GlycanAge report for medical professionals

Longevity Labs London

Client name:	Unique client ID:	Unique test ID:
Jane Doe	358123	603242

Test kit ID:	Date of sampling:	Date of birth:
Female-sample-report	24 Aug 2025	06 Apr 1996

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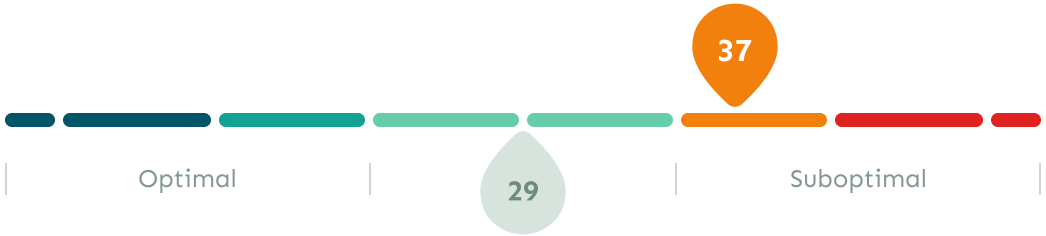
Key takeaways

Executive summary

GlycanAge measures **inflammaging**, which indicates the levels of chronic inflammation driven by the immune system as it ages.

GlycanAge result

37



This means that your client's immune system health resembles **an average 37 year old individual**

Result indications

- Accelerated immune aging
- High chronic inflammation

Common causes

- Existing chronic conditions
- Family history of chronic disease
- Inadequate or excessive exercise
- Poor diet & nutrition
- Hormonal imbalances
- Chronic stress
- Sleep deprivation

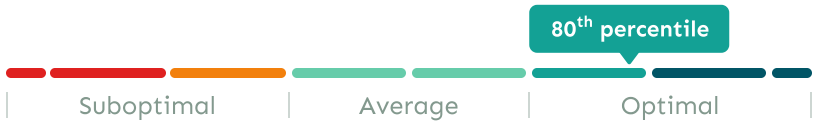
GlycanAge's biological age reflects the health of the immune system and its ability to manage chronic inflammation.

A much higher biological age compared to chronological age is not uncommon and can often be explained by factors such as genetic predisposition, presence of inflammatory diseases, or extreme lifestyle factors.

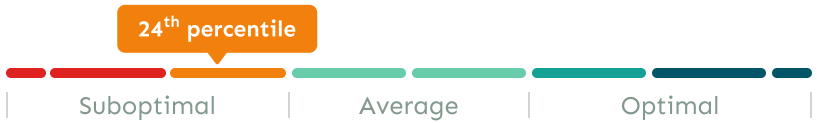
This page was updated since the previous version. See changelog for more info.

Primary glycan indexes

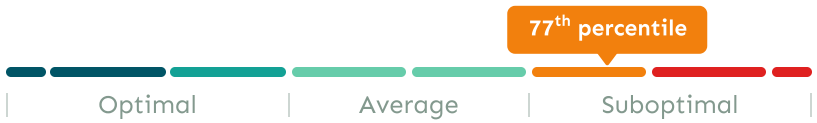
Glycan Shield (S)
Anti-inflammatory index



Glycan Youth (G2)
Anti-inflammatory index

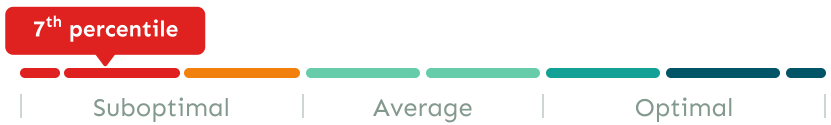


Glycan Mature (G0)
Pro-inflammatory index

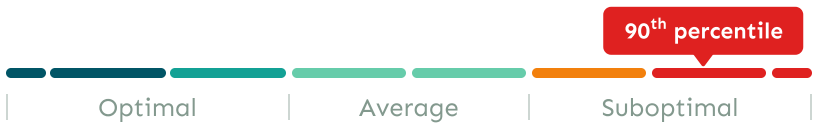


Supportive glycan indexes

Glycan Median (G1)
Supportive index



Glycan Bisection (B)
Supportive index



Result indications

Suboptimal Glycan Youth and Glycan Mature

A low Glycan Youth (G2) with high Glycan Mature (G0) represents a classical "manager's profile", reflecting accelerated immune aging from chronic lifestyle strain. It is typically driven by prolonged stress, disrupted sleep or circadian rhythm, frequent travel, and insufficient recovery, leaving the immune system less adaptable and prone to low-grade inflammation. This profile carries an elevated long-term risk for cardiometabolic and autoimmune conditions if sustained.

Suboptimal Supportive Indexes

Low Glycan Median (G1) and high Glycan Bisection (B) are associated with respiratory distress, cardiovascular instability, and systemic stress. This profile suggests autonomic dysregulation and heightened environmental strain, potentially linked to circadian disruption, poor recovery, or chronic exposure to irritants (e.g., air quality, smoking).

This page was updated since the previous version. See changelog for more info.

Glycan insights

Cardiovascular health	Significantly out of range
Metabolic health	Slightly out of range
Autoimmunity	Significantly out of range
Respiratory health	Significantly out of range
Female health	Slightly out of range

This overview highlights how chronic inflammation, as measured by the client's glycans, may be impacting different systems in their body. Use this as a guide to identify where lifestyle adjustments could be most effective.

To understand the specific glycan markers and scientific data informing this summary, see our glycan insights section.

Result indications

Significant areas for attention

Areas for attention

- Inc. risk of hypertension
- Pre-hypertension
- Hypertension
- MI & CVA
- Atherosclerosis
- Coronary artery disease
- Type 2 diabetes
- Dyslipidemia
- Rheumatoid arthritis
- Ulcerative colitis
- Crohn's disease
- SLE
- COPD
- Perimenopause

Please note: While certain patterns may show similarities to those observed in specific conditions, this does not confirm the presence of a disease or any of its subclinical forms.

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Action steps

Primary focus — based on primary indexes

Rebuild immune balance by restoring circadian rhythm and hormonal regulation

A comprehensive health evaluation is recommended to investigate underlying contributors. Prioritize circadian alignment with consistent sleep–wake schedules, integrate brief but regular recovery practices during the workday (e.g. short walks, breathwork, movement breaks), and avoid overreliance on high-intensity exercise in favour of balanced strength and mobility training. Address central drivers of immune disruption like hypertension, insulin resistance, dyslipidaemia, or hormonal imbalance.

Further testing suggested:
CBC, liver and kidney panels, lipid profile, glucose–insulin panel, full thyroid, adrenal, and sex hormone assessment, inflammatory markers (including hs-CRP), vitamin D, iron status, B12, folate, magnesium, zinc, homocysteine, Omega-3 Index, gut function tests (stool analysis, microbiome, breath tests), and autoimmune markers if indicated. Functional metrics such as HRV, VO_2max, and body composition can also support tracking of recovery.

Secondary focus — based on secondary indexes

Reduce systemic and environmental strain to stabilise vascular–respiratory resilience

Address autonomic stress by improving circadian alignment, enforcing structured recovery routines, and minimizing environmental exposures such as poor air quality, smoking, or occupational irritants. Support cardiovascular and respiratory health with moderate aerobic conditioning and regular monitoring of blood pressure and lung function.

Further testing suggested:
Blood pressure assessment (including variability), lung function testing, full cardiometabolic panel. Consider advanced vascular imaging if risk factors or family history indicate. Where relevant, conduct sleep studies to rule out sleep apnoea and assess autonomic regulation using HRV or similar metrics.

When to retest?

Retest in 3-6 months

The presence of significant glycan imbalances suggests that underlying chronic inflammation is impacting multiple systems and requires a comprehensive approach. We strongly advise a retest in 3-6 months.

Glycans can respond relatively quickly to substantial lifestyle changes, and this shorter interval enables you to closely monitor the effectiveness of your interventions and make prompt adjustments to your client's plan, ensuring they are on the most effective path toward improvement.

This page was updated since the previous version. See changelog for more info.

Client's progress

Result through time

Tracking biological age and glycan indexes through time provides valuable insights into a client's **health trajectory**.

Biological age through time

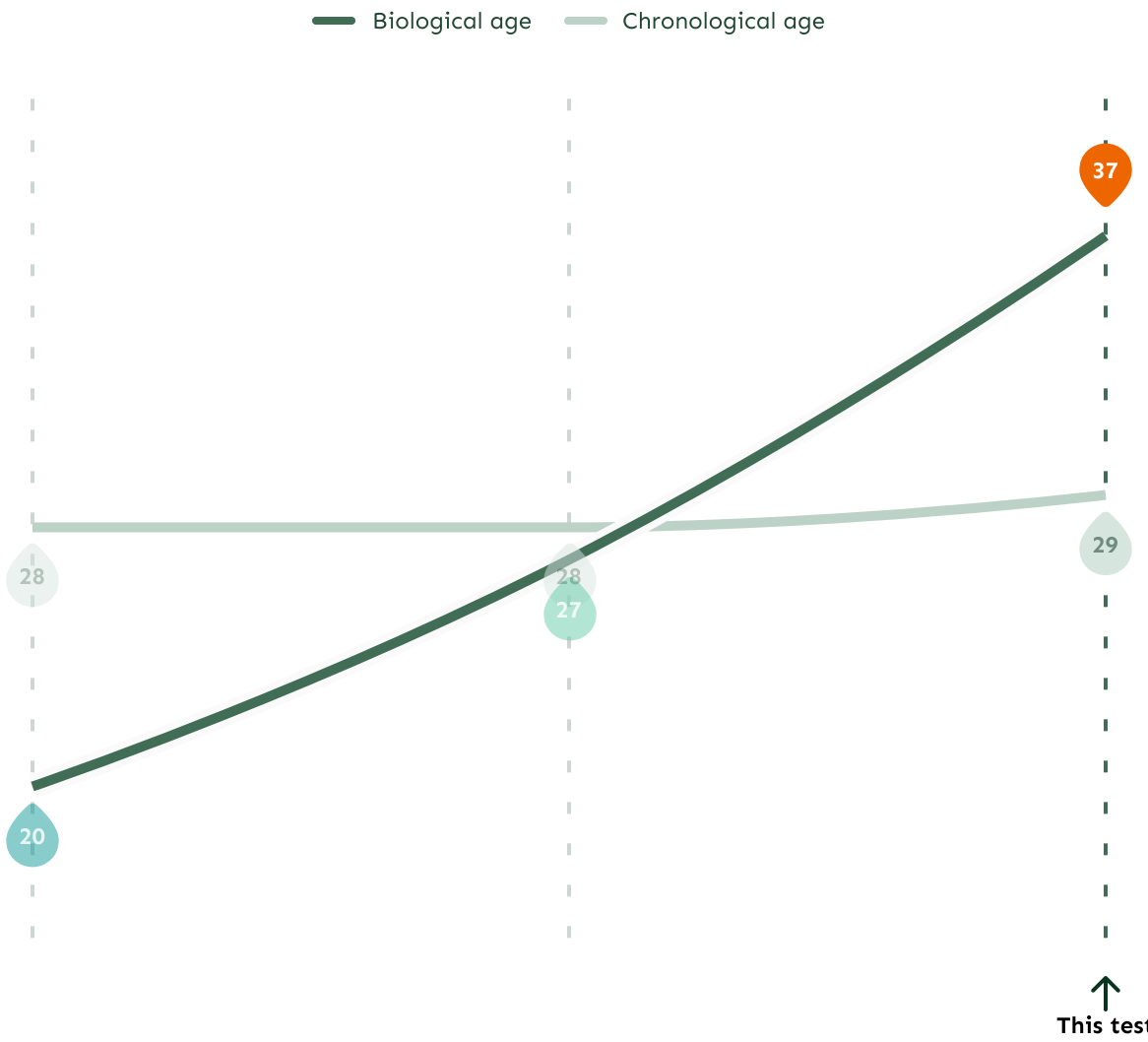
Tracking biological age through time provides valuable insights into a client's long term health. Monitoring changes in biological age can help to:

- Assess the effectiveness of interventions
- Identify early warning signs of future health decline
- Personalize care plans

Understanding result fluctuations

Chronic inflammation is a dynamic marker of immune health, responsive to both lifestyle and medical interventions.

Since there is no one-size-fits-all approach to health, tracking these fluctuations over time provides a clearer picture of what truly works for an individual—showing whether implemented changes are having the desired effect on inflammation and immune function.



Glycan indexes through time

Monitoring glycan indexes over time offers a more granular perspective on a client's health and aging trajectory.

