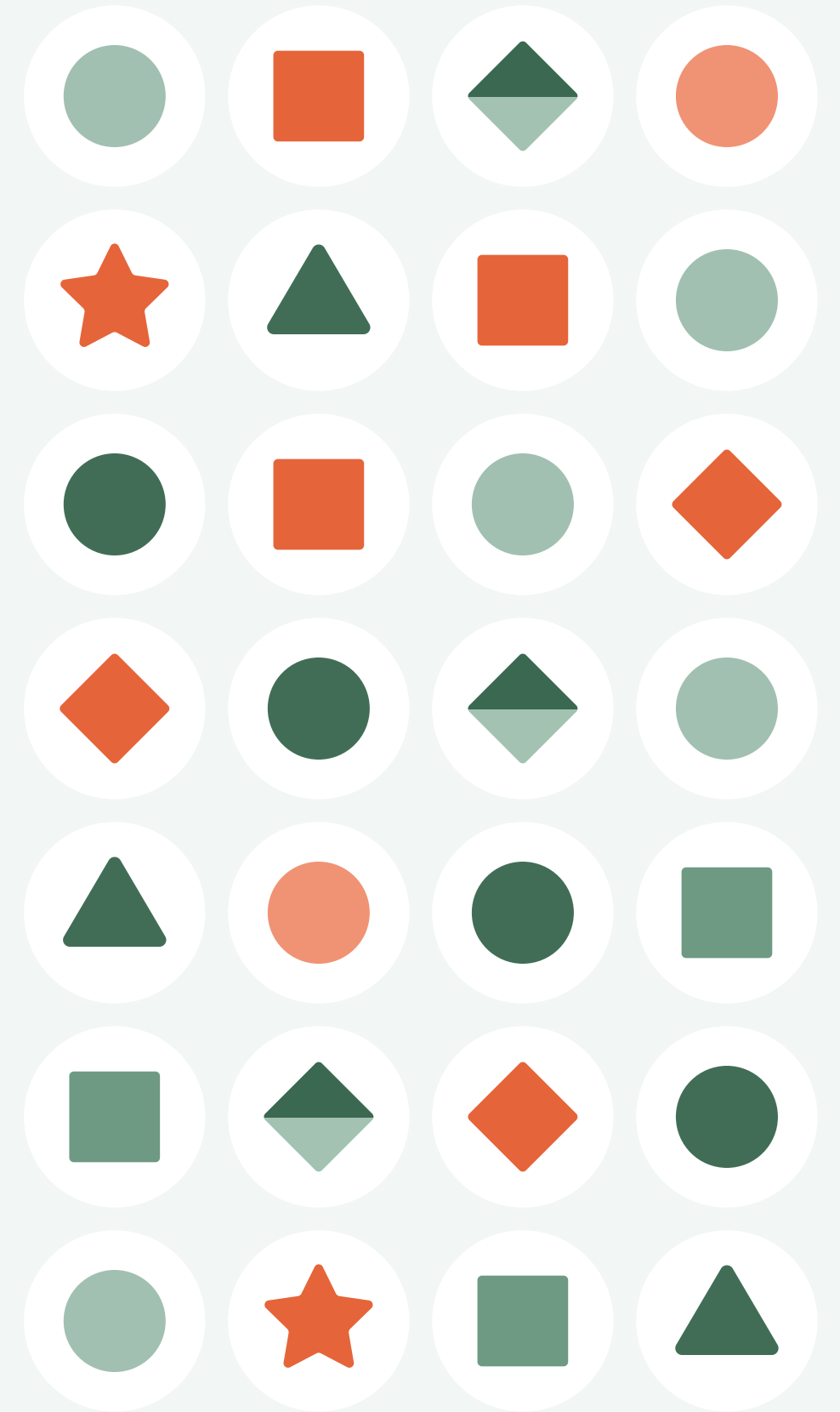


# GlycanAge 101

Understanding the basics

**GlycanAge**



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# Biological age

- What is biological age?
- Why is it important to know biological age?
- How is biological age calculated?

**Think of chronological age as the number of years you've owned your car.**

Your biological age resembles the mileage you've accumulated, reflecting the wear and tear your body has experienced so far.

## What is biological age?

Aging has two dimensions: **chronological** and **biological**.

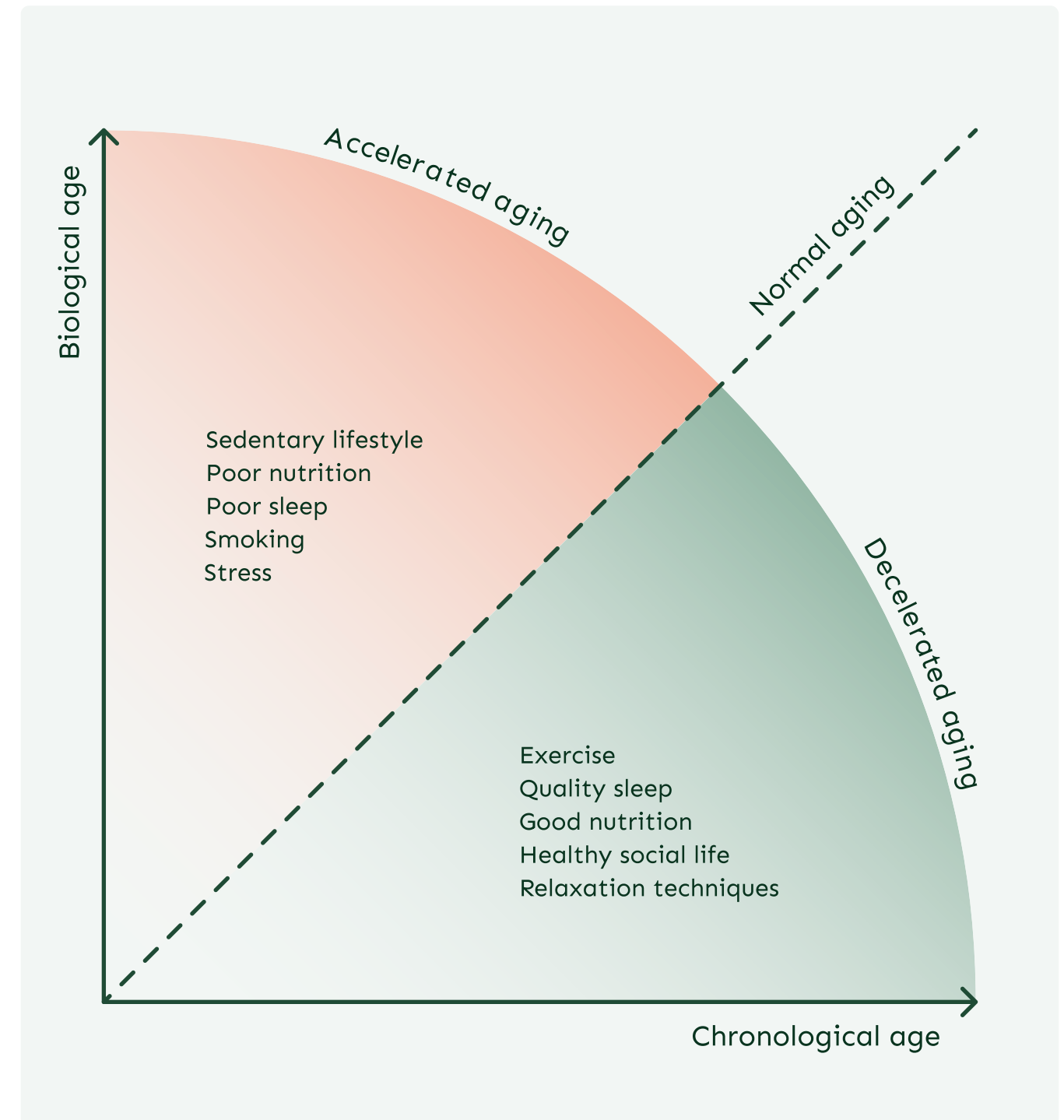
Chronological age simply counts the years since birth, and it works the same for everyone.

