# How much is my health dominated by my genes?

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Many people believe that the fate of their health is written in their genes, such as "I got bad genes from my parents and cannot do much against getting the same diseases as them". Fortunately, this is in most cases wrong! We can do a lot against staying away from diseases. To a large extend we have our health in our own hands, *i.e.*, **it is our own responsibility to stay as long as possible healthy**.

Since more than 20 years the human genome is known, *i.e.*, the order of the 3 billion "letters" that store the information about us in each of our body cells. However, what is freely accessible in the internet as "the human genome" is based only on 7 healthy males that represents all of us to 99% but not 100%. This means that about 1% of the genome differs between all of us (if we do not belong to the same family). This rather small difference gives us different eye, hair and skin color, but also different risks getting common diseases, such as diabetes, cancer and Alzheimer's. The latter was also the believe of scientists, when they started (shortly after having the complete human sequence available) to link variations in our genome with disease risk. In part, this concept was driven by the insight from rare monogenetic diseases, such as sickle cell anemia, cystic fibrosis, Huntington disease and Duchenne muscular dystrophy, where mutations in one specific region of the genome were found to predict that the concerned individuals will get the disease more or less for sure during their lifetime. However, most of us suffer rather from common diseases that have a polygenic basis, *i.e.*, multiple genes are responsible for them. After more than 15 years of research applying the method GWAS (genome-wide association study) with millions of participants, scientists concluded that most common diseases including type 2 diabetes (but also for anthropometric properties like body height) are affected by many hundred loci in our genome. The very most of these sites have only a tiny contribution to our disease risk. Surprisingly, for most diseases the sum of the risks is not 100% like for monogenetic diseases but less than 20%. This means that **most common diseases, including type 2 diabetes, can only to 20% be explained by variations in our genes**. For comparison, type 1 diabetes is one of the few common diseases, where the genetic contribution is as high as 50%.

**How to explain the remaining 80% of the disease risk**? There is something else to our genome, called the "epigenome". This epigenome is literally "on top" of our genome and is physically represented by the way how our genome is packed by proteins to a complex called "chromatin". The main purpose of chromatin is to protect our genome from unintended activation. Therefore, in every cell of our body only a small part of the genome is accessible to proteins that "read" the information on the DNA. This is as if you have a book with thousands of pages of which most is kept together with a glue and one can read only a few of them. Each tissue or cell type has a different epigenome, *i.e.*, different parts of the "book" are readable. In this way, kidney cells get another instruction than neurons. This part of the epigenome is constant and is determined in the early weeks of pregnancy. However, there is also an important **dynamic component of the epigenome**, which responds to changes in the environment, such as what we eat, how well we sleep, how much stress we have and how much physical activity we do. Thus, our lifestyle*, i.e.*, the numerous daily decision that we take

concerning the health of our life, are “recorded” in the epigenome of our metabolic organs like muscles, liver, pancreas and adipose tissue.

**How can we change our epigenome**? The dynamic part of our epigenome we have under our own control through clever lifestyle decisions. Some of them are obvious, such as eat healthy, not too much, reduce weight and have enough physical activity. All of these, in particular when they happen over a prolonged time, affect the epigenome in our metabolic organs. Thus, the best what we can do, when we get the diagnosis of a disease, such as type 2 diabetes or cancer, not to ask primarily for a drug and continue our “old life” but to try first ourselves to support our epigenome through a drastic change to an healthy lifestyle. Moreover, even those of us that are (still) at good health can prevent getting ill by modulating our epigenome through an healthy lifestyle decisions.

In conclusion, we are not “slaves” of our genes. We can escape the fate that our genome may suggest for our disease risk by addressing our epigenome. We have it in our own hands until the last day of our life. **Never give up!**

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This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 952601