While tracking biological age provides a valuable overall picture, observing changes in specific glycan indexes allows for a deeper understanding of the underlying biological processes and how they are influenced by interventions.

xx Percentile ranking of index at the time of testing

This page is a new feature in the report. See changelog for more info.

Glycan indexes breakdown

Glycan structures of similar chemical and functional composition are grouped into 5 different categories called **glycan indexes**.

Glycan Shield (S)

This index represents glycan structures containing sialic acid (S). It has an anti-inflammatory function. It reduces in abundance with age.

Optimal results associate with:

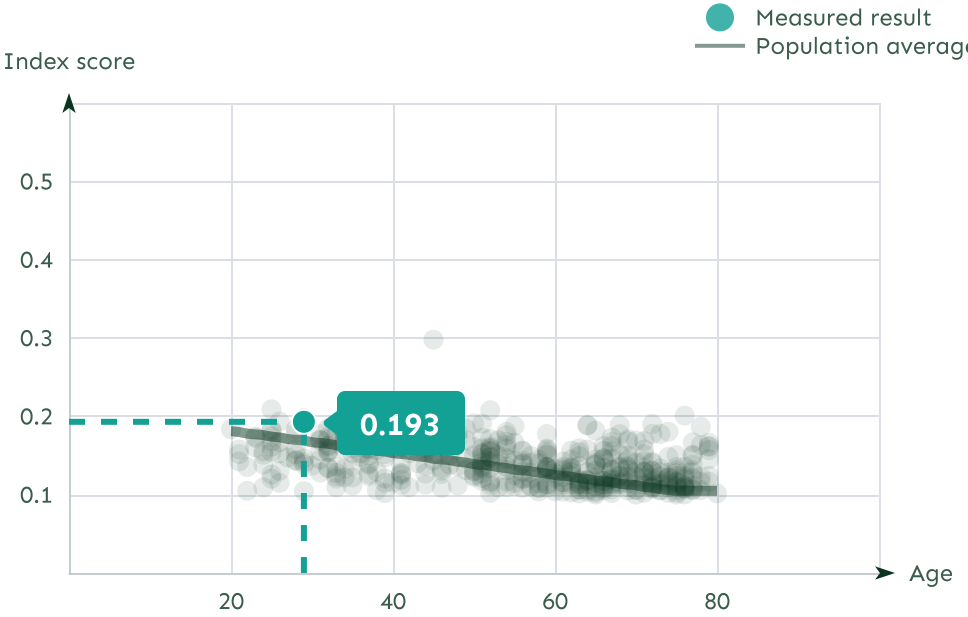
- Lower inflammation
- Healthier aging
- Strong immune regulation

Suboptimal results associate with:

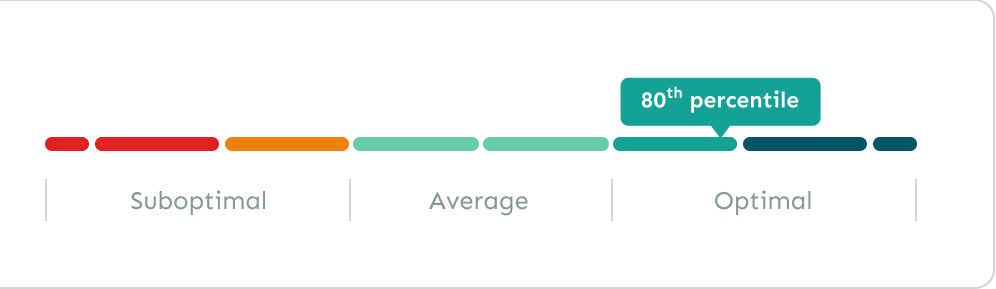
- Unbalanced hormones
- Poor sleep
- Sedentary lifestyle
- Nutritional deficiencies
- Gut and microbiome health

This page is a new feature in the report. See changelog for more info.

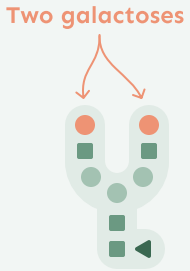
Compared to people in the same age group and biological sex:



This result ranks you in the 80th percentile:



Glycan Youth (G2)



This index represents glycan structures with two terminal galactoses (G2). It has an anti-inflammatory function. It reduces in abundance with age.

Optimal results associate with:

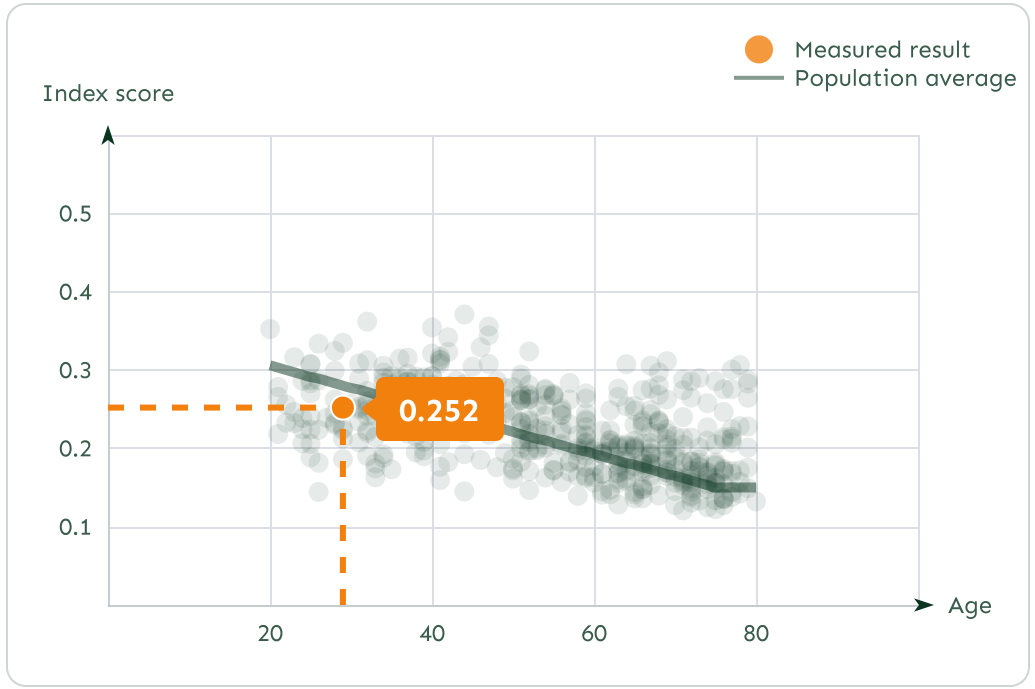
- Lower inflammation
- Healthier aging
- Strong immune regulation

Suboptimal results associate with:

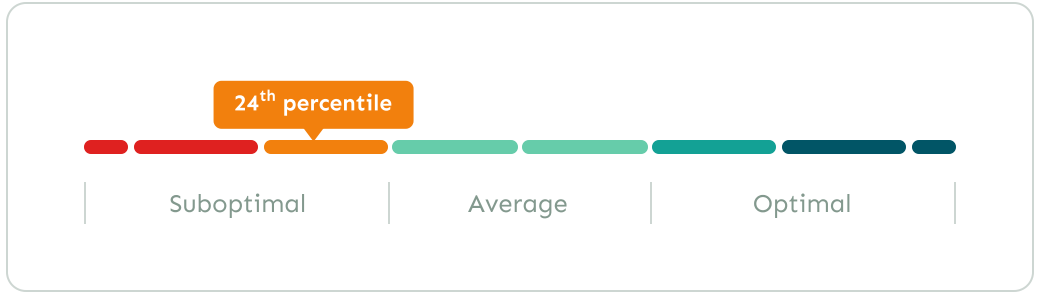
- Unbalanced hormones
- Poor metabolic health
- Stress
- Overexercising deficiencies
- Poor sleep
- Autoimmunity
- Unbalanced BMI
- Frequent travel
- Poor recovery

This page is a new feature in the report. See changelog for more info.

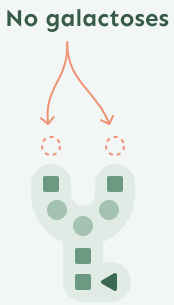
Compared to people in the same age group and biological sex:



This result ranks you in the 24th percentile:



Glycan Mature (G0)



This index represents glycan structures with no terminal galactoses (G0). It has a pro-inflammatory function. It increases in abundance with age.

Optimal results associate with:

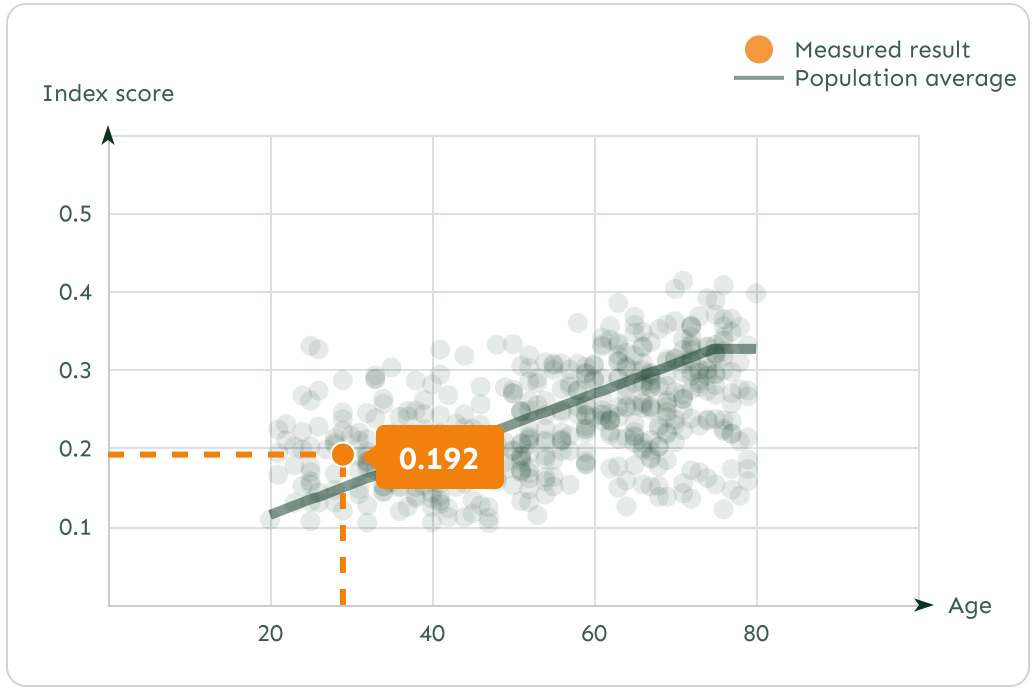
- Lower inflammation
- Healthier aging
- Strong immune regulation

Suboptimal results associate with:

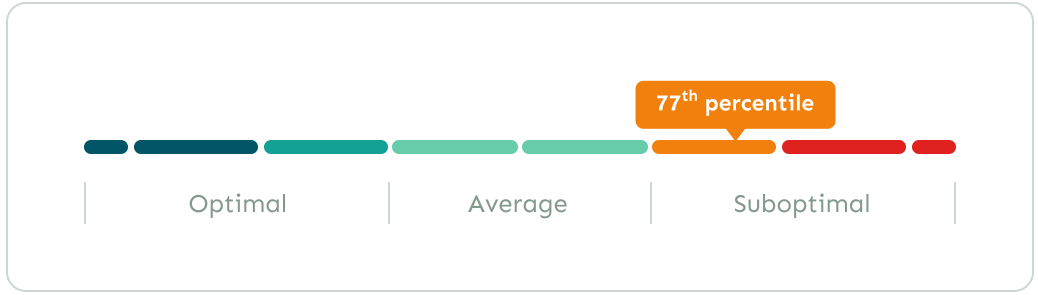
- Unbalanced hormones
- Poor metabolic health
- Stress
- Inflammatory diet
- Poor sleep
- Unbalanced BMI
- Frequent travel
- Poor recovery

This page is a new feature in the report. See changelog for more info.

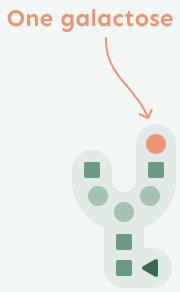
Compared to people in the same age group and biological sex:



This result ranks you in the 77th percentile:



Glycan Median (G1)



This index represents glycan structures with one terminal galactose (G1). As a supportive index, it can help narrow down associations with specific disease types, genetic traits, and/or some lifestyle habits.