On the other hand, biological age delves beneath the surface to measure how quickly or slowly the body is aging **internally**. This is influenced by much more than just time, with one important aspect being our **lifestyle**. Unhealthy habits can accelerate the process of biological aging, while a healthy lifestyle can slow it down, promoting a more vibrant and healthier aging journey.

## Why is it important to know one's biological age?

Biological age calculations can be accurate predictors of **health span** and **life span**. They provide invaluable insights into overall health and the quality of the aging journey.

Think of it as the **body's personal clock**, measuring the unique pace at which the body ages. This knowledge can help you make informed decisions about your patient's lifestyle, steer their health in the right direction, and steer them toward a more vibrant and fulfilling life.



## How is biological age calculated?

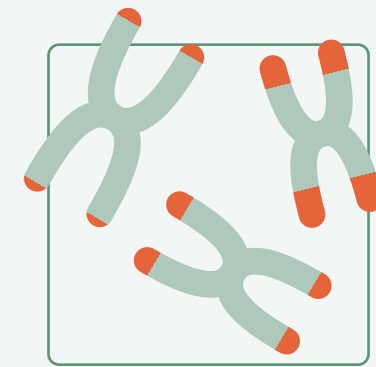
Biological age is calculated using **aging clocks**, which are tools based on specific biomarkers that naturally change as we age. These clocks establish a typical pattern for how this biomarker changes over time. By analyzing this biomarker in an individual, it pinpoints their biological age by comparing it to the expected pattern.

Many molecules and processes in our body change in a predictable pattern as we age. Therefore, there are many different aging clocks that can be used to calculate biological age.

So how do you choose the best biomarker? The American Federation for Aging Research (AFAR) has outlined a set of criteria that an ideal aging biomarker should possess. Those are:

- **Predictive power:** forecasting future health and longevity better than chronological age alone;
- **Safety and consistency:** safe and repeatable testing process with consistent results over time;
- **Fundamental monitoring:** tracking a core aging process, offering insights into overall well-being;
- **Broad applicability:** effective in both humans and laboratory animals for versatile research.

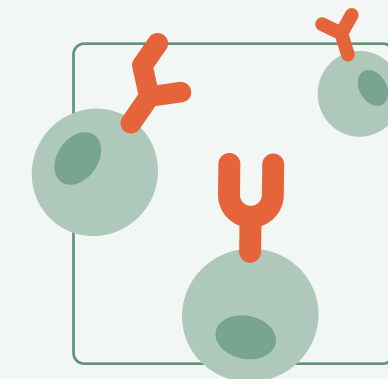
### Examples of some aging biomarkers:



Telomeres — capping ends of DNA



DNA methylation — small chemical groups attached to DNA (epigenetics)



Glycans — complex sugars attached to proteins

# The science behind GlycanAge

- Chronic inflammation as a biomarker of biological age
- What is inflammation?
- Measuring chronic inflammation
- Glycans as the ultimate layer of molecular complexity
- IgG glycans
- Ticking of the glycan clock

**Studying proteins without glycans is like studying birds without their feathers.**

You can understand their anatomy, but you cannot fully understand their function.

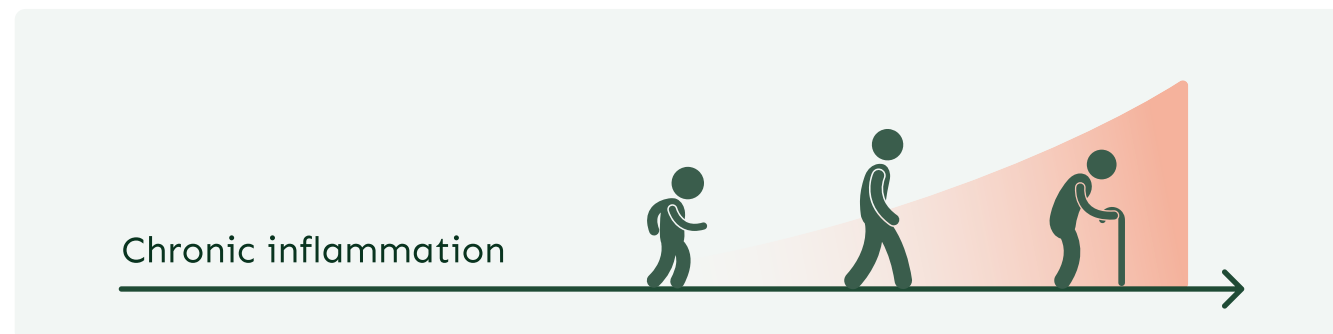
## Chronic inflammation as a biomarker of biological age

**GlycanAge** delves deep beneath the surface of human biology, uncovering one of the most significant markers of the aging process — **chronic inflammation**.

These are the 12 official hallmarks of aging:

- Altered intercellular communication
- Cellular senescence
- Chronic inflammation
- Deregulated nutrient sensing
- Disabled autophagy
- Dysbiosis
- Epigenetic alterations
- Genomic instability
- Loss of proteostasis
- Mitochondrial dysfunction
- Stem cell exhaustion
- Telomere shortening

GlycanAge emerges as a game-changer, as not all biological age tests clearly outline exactly **what is being measured**. For example, we know that with epigenetic tests that look at CpG sites (areas on DNA that are associated with aging), it is not always clear what biological process is actually driving the changes. This makes it difficult to derive clear actions from the information given by epigenetic tests.



## What is inflammation?

Inflammation is a fundamental biological process that can manifest in two distinct forms — acute and chronic.

