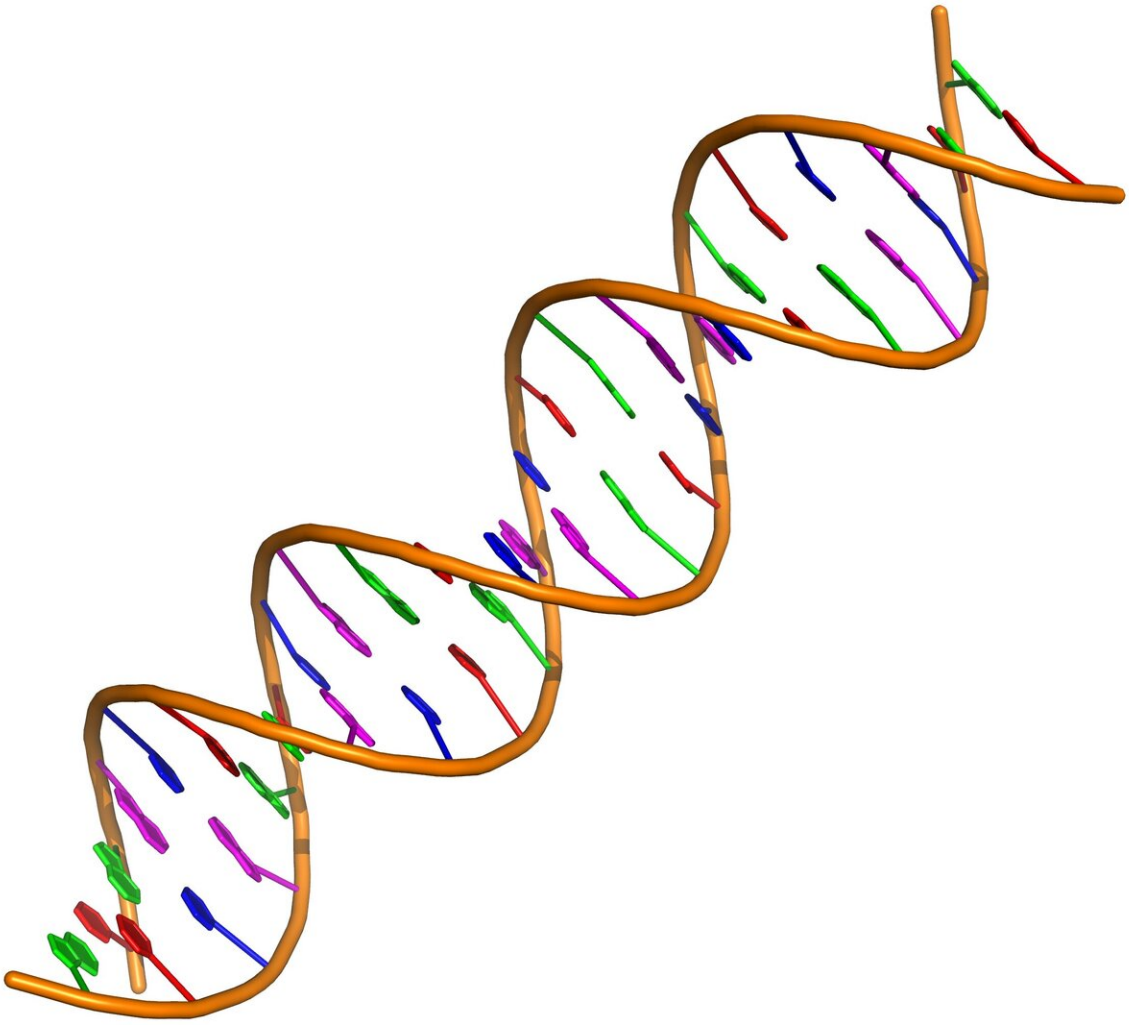
Our immune system is as unique as a fingerprint or our DNA

September 17 2021, by Aschwin Tenfelde



A double stranded DNA fragment. Credit: Vcpmartin/Wikimedia/ CC BY-SA

Every person appears to have a completely unique immune system. Researchers from Utrecht University discovered this immune diversity after mapping antibodies from healthy and sick individuals. The discovery could help explain why, for example, corona vaccines appear to be less effective for some people.