Optimal results associate with:

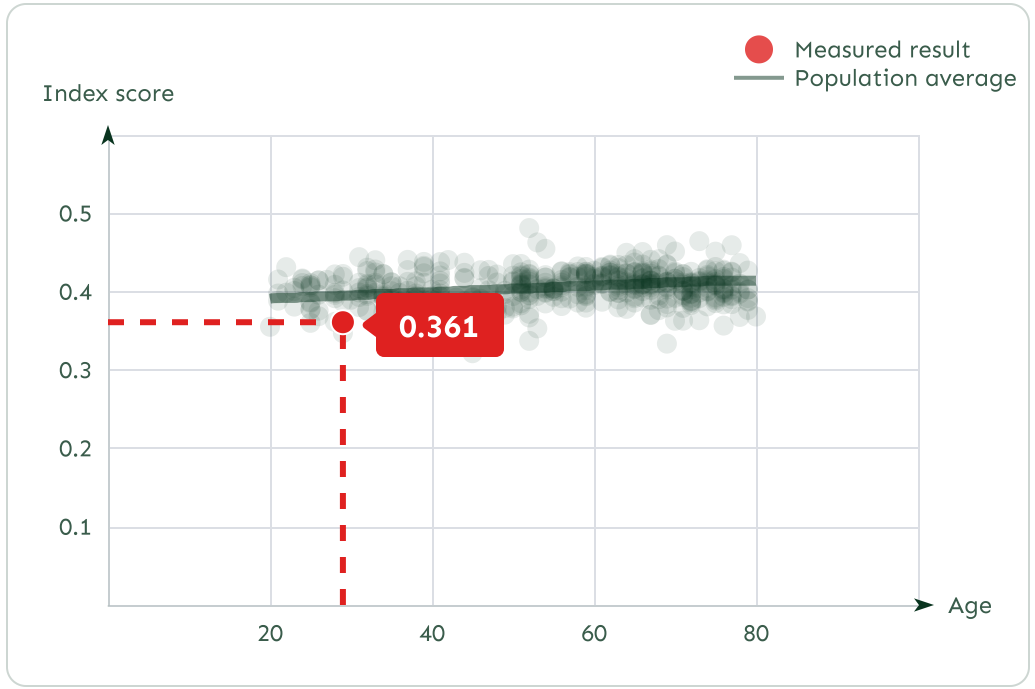
- Balanced immune adaptation

Suboptimal results associate with:

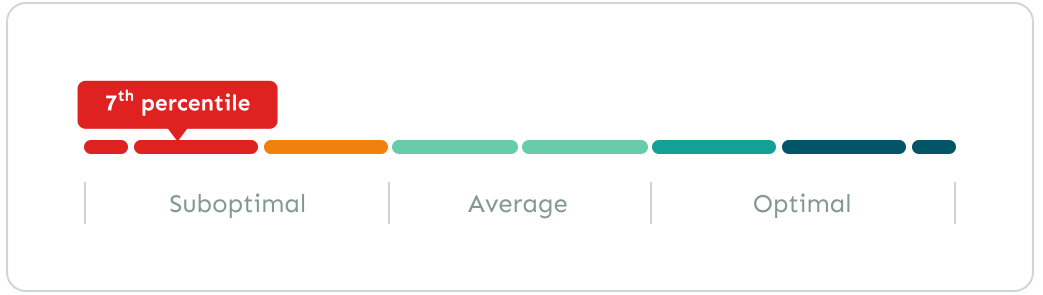
- Lower immune resilience
- Cardiovascular risk
- Disrupted immune adaptation

This page is a new feature in the report. See changelog for more info.

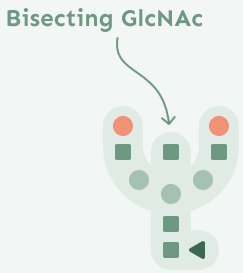
Compared to people in the same age group and biological sex:



This result ranks you in the 7th percentile:



Glycan Bisection (B)



This index represents glycan structures with a bisecting (B) GlcNAc modification. As a supportive index, it can help narrow down associations with specific disease types, genetic traits, and/or some lifestyle habits.

Optimal results associate with:

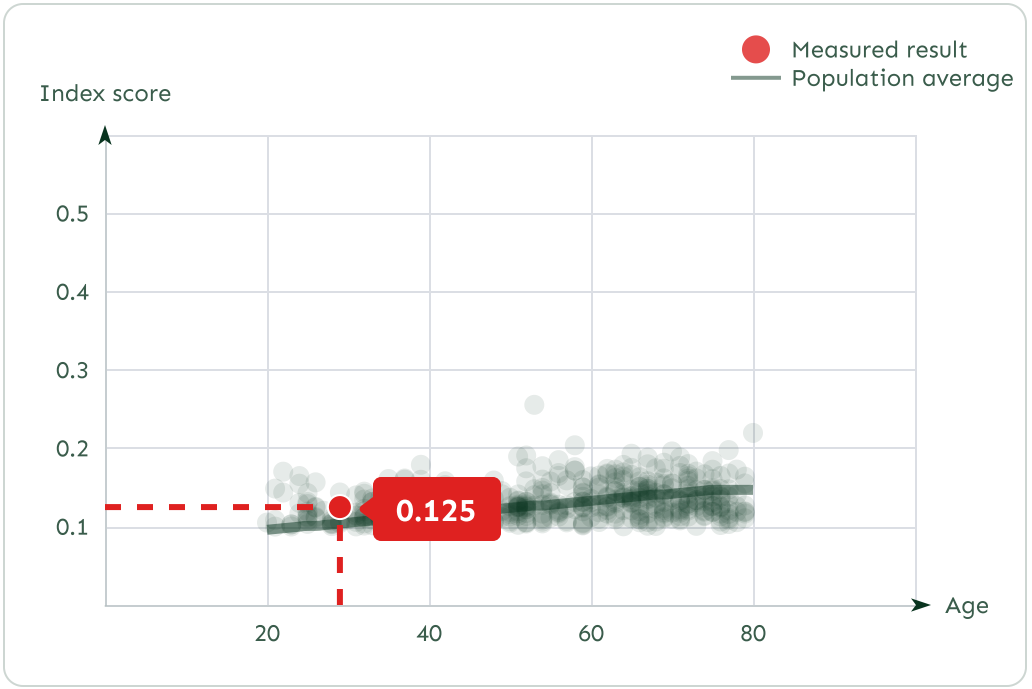
- Strong immune regulation
- Healthy habits

Suboptimal results associate with:

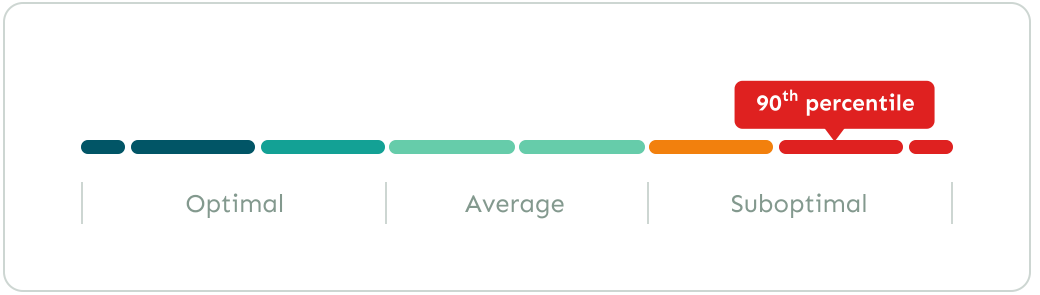
- Impaired adaptive response
- Reduced resilience
- Smoking
- Chronic stress
- Toxin exposure
- Alcohol intake
- Poor sleep
- Blood pressure disregulation

This page is a new feature in the report. See changelog for more info.

Compared to people in the same age group and biological sex:



This result ranks you in the 90th percentile:



Glycan insights

This part of the report compares your client's glycan index results to patterns seen in various diseases and conditions.

Please note: Glycan insights should be triangulated with other clinical data. Glycan changes may reflect progression of pathological changes into disease, and thus occur up to 10 years before the onset of any symptoms. The glycan profile presented here is for informational purposes only and cannot be used to diagnose any clinical disease. While certain patterns may show similarities to those observed in specific disorders, this does not confirm the presence of the disease or any of its subclinical forms. Proper diagnosis requires a comprehensive clinical evaluation by a qualified healthcare professional.

Glycan insights overview

Glycan insights compare your client's glycan index results to patterns seen in various diseases.

We've extracted data from over 300 scientific papers to understand how glycan indexes vary in individuals with specific diseases. Full study available on ScienceDirect.

Index overlaps

Each disease pattern consists of one or more indexes that are higher or lower than average. The overlap score (X/Y) shows how many of your client's indexes (X) match the pattern out of the total indexes in that disease (Y).

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Area	Condition	X/Y Index overlaps
Cardiovascular	Inc. risk of hypertension	**1/1** Significant overlap
	Pre-hypertension	**1/1** Significant overlap
	Hypertension	**3/3** Significant overlap
	MI & CVA	**1/1** Significant overlap
	Atherosclerosis	**4/5** Some overlap
	Coronary artery disease	**1/2** Some overlap
Metabolic	Type 2 diabetes	**4/5** Some overlap
	Dyslipidemia	**3/4** Some overlap
Autoimmune	Rheumatoid arthritis	**3/4** Some overlap
	Ulcerative colitis	**3/4** Some overlap
	Crohn's disease	**4/5** Some overlap
	SLE	**4/4** Significant overlap
Respiratory	COPD	**2/2** Significant overlap
Female	Perimenopause	**3/4** Some overlap

How to interpret glycan insights

1 Client's glycan fingerprint compared to disease-specific profiles

Disease-specific changes in glycan indexes are represented by arrows. Your client's results are shown above arrow.

2 At-a-glance summary

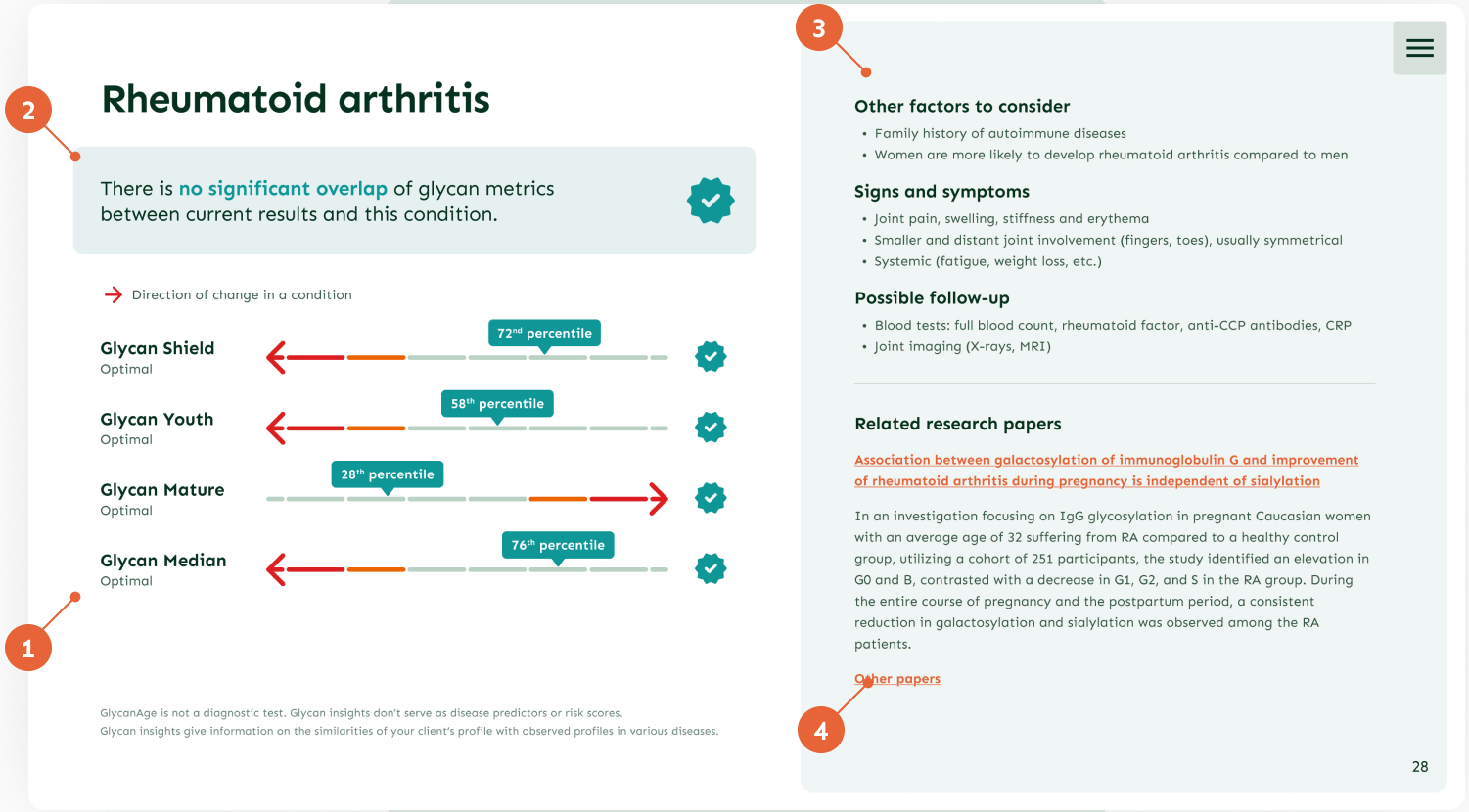
Here you can find a summary of glycan metrics. However, it is important to take your client's full medical history into account, as well as observe the amount of overlap of their glycan fingerprint.