**Acute inflammation** is the body's defense mechanism against injury, infection, and damage. However, if it persists beyond its protective role, it transforms into chronic inflammation.

**Chronic inflammation** poses a significant long-term threat. It involves the constant production of inflammatory molecules and over-activation of the immune system, which can gradually create a hostile environment suited for various health problems.

Surprisingly, **3 out of every 5 deaths** are tied to chronic inflammatory diseases. The insidious nature of chronic inflammation makes it a stealthy adversary, accumulating quietly over time and increasing the risk of chronic disease and potentially death. This is precisely why addressing elevated chronic inflammation is crucial before it reaches the point of no return.

In the context of aging, chronic inflammation is a natural part of the process, and while aging is inevitable, we have the power to shape its quality. Daily choices like **diet, exercise, sleep, stress, and the interventions** you offer your patients can influence levels of chronic inflammation and shape their aging journey.

## Measuring chronic inflammation

GlycanAge stands out as the only test that can effectively measure chronic inflammation. Traditional markers like CRP and other inflammatory cytokines are short-lived molecules, often reflective of acute inflammation.

GlycanAge looks at **immunoglobulin G (IgG)**, essential molecules of our adaptive immune system with a **half-life of around 3 weeks**. This enables GlycanAge to provide a more precise evaluation of chronic inflammation and therefore the risk of chronic disease.

Moreover, GlycanAge demonstrates **high responsiveness**. Thanks to the 3-week renewal cycle of IgG, GlycanAge not only precisely measures chronic inflammation but also **tracks changes over time**.

Lifestyle habits and medical interventions can influence chronic inflammation levels, and GlycanAge can capture this evolving inflammatory landscape, offering deeper insights into the efficacy of those interventions.

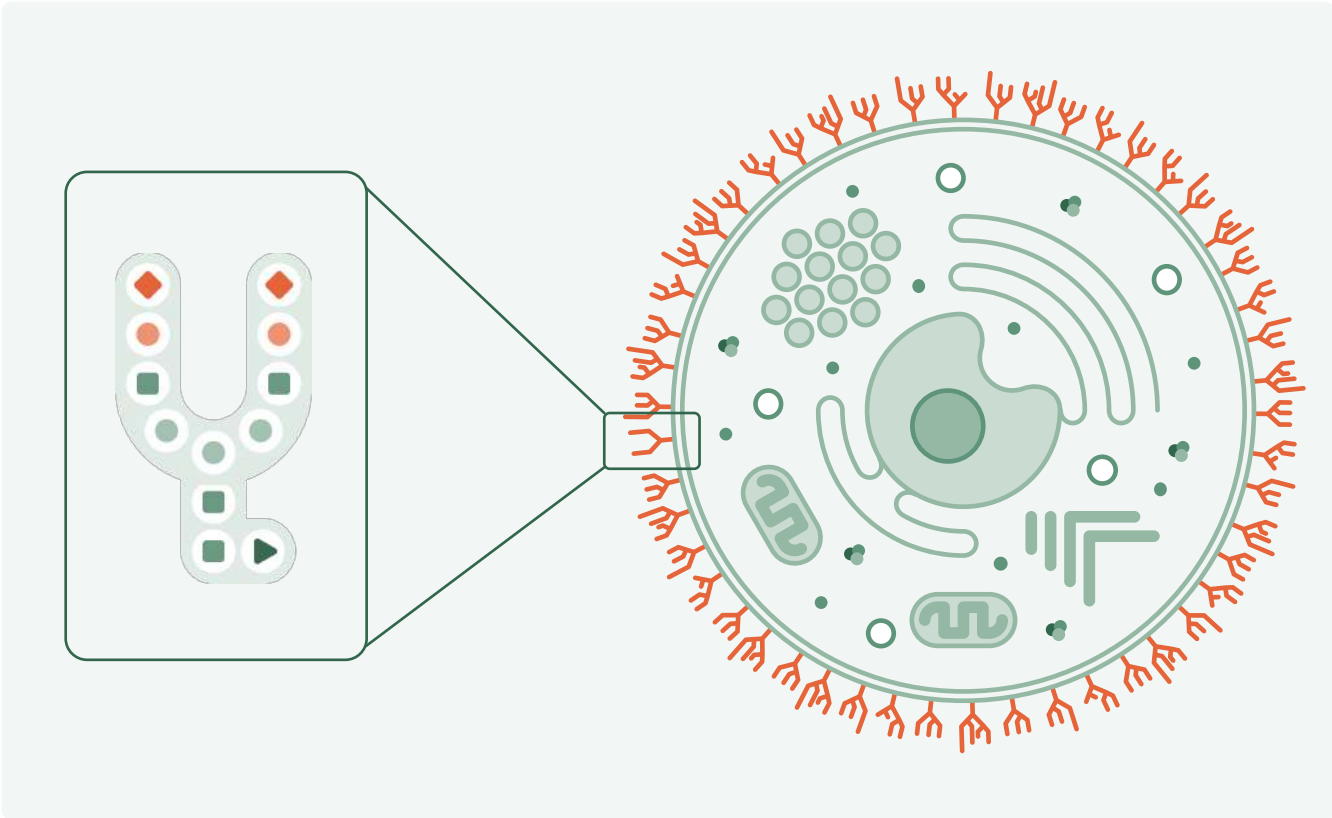
## Glycans as the ultimate layer of molecular complexity

**The Human Genome Project** aimed to decode our genetic blueprint, but its revelations only deepened the complexity of life beyond DNA. Epigenetics then added to this complexity by unveiling how genes can be switched on and off through DNA manipulation.

Taking the next step in unraveling life's secrets is The Human Glycome Project. This initiative is dedicated to decoding the hidden language of glycans - complex sugars that constitute one of the four fundamental building blocks of life, alongside proteins, lipids, and nucleic acids.

Glycans are not standalone entities, instead, they are attached to proteins and lipids through a controlled process called glycosylation.

These small sugars enable cell-to-cell communication and serve as accessories for proteins that enable them to fold properly and perform their function.

