

THE POLITICS OF GENES: HEALTH IS NOT SET IN STONE

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT GENES, OR WHY DOES IT MATTER WHO WINS ELECTIONS



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ABOUT EPHA

The **European Public Health Alliance (EPHA)** is a change agent – Europe's leading NGO alliance advocating for better health. We are a dynamic member-led organisation, made up of public health civil society, patient groups, health professionals, and disease groups working together to improve health and strengthen the voice of public health in Europe.

ABOUT THIS PAPER

This paper is a synthesis and a pitch.

It offers a fusion of the author's three decades of professional learning, offering snippets from her training as an applied geneticist, from her fifteen academic years of research and teaching, and from her decade of converting science into digestible parcels, including for policy makers.

It digs into the basics of the role of genes in our health, and into the importance of environmental factors that shape us and our health.

It puts up a simple message of why politics matters, and why it is important who wins elections, not least the EU Parliamentary ones in 2024.

So, let us start from the DNA, in simple parlance, and let us end with voting. Wisely.

By Dr Milka Sokolović

SKETCHED BY OUR GENES

The basis for everything that makes us who we are lies in the hereditary information in the DNA molecule packed at the kernels, or nuclei, of our cells. Let's imagine them as envelopes carrying the important life stuff. In those envelopes, our hereditary information is written in the form of "messages", or genes, composed of "letters" that we call nucleotides. From the moment of conception, the sequence of nucleotides in our genes sketches the contours of our lives.

Our entire hereditary information, the so-called genome, includes a bit more than three million nucleotides, or about 20-25 thousand genes. Most of the 10 quadrillion cells in our body contain a complete genome in their nuclei, packed into 46 rod-like packages of DNA, which we call chromosomes. 44 of them, or 22 pairs, are the so-called autosomes, varying in size between pairs, but very similar to each other within each pair. The remaining two, X and Y chromosomes, are the so-called sex chromosomes. They are of different sizes, and thus also differ in genes that lie on them. Only a few cell types do not contain the complete genome. Such are the mature red blood cells, which lose their nuclei during maturation, and the reproductive cells or gametes (oocytes and spermatozooids), which contain only half of the genome.

In addition to coding the processes in our organism, the role of DNA is to transfer hereditary information to the next generation. During fertilisation, it is transmitted from mother and father by gametes (germ, or sex cells), which pack sets of 23 chromosomes - one each of 22 autosomes, and one sex chromosome. We get X chromosome from our mother, and either X or Y from our father. This determines our biological sex as female (XX), or male (XY). The process of gender development, however, is influenced by many factors, which is why there are a number of us whose gender does not match the one we were apparently born with and which gets recorded in our identity cards.

In the fertilized egg, genetic information from the two parental sets of chromosomes gets recombined like two well-shuffled decks of cards. This shuffling will determine the pigment in our skin, eyes, hair, our blood group, our proneness to diseases. Whose and which features will prevail in each of us mainly depends on luck.

Of course, card shuffling is an oversimplified illustration of what really happens. Various rules direct the processes of transmission of hereditary information, so we talk about dominant and recessive (and co-dominant) genes, we mention mitochondrial DNA (that we inherit only from our mothers), or processes like mutations that affect how our genes will eventually behave.



SHAPED BY THE ENVIRONMENT

In biology, everything is more complex than at first glance, so hereditary traits are most often not only hereditary. Many of our characteristics, from the obvious ones, like our height and weight, to our personality features, depend on the interaction between genes and the external environment.

How our genes will be expressed - how we will look and behave, and what our preferences or predispositions to diseases will be - are influenced by almost everything that surrounds us. And if 46 chromosomes with a few tens of thousands of genes and three million nucleotides was not complicated enough, then an unlimited number of factors and environmental influences will certainly satisfy our appetite for complexity!

Let's look into the DNA: environmental factors can change it directly, including the arrangement of nucleotides in a gene. For example, UV radiation can break the DNA chain. Some chemicals, such as those in plastics or in cigarette smoke, can change the chemical behaviour of nucleotides and can cause them to replace one another. During infection, viruses, which do not have their own reproduction mechanism (they multiply at the expense of the host), insert their genetic material into our DNA, sometimes right in the middle of a gene. This can lead to a change in the DNA behaviour, or to the replacement of its nucleotides.