3 Follow-up hints

Useful follow-up tests and symptoms to check for when assessing the risk of a disease.

4 Related research papers

Research that was done to observe glycosylation patterns within a specific disease or condition.



Increased risk of hypertension

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition

Glycan Bisection
Suboptimal

GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Usually asymptomatic

Possible follow-up

- Serial blood pressure (BP) measurements ± 24-hour BP monitoring
- BMI and/or body composition check
- Basic bloods (lipid profile, renal and liver function)

Related research papers

N-glycosylation of immunoglobulin G predicts incident hypertension

In a study investigating the relationship between IgG glycosylation and hypertension, 989 unrelated incident hypertension cases and 1,628 controls from the TwinsUK cohort, with a mean follow-up of 6.3 years, were examined. The average age of the participants was 56. The findings, which included an observed increase in B, were validated in additional cohorts from the "10,001 Dalmatians" (106 individuals) and KORA S4 (729 individuals). A predictive model incorporating age, BMI, mean arterial pressure (MAP), and specific glycan peaks with B modifications demonstrated robust predictive accuracy, achieving a very high AUC of 0.983.

Pre-hypertension

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition

Glycan Youth
Suboptimal

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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Usually asymptomatic

Possible follow-up

- Serial BP measurements and/or 24-hour BP monitoring
- BMI and/or body composition check
- Basic bloods (lipid profile, renal and liver function)

Related research papers

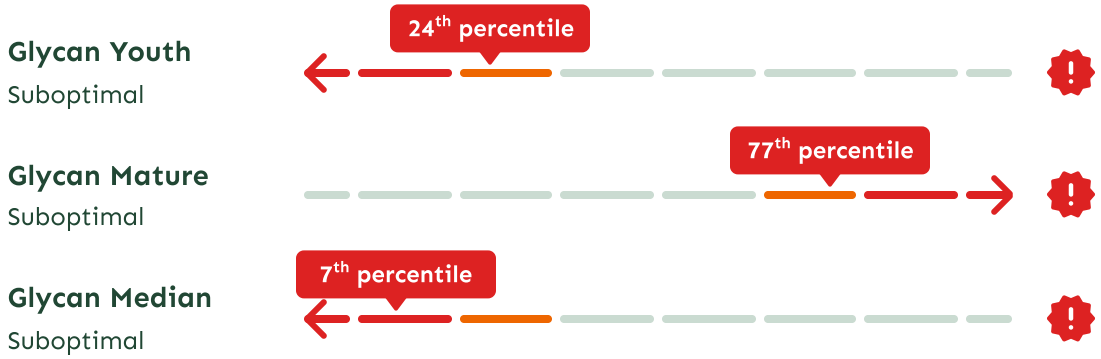
The Association Between Glycosylation of Immunoglobulin G and Hypertension: A Multiple Ethnic Cross-Sectional Study

In an extensive study with 4,757 participants, including 913 from the Chinese Han Beijing population, 985 from Croatian Korčula, 896 from Croatian Vis, and 1,963 from Scottish Orkney, researchers investigated changes in IgG glycans associated with prehypertension and hypertension. The demographic composition of the study was approximately 40% female and 60% male participants. A notable observation was the decrease in G2 in the cohort with prehypertension.

Hypertension

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Usually asymptomatic
- BP consistently >140/90 mmHg
- Signs of malignant hypertension (headache, dizziness, breathlessness, etc.)

Possible follow-up

- Serial BP measurements and/or 24-hour BP monitoring
- BMI and/or body composition check
- Basic blood tests (lipid profile, renal and liver function)

Related research papers

The Association Between Glycosylation of Immunoglobulin G and Hypertension: A Multiple Ethnic Cross-Sectional Study

In an extensive study with 4,757 participants, including 913 from the Chinese Han Beijing population, 985 from Croatian Korčula, 896 from Croatian Vis, and 1963 from Scottish Orkney, researchers investigated changes in IgG glycans associated with prehypertension and hypertension. The demographic composition of the study was approximately 40% female and 60% male participants. Among hypertension patients, there was a noted decrease in G2 and S, alongside an increase in G0.

MI & CVA Myocardial infarction and cerebrovascular accident

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition

P22
Suboptimal

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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Past medical history (cardiometabolic syndrome, autoimmune disease)
- Medication history (e.g., statins, blood thinners)
- Current/previous smoking history

Possible follow-up

- Blood tests: basic and extended lipid profile (e.g., Lp(a), ApoB), hsCRP, homocysteine, renal and liver function, HbA1c
- BP check
- ECG
- Cardiology referral for other tests (e.g., cardiac echo, coronary CT)

Related research papers

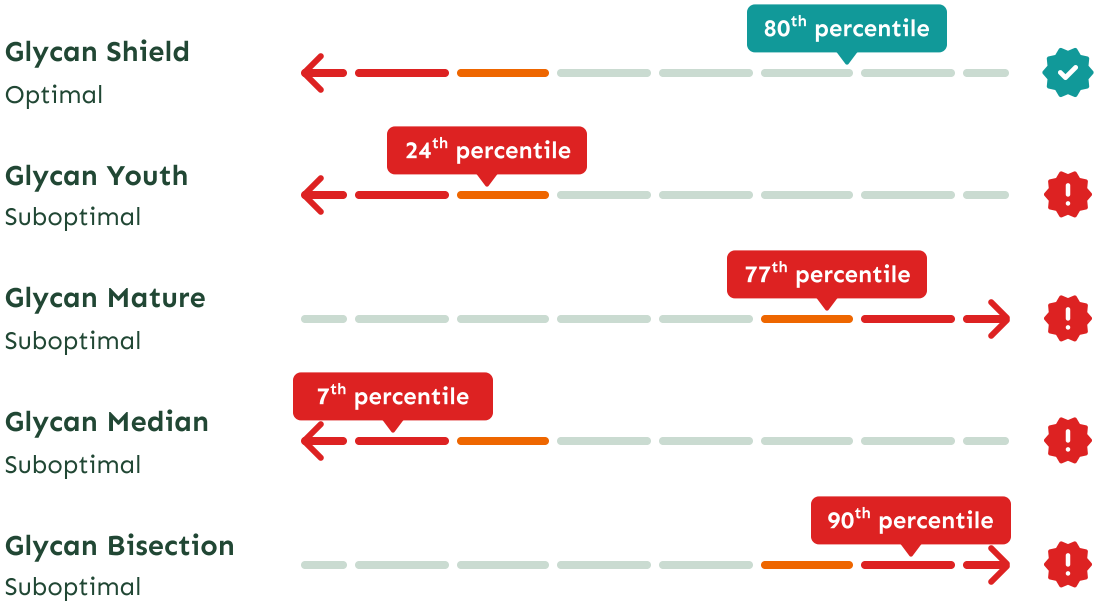
Immunoglobulin G N-Glycosylation Signatures in Incident Type 2 Diabetes and Cardiovascular Disease

In the EPIC-Potsdam cohort, involving 2,175 participants in the cardiovascular disease (CVD) subcohort, which includes 417 cases of MI and CVA, changes in IgG glycosylation were analysed. This cohort comprised 61% females and 39% males, with an average age of 49. For female participants, a significant association was found with a single glycan peak (peak 22), identified as a predictive marker for future MI and CVA, exhibiting a hazard ratio (HR) of 0.74.

Atherosclerosis

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Usually asymptomatic
- Signs of coronary artery disease (e.g., self-resolving chest pain, breathlessness)
- Signs of peripheral artery disease (e.g., leg pain during activity)

Possible follow-up

- Blood tests: basic and extended lipid profile (e.g., Lp(a), ApoB), hsCRP, homocysteine, renal and liver function, HbA1c
- BP check
- ECG
- Cardiology referral for other tests (e.g., coronary artery calcium score)

Related research papers

Glycosylation Profile of Immunoglobulin G Is Cross-Sectionally Associated With Cardiovascular Disease Risk Score and Subclinical Atherosclerosis in Two Independent Cohorts

In a study involving 2,970 women aged 40–79 from the TwinsUK cohort, IgG glycosylation was examined in relation to the estimated 10-year risk of atherosclerotic cardiovascular disease and the presence of carotid and femoral plaque. A decrease in G1, G2 and S was observed, alongside an increase in G0 and B. These findings were replicated in 967 women from the ORCADES cohort (Orkney Complex Disease Study). Additionally, some of these glycan changes were also associated with 845 men in the study.

Coronary artery disease

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition

GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Self-limiting chest pain ± radiation into jaw/left arm/back
- Breathlessness
- Other (syncope, palpitations, leg edema, orthopnea, etc.)

Possible follow-up

- Blood tests: basic and extended lipid profile (e.g., Lp(a), ApoB), hsCRP, homocysteine, renal and liver function, HbA1c
- BP check
- ECG
- Cardiology referral for other tests (e.g., stress echocardiogram)

Related research papers

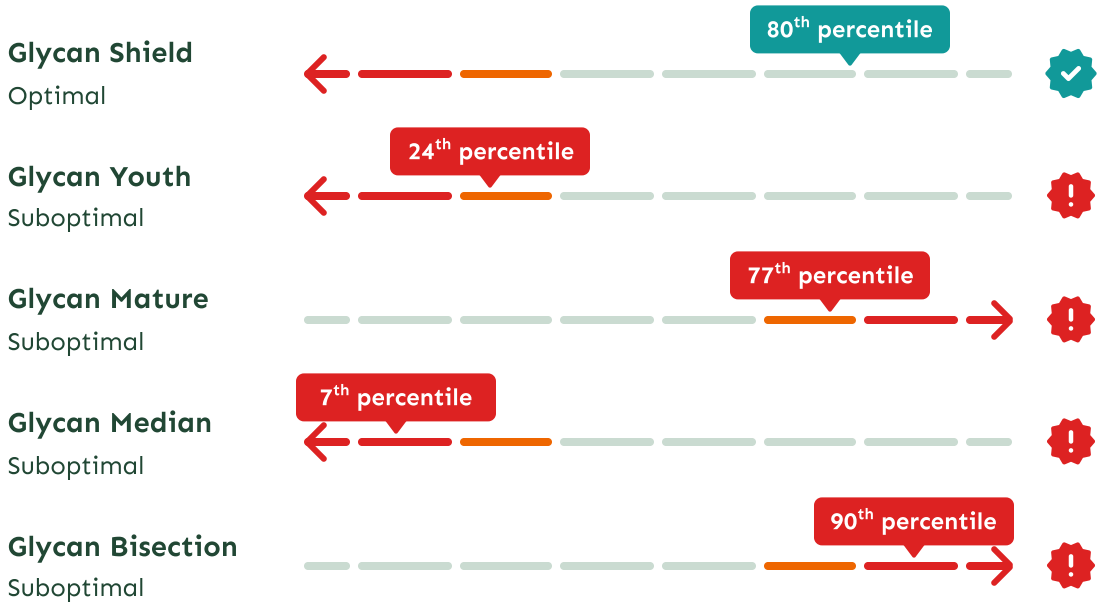
IgG N-Glycosylation Is Altered in Coronary Artery Disease

In the CAPIRE study, male and female participants aged 45 to 75 years without prior clinical manifestations of coronary artery disease (CAD) were assessed using coronary computed tomography angiography (CCTA). They were categorized into CAD-negative (clean coronaries) and CAD-positive (significant coronary atherosclerosis) based on CCTA findings, aligning with the AHA classification. This research paper aimed to explore the association between the N-glycome profile of immunoglobulin G (IgG) and CAD presence. Among the 198 women in the study, with an average age of 59.9 years, significant glycan alterations were noted, specifically an increase in G0 and a decrease in S.