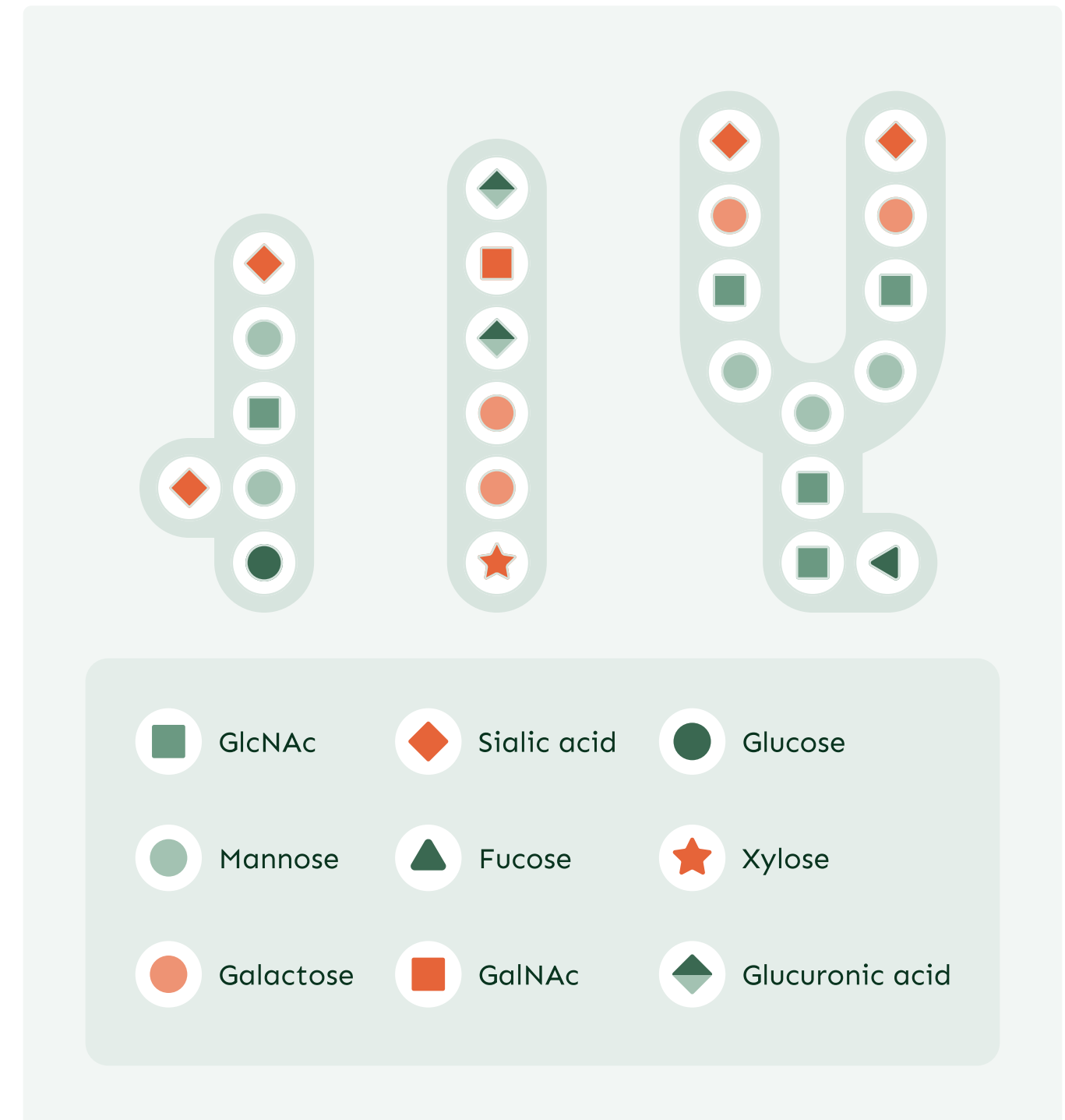




Glycans exhibit remarkable structural versatility. Unlike DNA, which is structurally a straightforward sequence of just four building blocks — thymine, adenine, cytosine, guanine — glycans can be branched structures.

Think of glycans as complex LEGO structures, and in humans, there are 9 different building blocks. These blocks can be built in any order, making glycans highly versatile.

The process underlying glycan synthesis is highly complex, involving **genetics, epigenetics, and environmental factors** operating within an intricate network. This complexity shows that glycans act like central hubs, providing valuable information by reflecting the combined effects of these factors.



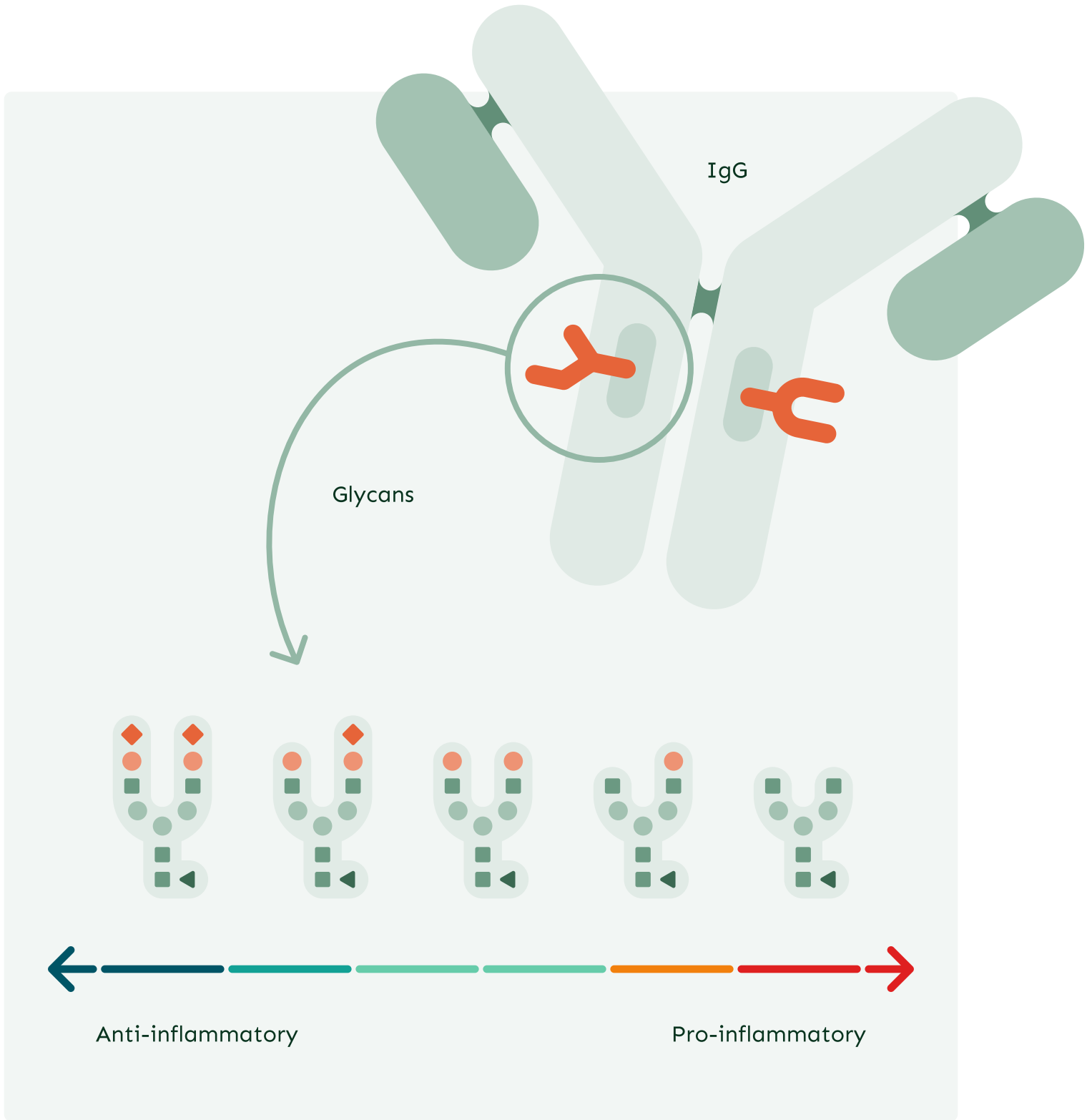
# IgG glycans

GlycanAge focuses on glycans attached to **immunoglobulin G (IgG)**, the crucial antibody steering the **adaptive immune system**. These glycan-covered proteins play diverse roles in immune processes and are associated with various health conditions.