Our cells are quiet masters at correcting such changes, and this mastery mainly passes unnoticed. However, every now and then a change or two can slip their attention, or get ill-corrected. If too many such changes accumulate,

the likelihood of which increases with age, cancers can occur. The factors that lead to cancer development are called carcinogenic.

Today we know that the environment can also finely modify the surface of the DNA molecule and change its behaviour, while keeping the arrangement of its nucleotides unchanged. If this happens in germ cells, a part of these so-called epigenetic changes also becomes heritable.

Speaking of complexity, our genes are just a blueprint of our life's "construction". Based on this blueprint, our cells produce proteins, which are then responsible for everything - from life's walls, floors and ceilings, through water-pipes, electricity, sewage, all the way to energy and vibe in our life's "residence". The final outcome of this process will depend on how the contractor understood the project (i.e. on the precision of translating genes into proteins), on the cooperation between the contractors (or interaction between different proteins), the quality of materials (the behaviour of proteins in a given environment), etc.

As it stands, the message written in our genome is not exactly carved in stone, it is rather a copy of the blueprint of our life-project through an indigo-paper (in case anyone still recalls the olden ways of carbon-copy).

What's exciting is that the number of interactions and combinations is infinite, and thus the number of outcomes. This makes us unique, even if we have identical genomes, as is the case with identical twins.



IN CHARGE OF PHYSICAL

We have seen that genetic heritage paints only a part of our health landscape. Regardless of whether we inherited the contours of tame valleys or karst sinkholes, how green and lush they will end up being, will depend on how well we water them, fertilize them, protect them from pollution, preserve their biodiversity. In less poetic-ecological terms, even with health burdens coming from our family (with, for instance, diabetes and cardiovascular diseases “smiling” at us from our mother’s side, and cancer from our father’s), our own health will greatly depend on our environment and our way of life. Our health will be affected by the quality of food, air and water, by the quality of our homes, by the degree of preservation of the nature around us. These factors all directly affect the way our genes end up expressing themselves.

We must be careful, however: the responsibility for an individual’s health must not be placed solely on people’s personal choices. Certainly, many of our choices and behaviours depend on us, but a significant part of our decisions is conditioned by the environment, which, again, is shaped by social, economic and political factors - by the so-called determinants of health.

Let’s take nutrition for example. We know that foods rich in fat (especially saturated), salt and sugar, and based on proteins of animal origin, have the strongest negative impact on our health. Diets based on these foods contribute to the development of non-communicable diseases, such as obesity, diabetes, cardiovascular diseases, and cancer. In conjunction with other lifestyle habits, like the use of tobacco and alcohol, or insufficient physical activity, inadequate nutrition is one of the main causes of mortality globally. Research unequivocally shows that diets rich in vegetables, fruits, cereals, nuts, with a low proportion of sugar, salt and saturated fat, and rich in fibre, contribute to reducing the number and degree, as well as the mortality from these diseases. Today, the majority of us are aware of these facts. On the basis of knowledge alone, we would expect the majority of us to also be able to make everyday decisions to improve and not endanger our health. That, however, is simply not the case.

Just as the expression of genes is greatly influenced by the circumstances of external environments, so are our choices and behaviours. Back to the example of food, our understanding of its healthiness is an important factor in our decision-making - but not the decisive one! Research shows that the choice of food products that we will buy and consume is primarily influenced by their taste and price. Their impact on health is only the third in the list of influencing factors, while the impact on the environment is taken into consideration even less when deciding what ends up in our shopping basket. Add to this the way in which foods are advertised in the media, displayed on shelves, available in schools and hospitals (and around them), offered in military or prison canteens, or in the foodbanks to those who cannot afford it; add on top of this the economic context and cultural pressures, and the significance and magnitude of the impact of the environment on our decisions and behaviour (and thus our health) becomes crystal clear. And that is only on the example of food choices!

In addition to its nutritional value, our health is also affected by the way food is grown, transported, and stored. These impacts are more or less direct: pesticides and antibiotics, for example, affect both ours and the health of the environment, which then inevitably reflects back on people’s health. Fertilizers, contribute to the oversaturation of waters with nutrients, which disrupts the ecological balance. Both the production and transportation of food contribute to air pollution, which according to WHO carries the highest environmental risk to health. Unfortunately, the list does not end there.

Unlike those related to nutrition, our daily decisions have (even) less influence on other factors that directly affect our health, such as the quality of the air we breathe and the water we drink, the amount of greenery in our cities, or the infrastructure for active transport and physical activity.