Type 2 diabetes

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Fatigue
- Increased thirst and frequent urination
- Slow wound healing, blurred vision, frequent thrush

Possible follow-up

- Blood tests: full blood count, renal and liver function, fasting glucose and insulin, HbA1c, HOMA-IR
- BP check
- BMI and/or body composition check

Related research papers

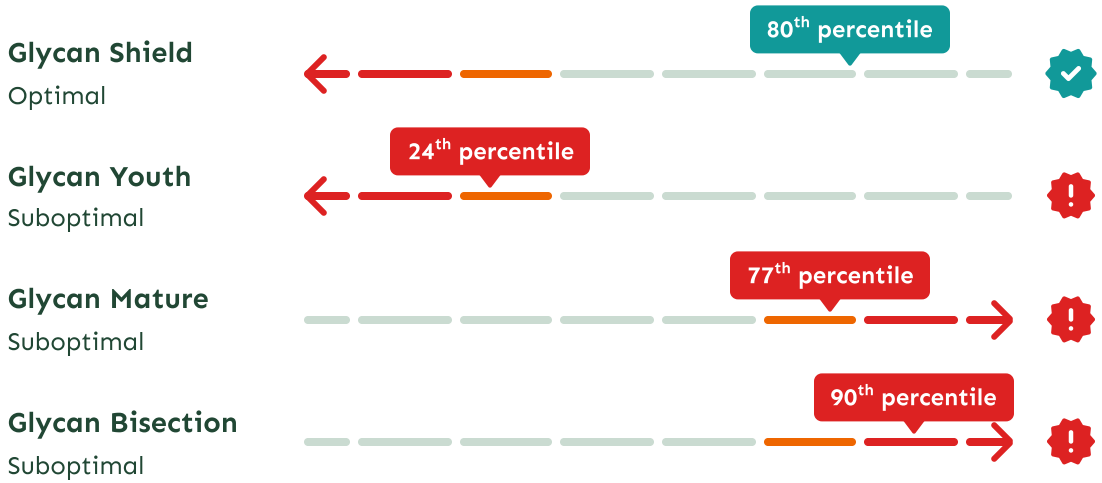
IgG glycan patterns are associated with type 2 diabetes in independent European populations

In the DiaGene study, a population-based case-control study with 1,886 cases and 854 controls, 58 IgG glycan traits were analyzed. The findings were then replicated and meta-analyzed in the combined population-based studies of CROATIA-Korcula, CROATIA-Vis, and ORCADES, involving 162 cases and 3,162 controls. Within this research, 46% of cases and 60% of controls were female, with an average participant age of 65. The analysis revealed a decrease in G1, G2, and S glycans, alongside an increase in G0 and B. A predictive model incorporating four specific glycan peaks achieved an AUC of 0.729. When IgG glycans were added to a model containing only age and sex, the AUC improved from 0.542 to 0.734, although incorporating them into a more comprehensive model did not significantly enhance the AUC.

Dyslipidemia

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of cardiovascular diseases
- BMI above 25

Signs and symptoms

- Usually asymptomatic

Possible follow-up

- Lipid profile blood tests: basic and extended (incl. oxLDL, VLDL, LDL-P, Lp-PLA2, Lp(a), ApoB)
- Other blood tests: hsCRP, homocysteine, renal and liver function, HbA1c
- BP check

Related research papers

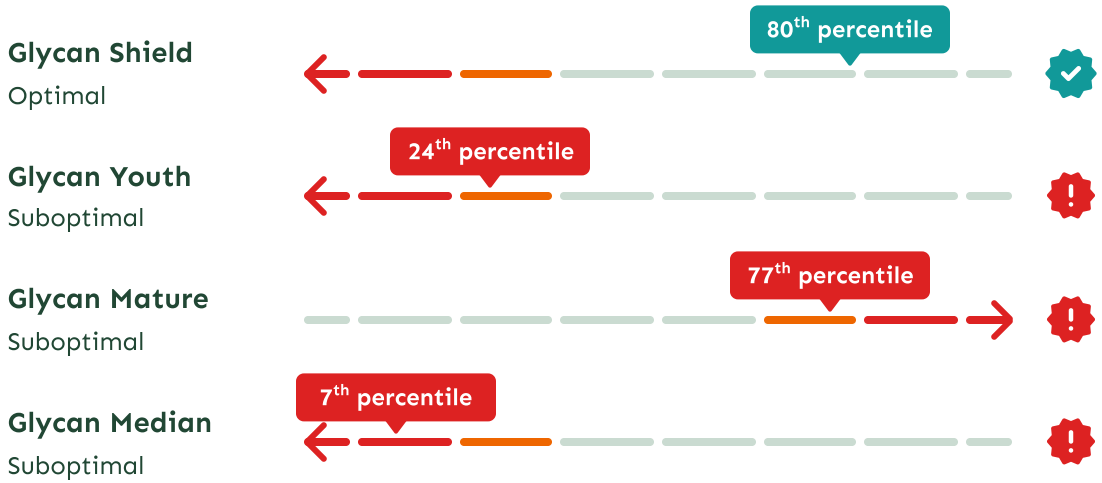
The changes of immunoglobulin G N-glycosylation in blood lipids and dyslipidaemia

In a study focusing on IgG glycome changes related to dyslipidemia, 598 participants (67% female participants) were selected from a larger observational cross-sectional study conducted in 2012, which initially involved 913 participants of Chinese Han ancestry from Beijing. The glycomic analysis revealed a decrease in G2 and S, coupled with an increase in G0 and B. A predictive model incorporating six specific glycan structures was developed from these findings, resulting in an AUC of 0.692.

Rheumatoid arthritis

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of autoimmune diseases
- Women are more likely to develop rheumatoid arthritis compared to men

Signs and symptoms

- Joint pain, swelling, stiffness and erythema
- Smaller and distant joint involvement (fingers, toes), usually symmetrical
- Systemic (fatigue, weight loss, etc.)

Possible follow-up

- Blood tests: full blood count, rheumatoid factor, anti-CCP antibodies, CRP
- Joint imaging (X-rays, MRI)

Related research papers

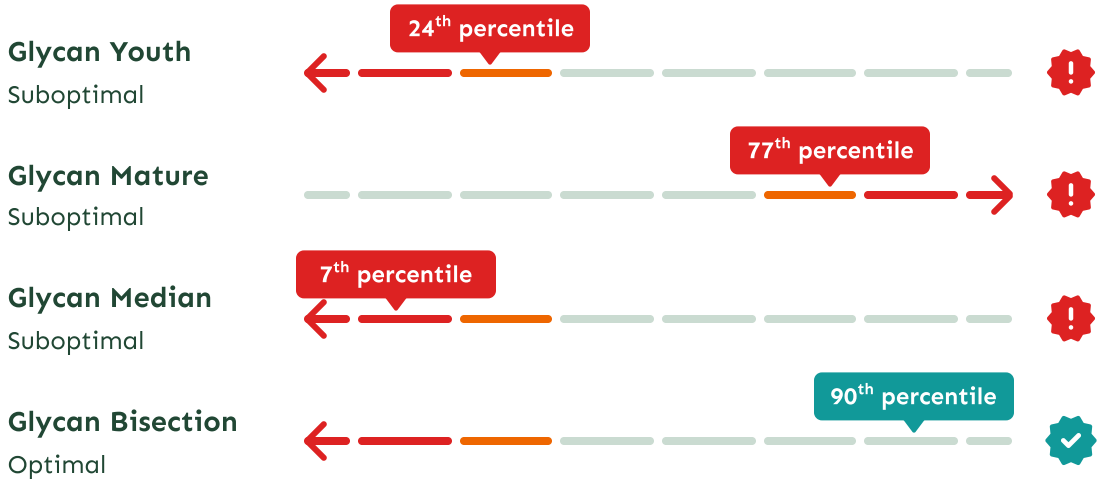
Association between galactosylation of immunoglobulin G and improvement of rheumatoid arthritis during pregnancy is independent of sialylation

In an investigation focusing on IgG glycosylation in pregnant Caucasian women with an average age of 32 suffering from RA compared to a healthy control group, utilizing a cohort of 251 participants, the study identified an elevation in G0 and B, contrasted with a decrease in G1, G2, and S in the RA group. During the entire course of pregnancy and the postpartum period, a consistent reduction in galactosylation and sialylation was observed among the RA patients.

Ulcerative colitis

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of autoimmune diseases

Signs and symptoms

- Abdominal pain and cramping
- Urgency to defecate
- Recurring diarrhea (± blood)

Possible follow-up

- Blood tests: full blood count, renal and liver function, CRP
- Stool tests: faecal immunochemical test (FIT), fecal calprotectin
- Referral for CT colonoscopy

Related research papers

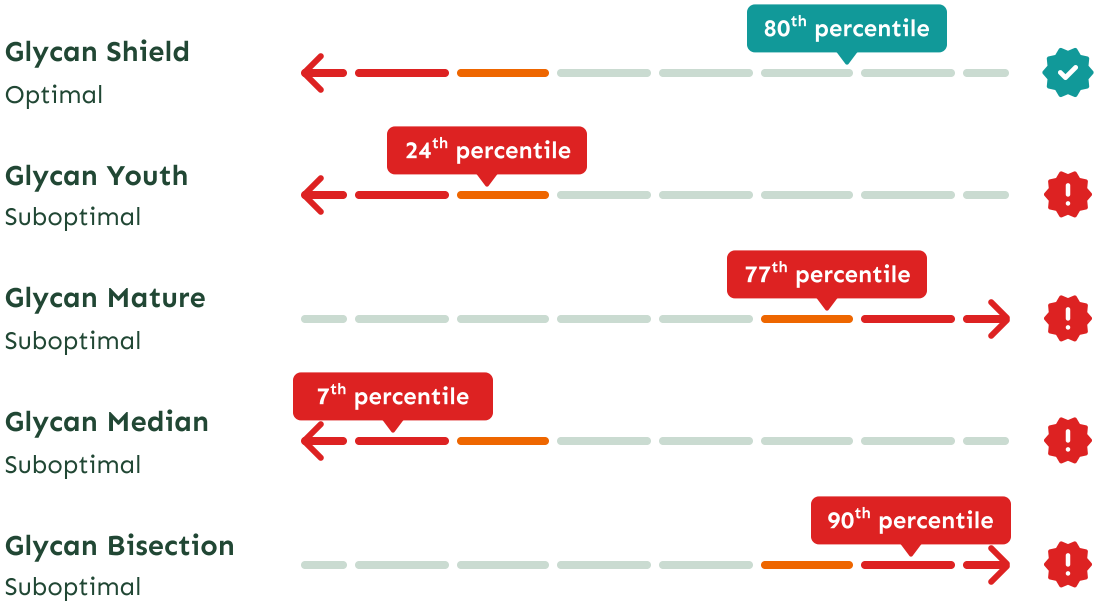
Inflammatory bowel disease associates with proinflammatory potential of the immunoglobulin G glycome

In a Scottish study examining IgG glycosylation in IBS, focusing on the ulcerative colitis (UC) segment, a cohort of 507 UC patients and 320 controls, all with an average age of 45, was evaluated.The analysis revealed a significant increase in G0 and a decrease in G1 in the UC patients compared to the controls. Observed alterations of specific glycan peaks demonstrated predictive power, with an area under the curve (AUC) of 0.72, indicating their potential utility in distinguishing between UC patients and healthy individuals.