Each IgG has **two glycans** attached to its protein core that enable it to communicate with immune cells and other parts of the body.

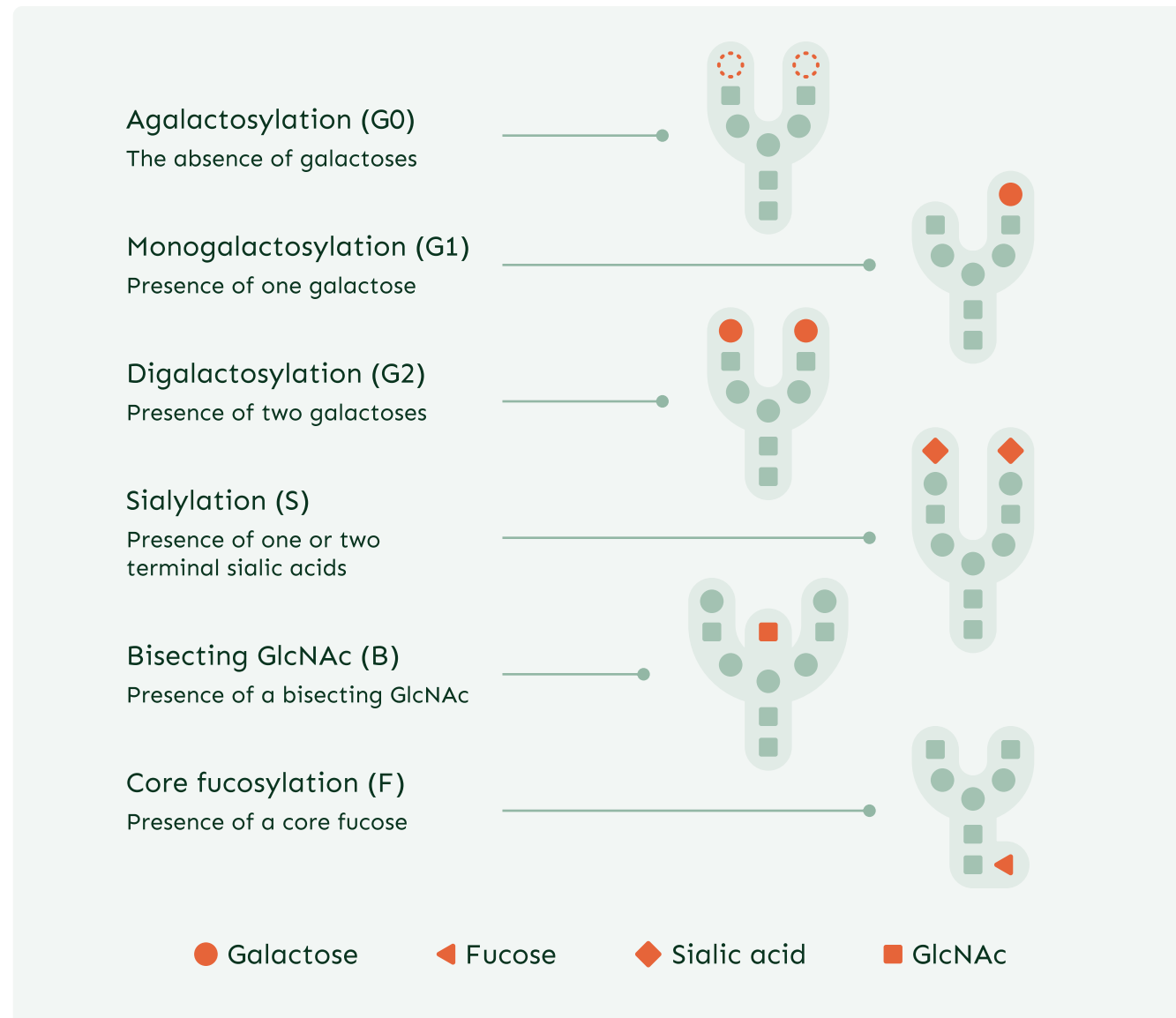
By binding to receptors on the surface of immune cells, IgG activates various immune pathways. Glycans that promote activation of those pathways are considered **pro-inflammatory**, and those that have a suppressing effect are considered **anti-inflammatory**.

There are 29 different glycan structures associated with IgG. The collective of all IgG glycans is termed the **IgG glycome** and it reflects levels of chronic inflammation inside the body.

