitter Foods	Bitter Drinks
Chicory, chard, endive, artichokes, cress, broccoli, thistles, cabbage, Brussels sprouts, cauliflower, chayote, pak choi, asparagus, lettuce, rocket, leaves of rhubarb, rutabaga, tomatoes, dandelion, tender leaves of milk thistle, mustard from China, uncured olives, cucumbers, pumpkins, courgettes, melons, many mushrooms, bitter melon, lemon juice, grapefruit juice, ginger or galangal, radicchio, arugula, kale, oranges, lemons, limes, chocolate, dandelion	Beer, red wine, coffee, tonic water, sugar-free dark chocolate, gentian spirit, juniper gentian spirit, wine of gentian, gentian liquor

Source: Botanical-online and Healthy Hildegard (modified)

Sweet Taste Perception and Sugar Consumption

The World Health Organization recommend adults and children to reduce their daily intake of free sugars (all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices) to less than 10% of their total energy intake (roughly 50 grams), or even to below 5% (roughly 25 grams) per day to provide additional health benefits. Naturally occurring sugar, such as that found in fruit and milk, is not included.

Eating too much sugar is associated with higher risk of a number of diseases, including diabetes, heart disease and obesity, as well as other problems such as tooth decay or accelerated aging.

In this section, you will find a list of sweet foods and drinks highest in sugar to limit or avoid, as well as a list of foods that can help fight sugar cravings.

Sweet foods and drinks highest in sugar to limit or avoid

Food	Grams of sugar per portion
Dulce de leche (sweetened and condensed milk)	151
Milkshake (blended with candy)	85
Grape juice	72
Sugary Drinks (Cream Soda)	66
Cake with Coconut Frosting	64
Commercial Candies	47
Fortified Yogurt	47
Fast Foods (Hot Cakes with Syrup)	45
Cereal Bars (Nutri-Grain)	39
Ready to Eat Cereals	28

Source: adapted from myfooddata.com

Foods to help fight sugar cravings

Food	Rationale
Fruit	Fruits naturally contain varied amounts of sugar, but also other beneficial nutrients. In particular, berries have a low amount of sugar and strong anti-oxidant and anti-inflammatory properties while they taste sweet. Other recommended low-sugar fruits are granny smith apples, avocados, and cucumbers.
Dark chocolate (>70%)	This is the healthier chocolate variety, as it contains polyphenols with anti-oxidant and anti-inflammatory properties
Snack bars (low-sugar content)	Some snack bars, if made with whole oats and sweetened with fresh or dried fruit, are healthier than others as they contain fiber and other healthy nutrients
Chia seeds	These contain healthy nutrients, such as omega-3 fatty acids, soluble dietary fiber and some healthy plant compounds.
Xylitol-based gum or mints	These contain no sugar and very few calories.
Legumes	Legumes have a high content of protein and fiber, which increase feeling of fullness and therefore decrease hunger-driven sugar cravings. Examples include lentils, kidney beans, and chick peas
Yogurt (sugar-free)	It is a healthy snack with protein and calcium, which has been shown to control appetite and cravings.
Dates and prunes	These are sweet foods, but also highly nutritious and full of fiber. They are also high in concentrated fruit sugar calories, so it is recommended to be careful with the portions.
Sweet potatoes	These are very sweet and filling, and also contain some amount of fiber and vitamins and minerals.
Meat, Poultry and Fish	These foods are good sources of protein, that make you feel full and help prevent sugar cravings. Other vegetarian sources of protein can have the same effect.
Smoothies	Mixes of fruit with yogurt, they are sweet and can keep you full while providing healthy nutrients.
Eggs	Eggs are other high-protein food, and it has been shown that if consumed in the morning, they will keep you fuller during the day.
Fermented foods	These have been shown to help maintain a healthy gut and prevent food cravings. Examples include sauerkraut, kimchi, and kombucha.
Whole grains	High in fiber and other healthy nutrients, these can keep you full and help prevent food cravings. Examples include brown rice, barley, and quinoa.
Vegetables	High in fiber and other healthy nutrients while low in calories. Vegetables are very healthy foods and eating them regularly can fill you up and help prevent hunger-driven sugar cravings.

Source: adapted from healthline.com

Fat Taste Perception and Response to Fat Intake

Recommended amounts

The Dietary Reference Intake according to the National Institutes of Health (USA) for fat in healthy adults is 20%-35%, which is about 44g-77g in a 2,000kcal daily diet. Overall, a healthy diet should have higher amounts of healthy unsaturated fats and limit saturated fats and work to eliminate unhealthy trans fats. However, individuals may need different ratios and higher amounts of fats than others based on genetic factors, lifestyle, and health needs. In general terms, the recommended amounts of different types of fats are as follows*:

- Monounsaturated fats: 15% to 20%.

- Polyunsaturated fats: 5% to 10%.

- Saturated fats: less than 10%.

- Trans fats: 0%.

Dietary Sources

Type of fat	Sources
Monounsaturated fats	Olive oil, macadamia oil, avocado oil, avocados, lard (technically a monounsaturated fat), some nuts (cashews and almonds)
Polyunsaturated fats	Fish, flax, hemp seed oil, sesame oil, some nuts (brazil nuts)
Saturated fats	Meat (beef, pork, lamb, and processed meats), high-fat dairy foods (whole milk, butter, cheese, sour cream, ice cream), butter, plant-derived sources (palm oil, coconut oil, milk and cream), ghee
Trans fats	Plant-derived sources (cooking margarine and copha), vegetable spreads, package foods, margarine
Fats in manufactured and packaged foods	Fatty snack foods, cakes, biscuits, etc can contain a mixture of highly-processed, highly-heated combinations of the above-mentioned fats and should be minimized or avoided

*Source: Cleveland Clinic

Additional: Alcohol Consumption

There are two sections of this genetic profile which are relevant to predisposition to drink alcohol. These are:

- **Bitter Taste Perception**: individuals with a lower bitter taste ability (non-tasters) tend to drink more dark beer and red wine, given that they are less sensitive to the bitter taste of these drinks.
- **Sweet Taste Perception**: individuals with a lower sweet taste ability (sweet-likers) tend to drink more alcohol, given that they are less sensitive to the sweet taste of some alcoholic beverages.

To better understand the risk of over-consumption of alcohol, the "**Alcohol Intolerance**" section of the FoodChoice™ genetic profile is also relevant (https://www.fitgenes.com/product/foodchoice/). Research has shown that those individuals who are not predisposed to suffer from alcohol intolerance (those with a "beneficial" result in that section) are however more likely to be more often leading to alcoholism in some cases. One of these sections alone may not have a major effect on predisposition to drink alcohol, but the three of them in addition to lifestyle factors should be considered.

The diagram below summarises what results of this genetic profile and the FoodChoice™ genetic profile are related to a predisposition to drink more alcohol than the average, and therefore individuals with those results should pay special attention to their alcohol intake. It also summarises what results suggest a lower genetic predisposition to drink alcohol.

It is of course necessary to emphasize that alcohol should always be consumed in moderation for health reasons regardless of your genetic results.