Crohn's disease

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of autoimmune diseases

Signs and symptoms

- Abdominal pain and cramping
- Recurring diarrhea (± blood)
- Weight loss

Possible follow-up

- Blood tests: full blood count, renal and liver function, CRP
- Stool tests: faecal immunochemical test (FIT), faecal calprotectin
- Referral for CT colonoscopy

Related research papers

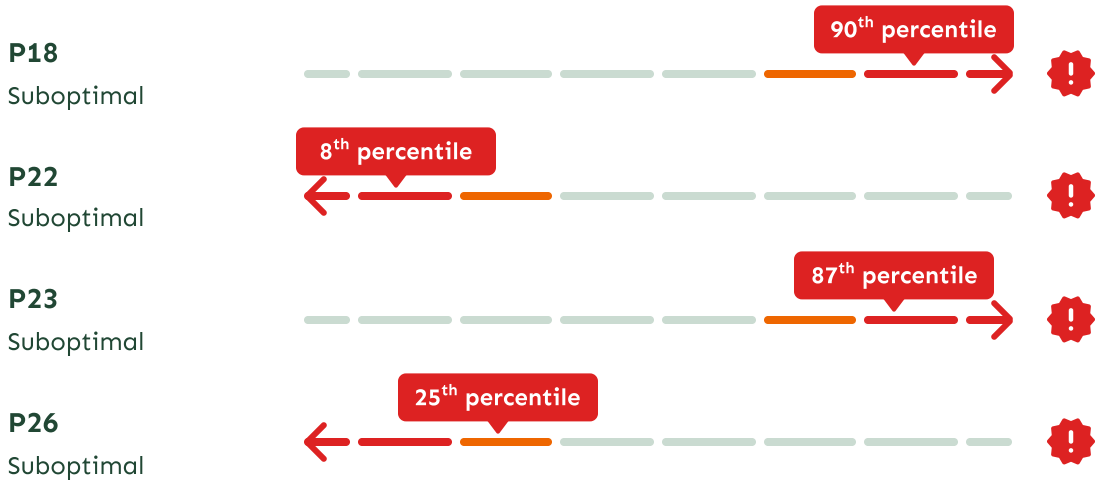
Inflammatory bowel disease associates with proinflammatory potential of the immunoglobulin G glycome

In a Scottish study examining IgG glycosylation changes in IBS, a cohort of 287 CD patients and 320 controls, all with an average age of 42, was evaluated. The analysis indicated a significant increase in G0 and B glycan traits and a decrease in G1, G2, and S in CD patients compared to controls. The changes in specific glycan peaks showed predictive value, with an AUC of 0.77.

SLE Systemic lupus erythematosus

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



These metrics represent individual glycan structures. While most research studies observe changes in glycan indexes (groups of multiple glycan structures), this study observed changes in individual glycan structures.

GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Family history of autoimmune diseases
- Women are more likely to develop SLE compared to men

Signs and symptoms

- Systemic (e.g., fatigue, weight loss, mouth ulcers, butterfly skin rash)
- Organ-specific (chest pain, difficulty breathing, leg swelling, anaemia, etc.)
- Joint pain and swelling

Possible follow-up

- Blood tests: full blood count, renal and liver function, CRP, ESR, autoantibodies (e.g., ANA, anti-dsDNA)
- Urinalysis
- Organ-targeted imaging (e.g., CT thorax, CT abdomen)

Related research papers

Association of Systemic Lupus Erythematosus With Decreased Immunosuppressive Potential of the IgG Glycome

In an analysis focusing on SLE, a discovery cohort consisting of 261 predominantly female SLE patients and 247 matched controls of Latin American Mestizo origin was studied for changes in IgG glycome, alongside two independent replication cohorts from Trinidad (108 SLE patients and 193 controls) and China (106 SLE patients and 105 controls). The study identified specific alterations in glycan traits, including a decrease in G2 and S, and notable changes in glycan peaks, with increases in peaks 18 and 23 and decreases in peaks 22 and 26. Utilizing these peak variations, a predictive model was developed, achieving an AUC of up to 0.882.

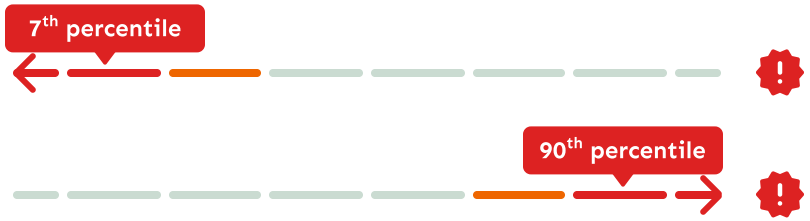
COPD Chronic obstructive pulmonary disease

There is **significant overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition

Glycan Median
Suboptimal

Glycan Bisection
Suboptimal



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Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Signs and symptoms

- Difficulty breathing
- Chronic cough (± productive)
- Fatigue

Possible follow-up

- Blood tests: full blood count
- Spirometry
- ECG, chest X-ray

Related research papers

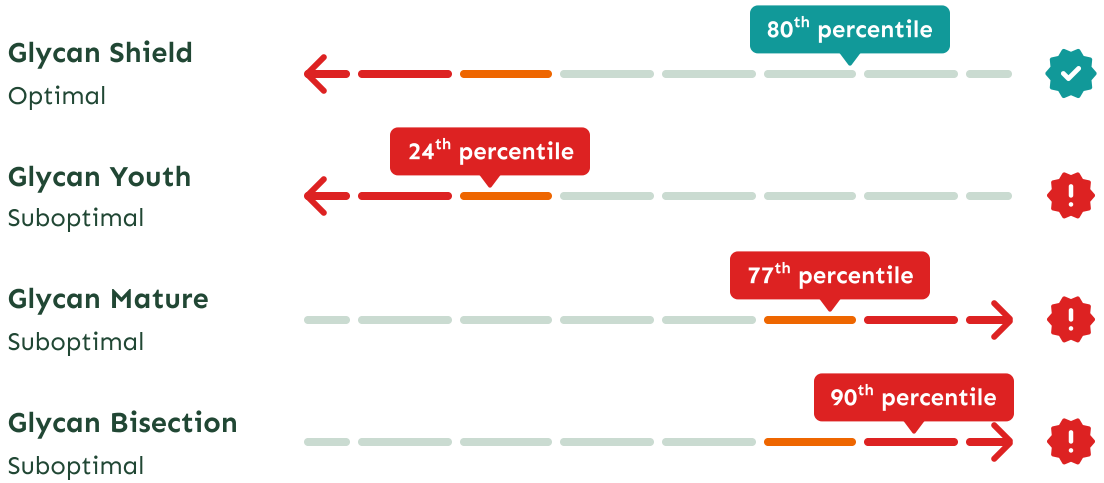
N-glycosylation patterns of plasma proteins and immunoglobulin G in chronic obstructive pulmonary disease

In a Croatian study focusing on COPD, researchers analyzed IgG glycosylation in 137 COPD patients and 95 controls in the discovery cohort, and 61 COPD patients and 148 controls in a replication cohort from another medical center. The discovery cohort included 97 female participants (42%), while the replication cohort had 116 females (56%). The study observed a decrease in G1 and an increase in B glycan structures in COPD patients.

Perimenopause

There is **some overlap** of glycan metrics between current results and this condition.

→ Direction of change in a condition



GlycanAge is not a diagnostic test. Glycan insights don't serve as disease predictors or risk scores.
Glycan insights give information on the similarities of your patient's profile with observed profiles in various diseases.

Other factors to consider

- Age between 40 and 55

Signs and symptoms

- Irregular menstrual cycle
- Vasomotor symptoms (e.g., hot flushes)
- Other (e.g., mood swings, cognitive difficulties, sleep disturbance)

Possible follow-up

- Blood tests (incl. FSH, oestradiol, progesterone, testosterone, AMH)
- Blood pressure check
- Referral to (peri)menopause specialist/gynaecologist

Related research papers

Estrogens regulate glycosylation of IgG in women and men

In a comprehensive study examining IgG galactosylation only, 713 healthy adults from two cohorts representing White, Hispanic, and African American back grounds, along with 159 subjects from four randomized controlled trials on endocrine manipulation, were assessed, totaling 872 participants with an equal gender distribution. The study found that menopause was linked to an increase in agalactosylated IgG glycans, particularly the fucosylated nonbisected (G0F) glycoform. Treatment effects were noted, where conjugated estrogens and raloxifene reduced G0F glycans in postmenopausal women, and in premenopausal women, leuprolide increased G0F glycans, an effect that was reversed by estradiol.

Influencing factors

Lifestyle, life stages, as well as **pharmacological interventions** can have a significant impact on chronic inflammation, which will likely reflect on GlycanAge results.

Diet

Dietary habits shape inflammation levels and affect the GlycanAge score. While short-term lapses in diet, such as an occasional indulgence, won't impact the GlycanAge score, long term changes in diet will most likely affect the results.

There is no one-size-fits-all diet, as each person's metabolism is unique and finding the optimal diet for an individual is a difficult task. This makes GlycanAge a valuable tool that can help you understand whether your patient's diet is good for them or if it fuels inflammation.

Our research found that in overweight individuals, only caloric restriction has an overall anti-inflammatory effect in most people whereas other types of diets show different effects depending on a individual.

Indeterminate effect
No clear outcome from the study

Related research papers

Effects of low-calorie and different weight-maintenance diets on IgG glycome composition

The study investigated the effects of different diets on IgG glycans, analyzing 1,850 samples from the Diogenes study, one of the largest dietary intervention studies. A total of 938 participants who were overweight underwent an 8-week low-calorie diet (800 kcal/day), followed by one of the weight maintenance diets for 6 months.

- Low protein / low glycemic index
- Low protein / high glycemic index
- High protein / low glycemic index
- High protein / high glycemic index

Only caloric restriction (CR) resulting in weight loss showed anti-inflammatory effects. After 8 weeks of CR, a decrease was observed in the pro-inflammatory Glycan Mature index and an increase in the anti-inflammatory Glycan Shield index. These changes returned to baseline after some of the weight was gained back on maintenance diets.

While no statistically significant changes in IgG glycans were observed on the maintenance diets, individual responses varied—some participants showed improvement, while others experienced worsening results. This variability underscores the importance of a personalized approach to nutrition showing there is no one-size-fits-all diet.

Stress

When the body experiences stress, it activates the fight-or-flight response, which is beneficial in short-term situations. However, chronic stress disrupts the hormonal balance, keeping hormones like adrenaline and cortisol high, which leads to disruption of the immune system and fuels inflammation.

Therefore, individuals who are under a lot of stress can have higher GlycanAge scores. Both individuals under constant stress, such as work-related pressure, and those who encounter sudden, intense stress, like major life events, may experience an increase in their GlycanAge due to the body's sustained inflammatory response.

Biological age
Chronic inflammation

Related research papers

N-glycosylation profiling of plasma provides evidence for accelerated physiological aging in post-traumatic stress disorder

The study aimed to explore whether traumatic stress accelerates the aging process by analyzing glycan profiles in individuals experiencing varying levels of stress. A total of 32 participants were included: 13 individuals with post-traumatic stress disorder (PTSD), 9 trauma-exposed individuals without PTSD, and 10 low-stress control subjects. The researchers used the GlycoAge test, a biomarker for physiological aging, and found that, on average, individuals with PTSD and those exposed to trauma showed signs of accelerated aging by 15 years compared to the low-stress controls./day), followed by one of the weight maintenance diets for 6 months.

Insufficient sleep

Insufficient sleep has been shown to raise inflammatory markers in the body. Both acute sleep deprivation (e.g., being awake for 24 hours) and chronic insufficient sleep can increase inflammation.

While short-term sleep deprivation does not affect the GlycanAge score, long-term insufficient sleep can cause elevated GlycanAge score.

Additionally, individuals with sleep disorders such as sleep apnea, which disrupts normal breathing during sleep, may also have higher scores due to the inflammatory nature of this condition. Our research indicates that people with severe obstructive sleep apnea (OSA) are, on average, 6.9 years older biologically than their chronological age.

Biological age
Chronic inflammation

Related research papers

Not-So-Sweet Dreams: Plasma and IgG N-Glycome in the Severe Form of the Obstructive Sleep Apnea

The aim of the study was to explore whether IgG glycans can be used as biomarkers for severe obstructive sleep apnea (OSA). IgG and total plasma glycans were analyzed in 70 subjects with severe OSA and 23 controls. Significant changes were observed in both IgG and total plasma glycans. Furthermore, patients with severe OSA exhibited accelerated biological aging, with GlycanAge score on average being 6.9 years higher than their chronological age. This study suggests that both IgG and total plasma glycans might be considered biomarkers for severe OSA./day), followed by one of the weight maintenance diets for 6 months.

Exercise

Regular physical activity and exercise have positive effects on biological age and glycan indexes.

However, individuals who engage in exercise after a long period of inactivity and sedentary lifestyle may initially experience an increase in chronic inflammation and their biological age, especially if they are overweight.

Exercise is also crucial for cardiovascular health and studies in women show that exercise has positive effects on a specific glycan that has a cardio protective role.

Cardio health
Cardio protective glycan

Related research papers

Physical Exercise Induces Significant Changes in Immunoglobulin G N-Glycan Composition in a Previously Inactive, Overweight Population

The study investigated the impact of regular exercise on IgG glycans in previously inactive, middle-aged, overweight population. 397 participants were subjected to one of the following exercise programs for 12 weeks:

- circular exercise program
- cardio exercise program
- Nordic walking program

After completing the program, the participants showed an increase in some pro-inflammatory glycans, which was somewhat expected as they were previously inactive.