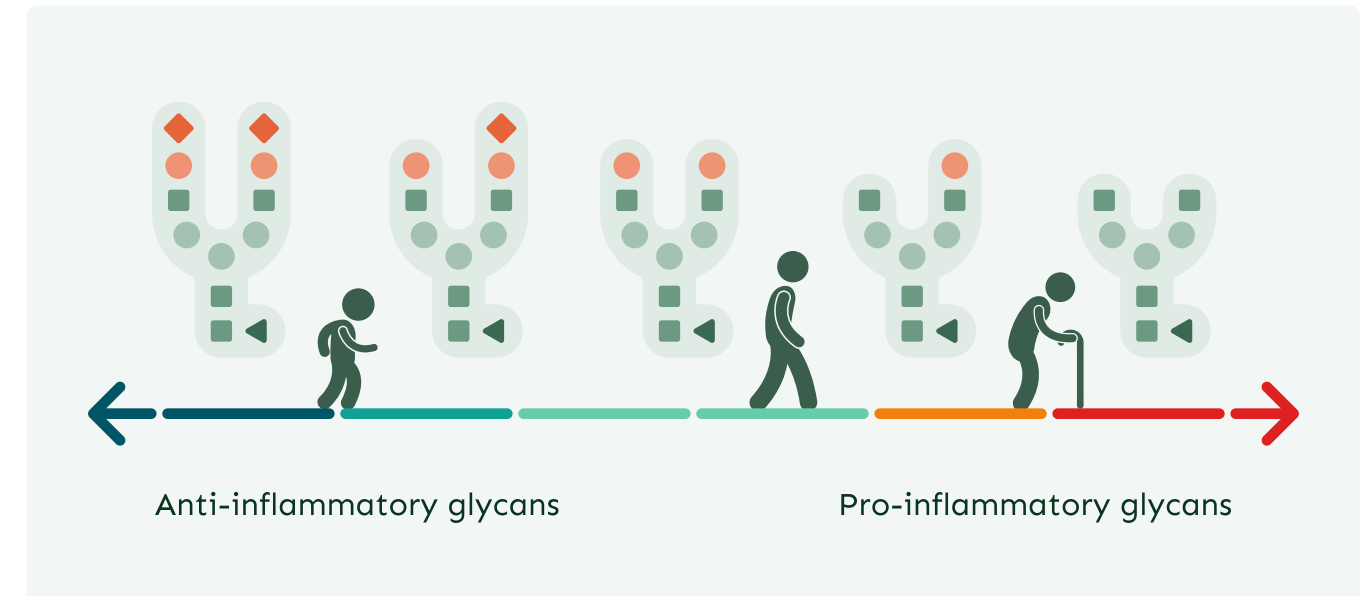


## Ticking of the glycan clock

Because of their complexity, glycans are grouped into categories based on specific traits. We call them **Glycan Indexes** and they include:



Throughout an individual's life, the proportion of glycans with certain traits changes in a predictable pattern. Generally, younger individuals exhibit a more anti-inflammatory profile, which transitions towards a pro-inflammatory profile with advancing age.



Although glycans gradually change with aging, they can also change in different pathological conditions.

Alterations in IgG glycans have been linked to various health conditions, including **autoimmune disorders, cardiovascular diseases, metabolic syndromes, neurodegenerative conditions, and cancer.**

These changes occur prior to the onset of a disease, sometimes **up to 10 years before** the official diagnosis. This emphasizes the value of GlycanAge as a tool for the early detection and prediction of future health outcomes.

# The GlycanAge test

- What is GlycanAge?
- The GlycanAge journey
- What's included: Biological age
- What's included: Indexes
- What's included: Glycan insights

## **Did you know?**

Our lab processes 85% samples for high-throughput glycomic studies in the entire world.

## What is GlycanAge?

**GlycanAge** is a pioneering biological age test that leverages the power of **glycans** to measure **chronic inflammation**, a key hallmark of aging.

Glycans unveil their potential as powerful indicators not just of aging, but also of evolving health conditions. Because they are responsive to both **lifestyle changes** and **medical interventions**, GlycanAge serves as a unique tool, empowering you to:

- **Evaluate:** Gain profound insights into your patient's health status;
- **Predict:** Predict diseases up to a decade in advance;
- **Validate:** Validate efficacy of treatment plans by measuring changes in GlycanAge before and after;
- **Motivate:** Track in-person response to therapies and motivate patients.



## The GlycanAge journey

The overall process of your journey consists of a few steps:

### 1. Order test kits

Order test kits to your practice or directly to your patients through your dashboard.

### 2. Collect the sample

Sampling requires four drops of blood. Instructions and everything needed for taking the sample are provided in the kit.

### 3. Send the sample back to us

Send the sample to our lab by using the return envelope provided in the kit.

### 4. Download the report

As soon as we analyze your samples, a process which takes about 3-4 weeks, you will get your report uploaded to your dashboard.

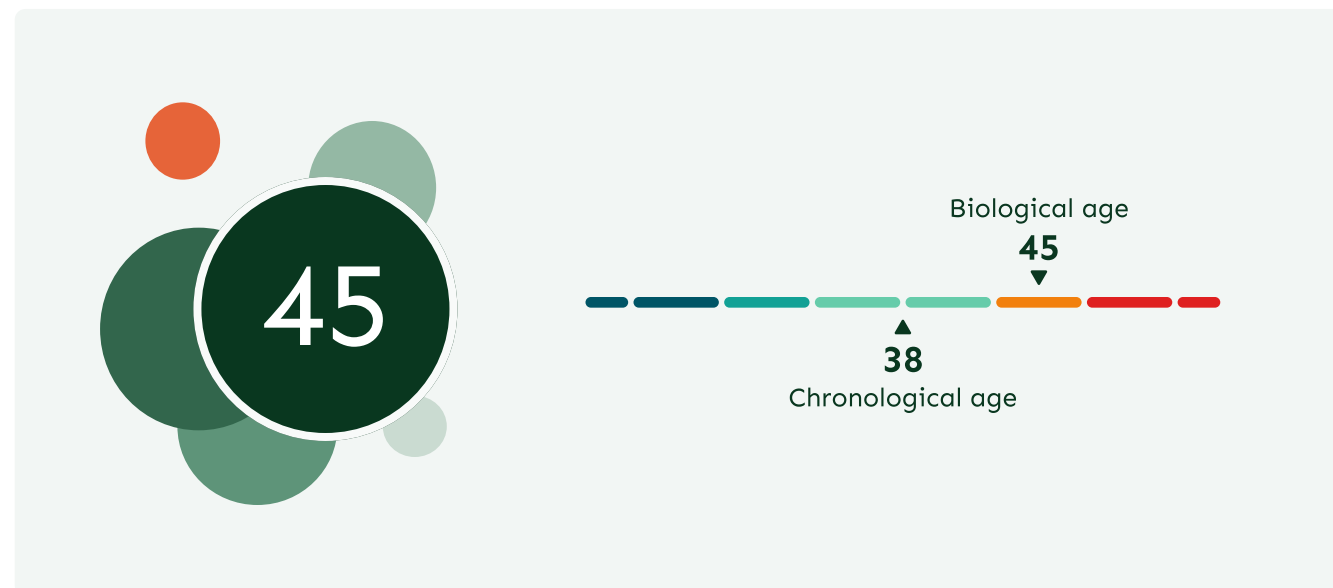
We offer educational training to help you interpret the report and gain deeper insights beyond biological age. Our goal is to guide you in understanding the results thoroughly, empowering you to support your patients in improving their overall health.

## What's included: Biological age

Your calculated biological age will be a number between 20 and 80.

It represents an overall measure of background chronic inflammation that contributes to aging.