That is why it is important to understand and accept that the **responsibility for people’s health does not lie with the individual alone.**

CARING FOR MENTAL HEALTH

The WHO defines mental health as a key and inseparable component of health, a state in which each of us realises our abilities, copes with normal life stresses, works productively, and contributes to our community. When changes occur in our thinking, mood, and behaviour that hinder our functioning or cause pain, then we talk about mental illnesses. Each of us will be affected by it at some point in our lives, either by an illness of our own, or of a person we care about. Just like physical, mental illnesses can affect anyone, regardless of age, gender, social status, education, nationality, ethnicity. That is why it is important to know what affects our mental health.

In terms of their complexity and form of inheritance, our personality features and mental health do not differ from the physical ones. All our complex traits are the result of interactions between genes and the environment.

Decades of research on twins, adopted children, and children raised in foster families have shown that there is a solid hereditary component behind personality features, generally estimated at around 30-60%. Children show signs of their personality very early on, through their temperament, which is estimated to be 20% to 60% determined by genetics. It is estimated that more than 700 genes are involved in the development of some of our personality traits, and some studies indicate that they could have a greater influence than the influence of culture or environment.

It is not surprising then that genes affect what we call talents, our inclinations to art, science, sports. They are to some extent innate, prompted by our genetics, but few will achieve success without motivation, support, and a great effort. We often hear that talent contributes to success with a mere 10%, and that the other 90% are delivered through hard work. It is possible that the share of talent is underestimated here, but the influence of effort, motivation, and support is difficult to overestimate.

At the same time, each of us, regardless of whether we had artists, scientists, or athletes in our family, can enjoy these activities and fruitfully engage in them. Talent helps, genes have some influence on our inclinations and ability, but most of the activities for which success it was once thought that natural predisposition was crucial, are to a large extent skills. They can be learned.

Not everyone can be a world-renowned painter, but everyone can learn to draw.

This might come across as an odd comparison, but the same is true with addictions to substances. Our natural tendency is partially determined by genes, but whether we will develop an addiction depends on the factors of the external environment, including family, peers, culture. The attitudes and behaviour of one's friends and family toward smoking, for example, plays a large role in whether a person develops a nicotine addiction.

When it comes to our mental health in general, some factors, such as genetic inheritance, or events that happened in our past, cannot be influenced, and they will inevitably impact us. But others can be influenced to improve our mental health, both at the individual and societal level. They include factors from our environments, our family, social, living, employment and economic contexts.

Social environment implies the quality of relationships with family, friends and community, and they are certainly modifiable. Factors from the living environment include, among others, the quality and place of residence, our built environment, or family circumstances (an example could be the cohabitation of more than one generation in a household). Our working environment, which can also be significantly influenced, includes working conditions, psychosocial factors (such as the ability to make decisions related to function and work tasks, relationships with co-workers, recognition of expertise and skills, etc.), or physical safety.

The economic context is recognised as one of the key factors affecting mental and physical health. Within it, the price of consumer goods (which determines whether individuals can satisfy their primary needs), the (un)employment rate, the distribution of wealth in society, all directly affect the health of individuals and society.

Similarly to factors impacting our physical health, some we can influence ourselves, but many more are in the hands of those who make decisions on our behalf.

POLITICS, THE NEEDLE MOVER

Regardless of the genes our ancestors bequeathed to us, along with our personal choices and behaviours, our mental and physical health are drastically affected by political, economic and social factors.

Even if not intuitive at first glance, almost all policies, from local to national and beyond, from agriculture, transport, construction and energy, to education, culture, sports, environmental protection, are affecting our health one way or another. On top of forming the political, economic and social contexts that we all live in, policies and politics of today are far-reaching, affecting the health of the environment, and thereby laying foundations for the health of our children and their children.

This all implies that **every political decision, regulation and law becomes a health policy in itself**, every single one of which should be in tune with improving (and not hampering!) public health.

That is why we must be aware of the laws passed and politics conducted on our behalf. That is why we should ask and be asked, why we should engage and demand responsibility - for ours, and for the health of the environment that our health and wellbeing depend on.

As Europe warms up to the 2024 EU parliamentary elections, let us keep in mind that - in addition to daily decisions on our nutrition, physical activity, tobacco or alcohol use, in addition to working on our relationships with our families or colleagues - **we can and should influence our health at the election polls**. And we should do so wisely, with our eyes set on the better and healthier future for all.





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