The main result of the study was an increase in a specific glycan structure (GP9) which is reported to have a protective role in cardiovascular health in women.

Overexercising

Although exercise and regular physical activity are crucial for good health, overexercising can have negative impacts on levels of inflammation.

The acute inflammation caused by a workout is beneficial. However, constant overexercise without proper recovery period can cause an increase in low-grade systemic inflammation and may increase the GlycanAge score.

Professional athletes and individuals with extreme exercise regimens generally have a higher GlycanAge score compared to those who engage in moderate and balanced exercise.

Biological age
Chronic inflammation

Related research papers

Regular moderate physical exercise decreases Glycan Age index of biological age and reduces inflammatory potential of Immunoglobulin G

The study included 276 healthy participants divided into 4 groups based on their activity level:

- inactive group
- newly involved recreational group
- regularly moderate active group
- professionally competing athlete group

On average, those who exercise regularly had the lowest GlycanAge score when compared to other groups. It was found that those who exercises regularly had on average a lower GlycanAge score by 7.4 years when compared to inactive individuals (around 10 years for women and 6 for men). Professional athletes showed an increased GlycanAge score by 7.6 years on average compared to those who exercise regularly, however, this trend was observed in women only.

Additional notes

Some forms of intense exercise, such as repeated sprint training (RST), show positive effects on glycans and lead to a reduction in biological age.

Weight loss

Excess body weight significantly influences IgG glycans and is associated with a higher GlycanAge score and poor index scores.

Weight loss, whether through dieting, exercise, or bariatric surgery, generally leads to a reduction in the GlycanAge score and improvements in nearly all indexes.

However, extreme weight loss can temporarily increase the GlycanAge score. Upon fat tissue reduction, inflammatory molecules stored in the fat are released into the bloodstream, causing increased inflammation.

Biological age
Chronic inflammation

Glycan Shield
Anti-inflammatory

Glycan Youth
Anti-inflammatory

Glycan Mature
Pro-inflammatory

Related research papers

Extensive weight loss reduces glycan age by altering IgG N-glycosylation

Individuals scheduled for bariatric surgery (n=37) were subjected to 3 weeks of low-calorie diet (900 kcal/daily). In the short period while under caloric restriction, an improvement in the Glycan Bisection index was observed, indicating a reduced pro-inflammatory potential of IgG glycans.

Following the bariatric surgery, additional improvements such as a decrease in the pro-inflammatory Glycan Mature index and an increase in anti-inflammatory indexes Glycan Youth and Glycan Mature were observed.

The results were further validated on 1680 individuals from the TwinsUK cohort followed for 20 years where it was observed that reduction of BMI through weight loss was associated with a reduced GlycanAge score and improvements in the Glycan Mature and Glycan Youth indexes.

Additional notes

In another study, we investigated the effects of different diet types on IgG glycans and found that caloric restriction, rather than a specific type of diet, is the main driver of positive changes.

Supplements

Supplements can affect the GlycanAge score both positively and negatively, as individuals have different responses to them.

Our studies looking at the effects of omega-3s and NAD+ precursor supplements, show positive effects on the GlycanAge score and indexes.

Experimentally we know various other supplements affect the GlycanAge score, especially if the supplements target common deficiencies (e.g. vitamin D) or have anti-inflammatory properties.

However, not all supplements are suitable for everyone and GlycanAge can help you understand how your patient is responding to them.

Indeterminate effect
No clear outcome from the study

Related research papers

The effect of n-3 polyunsaturated fatty acids-enriched hen eggs consumption on IgG and total plasma protein N-glycosylation in healthy individuals and cardiovascular patients

The study investigated the effects of omega-3 PUFAs-enriched hen eggs consumption on IgG glycans and other inflammatory biomarkers in healthy people and in cardiovascular (CV) patients. In healthy individuals who consumed omega-3 enriched eggs, we saw a decrease in the Glycan Bisection index and in those consuming normal eggs we saw an increase in the Glycan Mature index. In CV patients, we saw a switch towards a less-inflammatory profile of the total blood plasma glycans.

The use of a systems approach to increase NAD+ in human participants

This double-blinded, placebo-controlled crossover trial investigated the efficacy of the NAD+ supplement Nuchido TIME+. Healthy participants (n=26) aged 21-72 were randomized to receive either the supplement or a placebo for 28 days, followed by a one-week washout period, after which the groups switched treatments. Participants taking the NAD+ supplement experienced an average decrease in their GlycanAge score by 1.26 years after only 28 days, a change not observed in those receiving the placebo.

Metformin

Metformin is a prescription drug commonly used for treating type 2 diabetes and insulin resistance. Due to its supposed benefits, it is also being used in non-diabetics.

The effects of metformin are still being researched, especially for non-diabetics. Our studies show that metformin generally does not significantly influence GlycanAge in non-diabetics. However, some individuals do experience changes in their GlycanAge scores while on metformin, reflecting their unique response to the treatment.

Indeterminate effect
No clear outcome from the study

Related research papers

Effects of testosterone and metformin on the GlycanAge index of biological age and the composition of the IgG glycome

This clinical trial investigated the effects of metformin and testosterone replacement therapy (TRT) in 82 male participants dealing with obesity and low testosterone levels. They were randomized into receiving:

- metformin
- TRT
- metformin+TRT
- placebo

Samples were taken at 3 timepoints - before starting the treatment, at the 6-month mark, and again one year into the treatment. Significant changes in IgG glycans were observed only in the groups receiving TRT, whether alone or combined with metformin, indicating that these changes were attributed to TRT rather than metformin. In the metformin group, there was no consistent trend in GlycanAge scores - some individuals experienced a minor increase, while others experienced a minor decrease. The exception was one participant who showed a significant decrease in their GlycanAge score after taking metformin.

Additional notes

Preliminary data shows that metformin has some positive effects on IgG glycans in diabetics.

Irregular cycles

During a woman's menstrual cycle, hormones fluctuate cyclically, and IgG glycans also change in a cyclic pattern. However, these changes are typically not significant enough to affect the overall GlycanAge score, so the menstrual cycle phase generally does not influence the results.

However, for women with irregular menstrual cycles or conditions like polycystic ovary syndrome (PCOS) or endometriosis, which are characterized by hormonal imbalances and increased inflammation, the GlycanAge score may be higher.

Biological age
Chronic inflammation

Related research papers

Periodic Changes in the N-Glycosylation of Immunoglobulin G During the Menstrual Cycle

The study examined longitudinal changes in IgG glycans during the menstrual cycle in a cohort of healthy premenopausal women with regular cycles (n=70). The women were sampled at 12 time points during their cycle—every 7 days for 3 months. Although the average variation in Glycan indexes was only up to 1.1%, the changes exhibited a cyclic pattern.

The folicular phase was characterized by the highest abundance of Glycan Mature, Glycan Median, and Glycan Bisection indexes, which are known to have pro-inflammatory properties. After ovulation, we saw an increase in anti-inflammatory Glycan Youth and Glycan Shield indexes.

These variations were associated with female sex hormones and menstrual cycle phases, however, the changes in Glycan indexes didn't overlap with the highest concentrations of sex hormones but appeared as menstrual cycle phase-specific events. Despite the observed changes in IgG glycans, they weren't significant enough to affect the overall GlycanAge score.

Additional notes

If the patient has irregular cycles due to entering peri-menopause, you can refer to the perimenopause page for more information.

Pregnancy

During pregnancy, estrogen levels increase significantly, with a specific form of estrogen being predominantly produced by the placenta (estradiol E2).

Estrogen has known anti-inflammatory properties, similar to the effects seen with IgG glycans. During pregnancy, women can experience a reduction in their GlycanAge score, along with improvements in anti-inflammatory indexes (Glycan Youth, Glycan Shield).

Biological age
Chronic inflammation

Glycan Shield
Anti-inflammatory

Glycan Youth
Anti-inflammatory

Related research papers

Immunoglobulin G galactosylation and sialylation are associated with pregnancy-induced improvement of rheumatoid arthritis and the postpartum flare: results from a large prospective cohort study

We investigated changes in IgG glycans in Caucasian women diagnosed with rheumatoid arthritis (RA) from pre-pregnancy until six months postpartum. The study included 148 RA patients and 32 healthy controls. We observed an increase in the anti-inflammatory Glycan Youth and Glycan Shield indexes from preconception until the end of pregnancy, which was associated with remission of RA symptoms during pregnancy. After pregnancy, we observed a significant decrease in both Glycan Youth and Glycan Shield indexes, reaching their lowest levels at six months postpartum. This decrease was associated with a flare-up in RA severity.

Additional notes

Pregnancy has been observed to improve chronic conditions like rheumatoid arthritis, which often flare up again postpartum. These changes are likely due to the pregnancy-induced increase in estrogen and are also reflected in glycan levels and indexes.

Post-pregnancy

After giving birth, woman's body undergoes significant changes as hormone levels gradually return to their pre-pregnancy state.

The marked increase in estrogen observed during pregnancy diminishes, often leading to an increase in the GlycanAge score. This is often reflected by a reduction in anti-inflammatory indexes (Glycan Shield, Glycan Youth).

Biological age
Chronic inflammation

Glycan Shield
Anti-inflammatory

Glycan Youth
Anti-inflammatory

Related research papers

Immunoglobulin G galactosylation and sialylation are associated with pregnancy-induced improvement of rheumatoid arthritis and the postpartum flare: results from a large prospective cohort study

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Perimenopause

Perimenopause is a phase preceding menopause in which estrogen levels start to drop.

Before perimenopause, women exhibit a similar aging pace to men. However, upon entering perimenopause, their GlycanAge score rises abruptly, reflecting the increase in inflammation due to a large drop in estrogen levels.

Perimenopause is predominantly characterized by an increase in the pro-inflammatory Glycan Mature index and a decrease in the anti-inflammatory Glycan Youth index. Studies also observe an increase in Glycan Bisection index.

- ↑ **Biological age** — Chronic inflammation
- ↑ **Glycan Mature** — Pro-inflammatory
- ↓ **Glycan Shield** — Anti-inflammatory
- ↑ **Glycan Bisection** — Supportive index
- ↓ **Glycan Youth** — Anti-inflammatory

Related research papers

Immunoglobulin G glycome composition in transition from premenopause to postmenopause

The study analyzed the IgG glycome in 5080 samples from 1940 females multiple times during their transition from pre-menopause to menopause. The most prominent changes associated with entering menopause were an increase in the Glycan Mature and Glycan Bisection indexes and a subsequent decrease in Glycan Youth and Glycan Shield. These changes are known to occur with aging in general, however, they were more pronounced in peri-menopausal women compared to women of other age groups and to men.

Additional notes

During their transition from pre- to peri-menopause, women can experience an increase in their GlycanAge score by over a decade.

Hormone replacement therapy

Hormone replacement therapy (HRT) is often used in managing symptoms of peri- and menopausal women to restore hormonal balance, especially estrogen.

Estrogen is a known modulator of IgG glycans that has anti-inflammatory properties.

Women who undergo HRT often experience a reduction in their GlycanAge score and a reduction in the pro-inflammatory Glycan Mature index.

Biological age
Chronic inflammation

Glycan Mature
Pro-inflammatory

Related research papers

Effects of estradiol on biological age measured using the glycan age index

Postmenopausal women (n=58) with low estrogen levels were randomized to receive estrogen, raloxifene (medication used to relieve some symptoms of menopause) or placebo. Those on estrogen and raloxifene showed positive changes such as a reduction in the pro-inflammatory Glycan Mature index.

To confirm the effects of estrogen even further, pre-menopausal healthy women (n=21) were treated with leuprolide, which lowered estrogen production, mimicking symptoms of menopause. Some women received transdermal estrogen and others were on placebo.

The placebo group experienced an increase in the pro-inflammatory Glycan Mature index and showed an average increase in their GlycanAge score by 9,1 years. This effect was prevented by transdermal estrogen therapy. After recovery, GlycanAge scores of women returned to baseline.

Additional notes

HRT in women isn't just about optimizing estrogen - it's about finding the right balance between all female sex hormones, including progesterone.

Anti-Estrogen therapy

Anti-estrogen therapies are used to treat hormone receptor-positive (HR-positive) breast cancer, which accounts for 70-80% of all cases. These therapies, which work through different mechanisms, all block estrogen's effects on cancer cells, slowing or stopping tumor growth.

Estrogen has an anti-inflammatory effect on IgG glycans, so anti-estrogen therapies can shift IgG glycans toward a more pro-inflammatory profile, potentially increasing biological age. However, our studies show that different anti-estrogens affect IgG glycans in distinct ways.