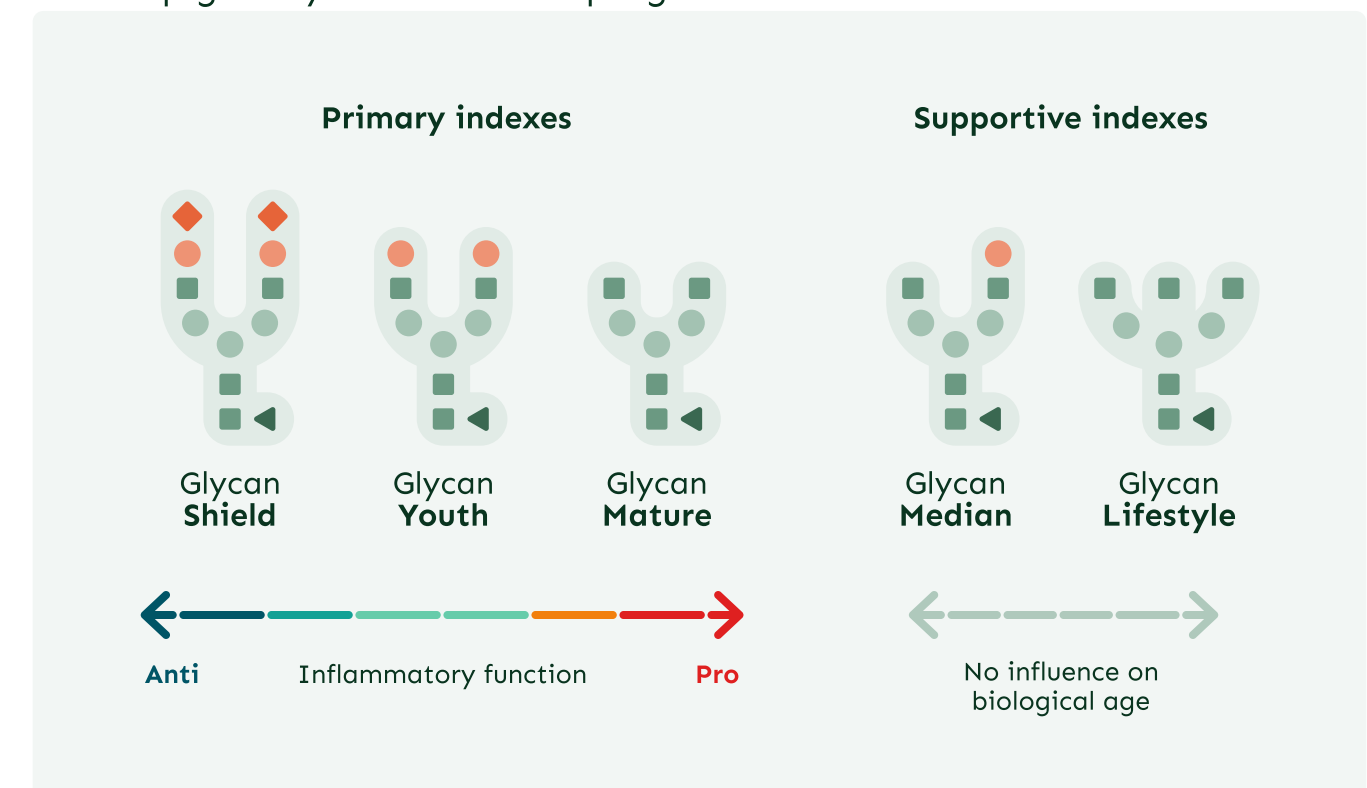
While biological age is a single number, it's important to consider what that number is reflecting, meaning what the test is measuring to determine biological age. GlycanAge looks through the lens of the immune system, reflecting the inflammatory status of an individual.



## What's included: Glycan indexes

Indexes are calculated by grouping glycans that share similar molecular properties. **Primary indexes** are used in the calculation of the biological age, while **supportive indexes** can be valuable in narrowing down associations with specific diseases, genetic traits, and certain lifestyle habits.

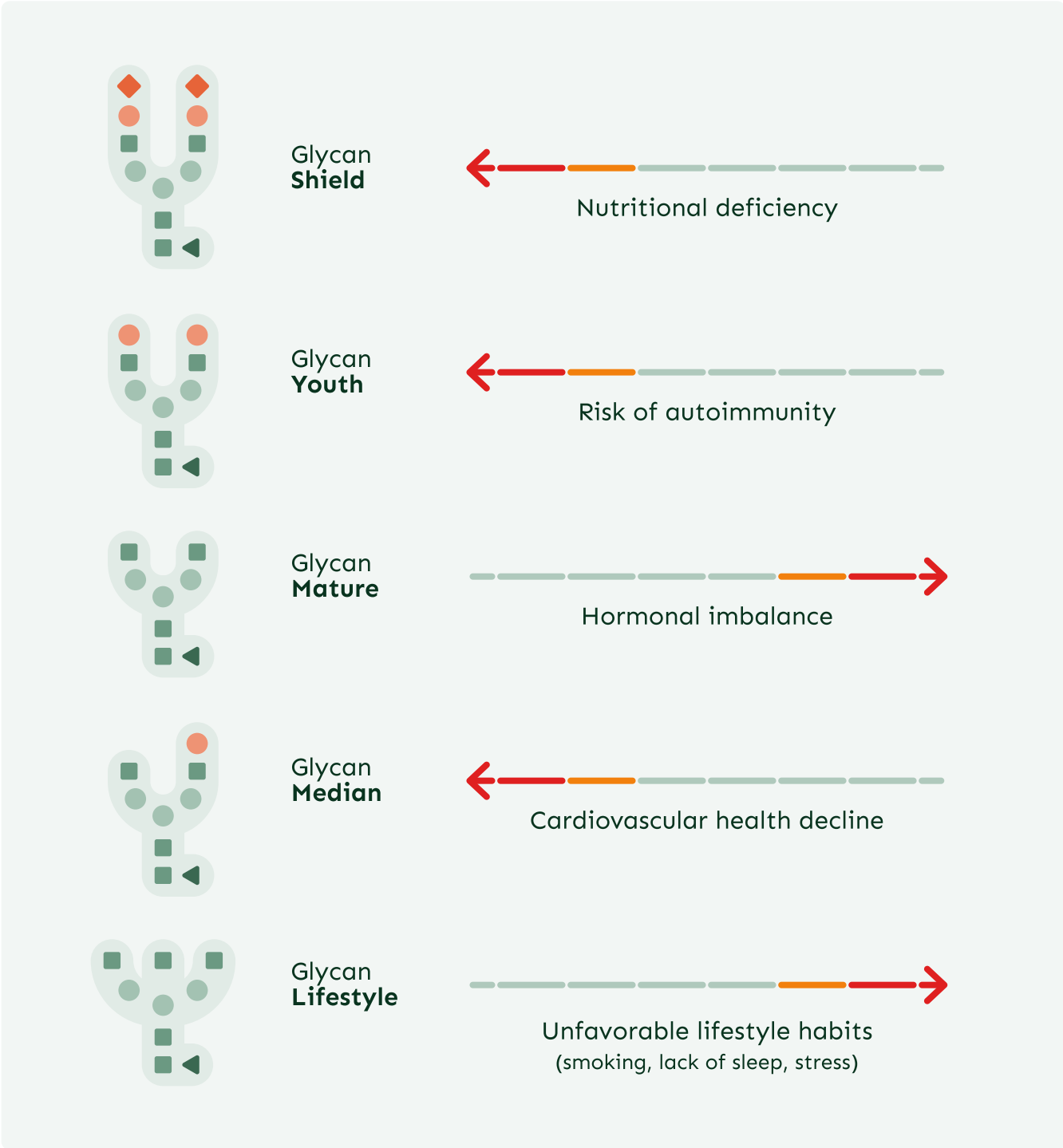
The indexes give information on what could be affecting your patient's inflammation levels and driving their GlycanAge. They also offer information on what you can do to address potential areas of concern and help guide your treatment programs.