The way our immune system responds to pathogens varies from person to person. Researchers at Utrecht University and UMC Utrecht discovered that each person develops a unique arsenal of antibodies, which are proteins produced as part of the body's immune response to infection. Also, the concentration of these proteins changes in a unique way during illness or after a vaccination. The researchers publish their results today in the journal *Cell Systems*.

The results may help explain why some people are more prone to becoming ill, or why they recover faster from illness than others. Extreme diversity in immune responses could also create new possibilities for personalized treatments and vaccinations.

No overlap

The Utrecht team discovered the diversity when they monitored antibodies in the blood of healthy and seriously ill individuals. The latter suffered from serious infections, from which they recovered following time spent in intensive care.

The researchers analyzed the concentrations of all co-appearing antibodies in the blood. They discovered that there was no overlap whatsoever in this respect between the blood samples of the people

investigated. The composition and concentrations of the antibodies were completely different in each person.

Rise and fall

The concentrations of antibodies also appeared to rise and fall in a unique way during illness. For instance, in some ill individuals, concentrations antibodies against an infection fluctuated more rapidly than in others.

The antibodies themselves also differed. Even antibodies that were aimed to target the exact same pathogens appeared to differ slightly at a molecular level.

Extremely sensitive measurements

Until now, this distinctiveness had not been noticed. Scientists considered it to be impossible to accurately map a complex mixture of antibodies in the blood. But the Utrecht research team, led by biochemist Albert Heck, managed to achieve this. The team developed an extremely sensitive analysis that reveals minute differences in mixtures of antibodies. The method is a refinement of a tried and tested technique called mass spectrometry, which separates substances based on their molecular composition.

Never exactly the same

"By now we have tested this technique in about a hundred individuals, including Covid patients and people being vaccinated," says Heck. "Not once did we encounter exactly the same antibodies in two different persons. It's safe to say that everyone's antibody profile is as unique as someone's DNA, or perhaps even more so."

Small differences, big consequences

Even though the differences in antibodies are small, they can greatly influence the course of a disease. According to Heck, the differences can even explain why some people become ill from an infection and others do not. If someone makes fewer antibodies against a certain pathogen, or variants that are less effective, then a disease might strike harder or multiple times.

Differences in Covid vaccine success

According to Heck, antibody diversity could also explain why some people still contract a disease against which they have been vaccinated—or even when they had the same disease before. This also applies to corona vaccines. Heck says that "after being exposed to the virus, either through infection or vaccination, your body starts producing perhaps dozens of different antibodies against the virus. But those antibodies may act mainly against just one corona variant. If another variant appears, you might become infected again."

In other people, the outcome can be very different, because their antibody profiles are different too. Heck says that "another person makes slightly different variants of antibodies, or in different concentrations, which might protect better against other virus variants. Such a person is therefore less likely to become ill from an infection with a new variant."

Tailor-made vaccination

According to Heck, this opens new opportunities to make optimal vaccinations, tailored to someone's immune system. "By mapping out someone's antibody profile, you can track how the body responds to a

vaccination or infection. This way, you can also check whether the body produces enough of the desired antibodies, for example those against the coronavirus. If the production is insufficient, you can consider offering booster shots. "

A dream come true

Heck describes the publication in *Cell Systems* as a dream come true. "About five years ago I was wondering if we could achieve this. Now it turns out to be technically possible, thanks to an enormous team effort, and we're seeing it opens up a huge amount of new possibilities for prevention and treatment."

More information: Albert Bondt, et al, Human Plasma IgG1 repertoires are simple, unique and dynamic, *Cell Systems* (2021). DOI: 10.1016/j.cels.2021.08.008

Provided by Utrecht University