Indexes are linked to specific health areas, and a higher score in an index indicates a greater abundance of glycans within that group.

Since IgG glycans can either be pro- or anti-inflammatory, a higher score in some indexes is better, while for others, a lower score is more favorable.

- Low Glycan Shield is related to diet and nutrition. It is a good indicator to check vitamins, toxins, and nutrient deficiencies.
- Low Glycan Youth is related to a higher risk of auto-immunity. This is observed in populations of older age or higher BMI, as well as cancer patients, or non-alcoholic fatty liver disease.
- High Glycan Mature is related to hormone health. It gives you an indication to review the hormonal balance of your patient.
- Low Glycan Median is related to cardiovascular health. When combined with a low Glycan Mature, it can indicate cardiac health issues.
- High Glycan Lifestyle is related to lifestyle in general, especially the 3 S's: sleep, stress, and smoking.





## What's included: Glycan insights

This is the newest addition to our report, where we have taken our understanding of glycans to another level!

While these molecules can't directly predict diseases, they do unveil distinct patterns characteristic of certain health conditions. Think of it like each disease having its own fingerprint!

These changes in patterns can sometimes **precede the development of a disease up to 10 years in advance**, making GlycanAge a valuable tool for possible disease prediction and timely intervention.

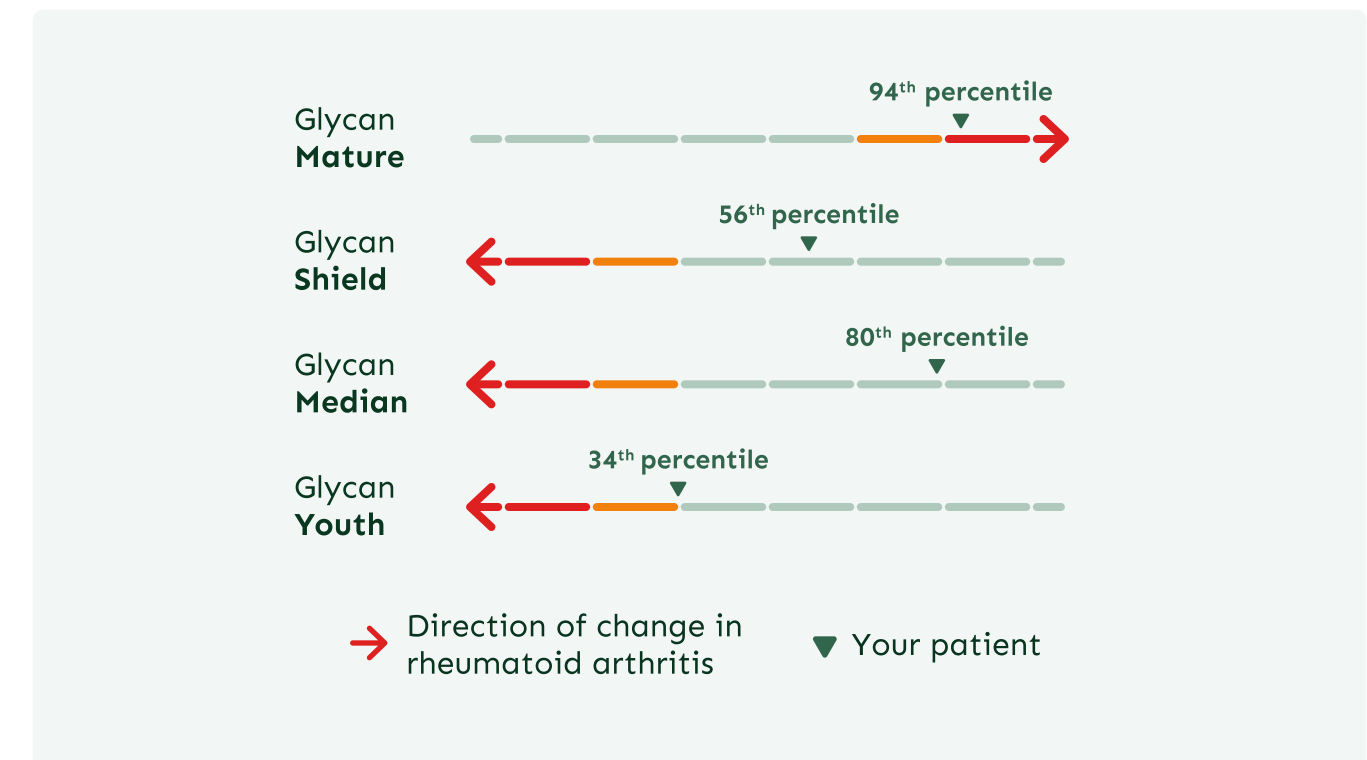
In our recent review, we investigated glycan fingerprints in over diseases! With insights drawn from over 300 scientific papers, we've focused on diseases and conditions that have the highest level of evidence:

- Increased risk of hypertension
- Pre-hypertension
- Hypertension
- MI & CVA
- Atherosclerosis
- Coronary artery disease
- Rheumatoid arthritis
- Ulcerative colitis
- Crohn's disease
- Systemic lupus erythematosus
- Type 2 diabetes
- Dyslipidemia
- Chronic obstructive pulmonary disease
- Perimenopause

This segment of the report is designed to spotlight potential similarities between your patient's glycan profile and a disease fingerprint.

Diseases are characterized by changes in various indexes. In some cases, the indexes are elevated, while in others they're lowered. **It is important to note that this doesn't serve as a definitive diagnosis.** However, it can equip you with insights to guide your patient's healthcare journey more effectively.

For instance, if there's a significant similarity, the report will help direct you to specific checkups or areas that merit closer attention in your patient's overall health assessment.





## So what are you waiting for?

The GlycanAge test is a revolutionary tool that can elevate your practice to new heights.

Glycans serve as powerful biomarkers, providing personalized insights into individuals' health status. Moreover, they hold great potential as medical biomarkers due to their implications in various diseases.

You can use your partner dashboard to find other useful resources such as webinars, eBooks, and scientific support behind our product. You can also reach out to your personal account manager who will help answer any questions you might have.

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# Thank you

And stay tuned in for more!

**GlycanAge**