Anastrozole, an aromatase inhibitor, blocks the final step in estrogen production, while tamoxifen, an estrogen antagonist, competitively binds to estrogen receptors. Women on anastrozole show a decrease in the anti-inflammatory Glycan Shield index, whereas women on tamoxifen show an increase.

Anastrozole

Glycan Shield
Anti-inflammatory

Tamoxifen

Glycan Shield
Anti-inflammatory

Related research papers

[Anastrozole and Tamoxifen Impact on IgG Glycome Composition Dynamics in Luminal A and Luminal B Breast Cancers]

The study explored the impact of anti-estrogen therapies on IgG glycans in 40 women diagnosed with Luminal A and B subtypes of breast cancer. It focused on two therapies: anastrozole, an aromatase inhibitor, and tamoxifen, a selective estrogen receptor modulator (SERM).

The results showed distinct effects between the two therapies. Anastrozole was associated with a shift toward a more pro-inflammatory profile, with increases in Glycan Mature and Glycan Bisection indexes, and decreases in Glycan Youth, Glycan Median, and Glycan Shield. In contrast, tamoxifen showed the opposite effect across most indexes, except for Glycan Bisection and Glycan Youth. The most notable difference was in the Glycan Shield index, which decreased with anastrozole and increased with tamoxifen.

Appendix

Science behind

GlycanAge 101 Part 1/3

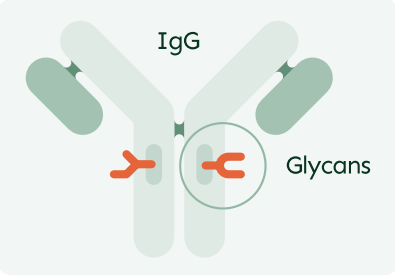
What is GlycanAge?

GlycanAge is a biological age test. It assesses the health of the immune system by measuring levels of chronic inflammation.

Is GlycanAge a diagnostic tool?

GlycanAge can be categorized as longevity diagnostics. It provides valuable insights into potential health risks and areas for intervention. It isn't a traditional diagnostic tool, since aging isn't considered a disease.

What does GlycanAge analyze?



GlycanAge analyzes glycans (complex sugars) attached to immunoglobulin G (IgG) antibodies. These glycans regulate inflammatory responses in the body.

How is biological age calculated?

GlycanAge calculates biological age by combining glycans most correlated with aging (primary glycan indexes) into a score and comparing it to a baseline of healthy individuals aged 20-80.

What are the benefits of using GlycanAge?

Chronic inflammation is a key driver of disease development, influenced by genetics, environment, and lifestyle. GlycanAge provides a deeper understanding of inflammation at a molecular level, reflecting biological changes that precede disease and serving as a predictive biomarker for future health outcomes.

GlycanAge is a modifiable biomarker responsive to both lifestyle and medical interventions. It reflects individual responses to treatments in as little as 3 months, and can serve as a tool to measure the effectiveness of introduced changes.

GlycanAge 101 Part 2/3

What are glycan indexes?

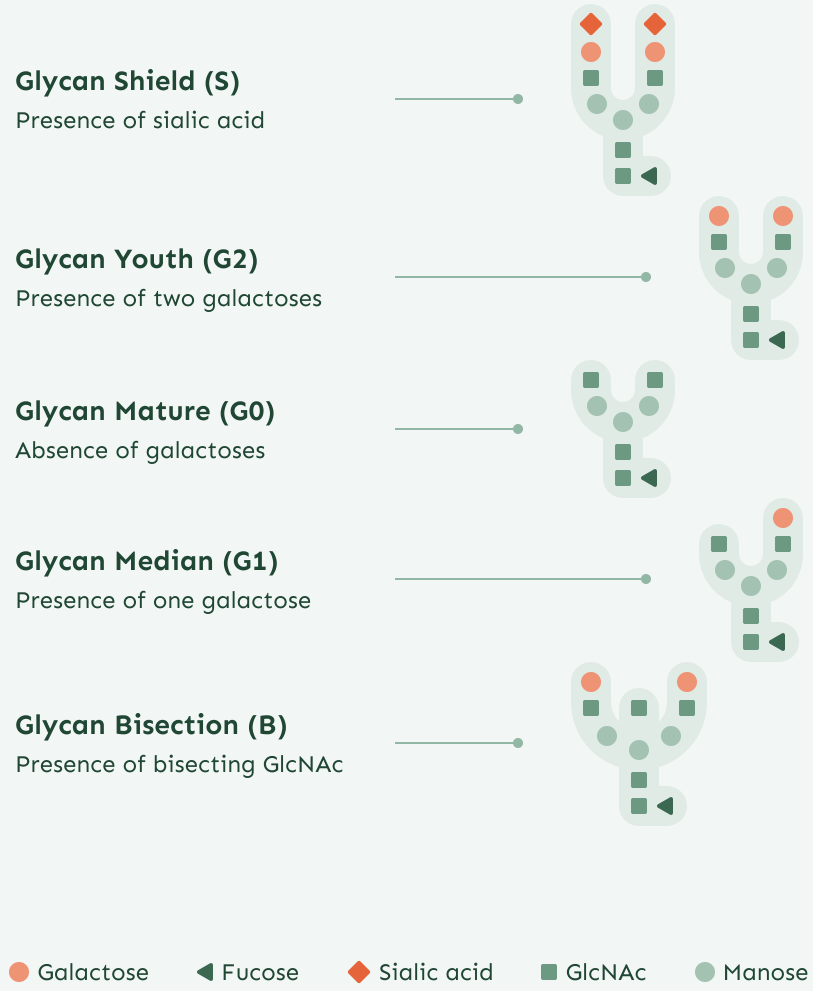
GlycanAge analyzes 29 different glycan structures gathered from the blood sample. Glycan structures of similar chemical and functional composition are grouped into 5 different categories called glycan indexes.

Primary indexes have a clear pro- or anti-inflammatory function, and are used to calculate the biological age of a person. Primary indexes are:

- Glycan Shield (anti-inflammatory),
- Glycan Youth (anti-inflammatory),
- Glycan Mature (pro-inflammatory).

Supportive indexes can help narrow down associations with specific disease types, genetic traits, and/or some lifestyle habits. Supportive indexes are:

- Glycan Median
- Glycan Bisection



GlycanAge 101 Part 3/3

What are glycan indexes?

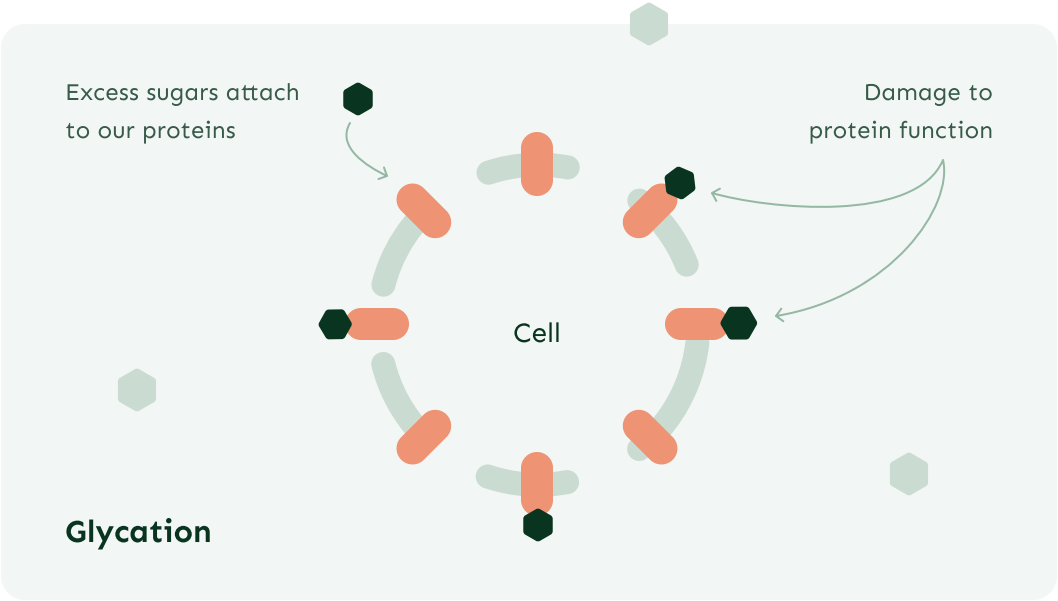
No. GlycanAge measures glycosylation, a controlled process which is fundamentally different from the random, damaging process of glycation.

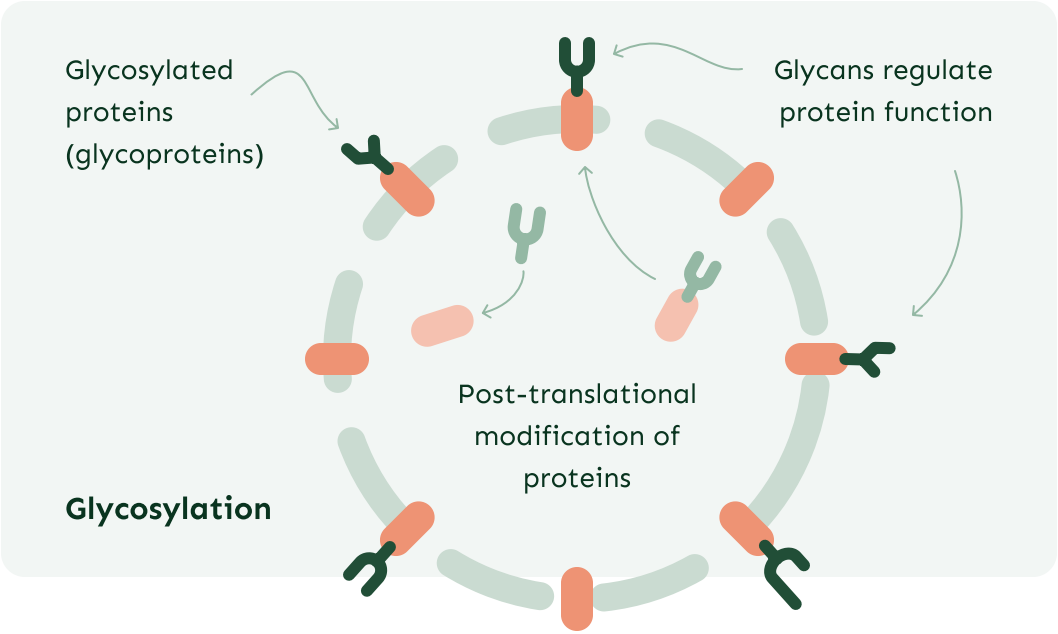
Glycation (what we don't measure):

- A random, uncontrolled chemical reaction.
- Damages proteins due to excess sugar exposure.
- Contributes to aging and is linked to high blood sugar.

Glycosylation (what we do measure):

- A precise, controlled, and vital biological process.
- Regulates protein function, telling them what to do.
- Glycosylation patterns in IgG provide insight into chronic inflammation and biological age.





Technical information

CLIA-certified laboratory

Our laboratory is CLIA-certified, ensuring adherence to the highest standards of quality and accuracy in laboratory testing.

1. Plasma is used as the starting material for the isolation of Immunoglobulin G (IgG), which is then glycoprofiled. IgG is isolated from the complex mixture of plasma proteins using affinity chromatography to specifically analyze its glycosylation. The concentration of the isolated IgG is determined using a UV-Vis method on the Nanodrop 8000. To assess chronic inflammation markers, the glycoprofiling of isolated IgG is performed.
2. For the analysis of N-glycans, samples undergo deglycosylation, where N-glycans are released from glycoproteins using the PNGase F enzyme. Fluorescent labeling of N-glycans is then performed, preparing the N-glycans for subsequent separation and quantification.
3. Capillary Gel Electrophoresis with Laser-Induced Fluorescence (CGE-LIF) is employed for glycoprofiling. This method enables high-throughput analysis with superior sensitivity. The glycoprofiles are generated using an ABI 3500 DNA sequencer, where the complex mixture of IgG glycans is separated into 27 glycan peaks.
4. Glycans under each peak are relatively quantified and compared to a reference population using a proprietary algorithm. This approach ensures accurate and reproducible quantification of glycan species, providing insights into disease-associated glycan structures and their relevance to inflammatory processes.

Research papers

Biological age

Glycans Are a Novel Biomarker of Chronological and Biological Ages

Immunoglobulin G glycans – Biomarkers and molecular effectors of aging

Heritability of the glycan clock of biological age

Immunoglobulin G glycosylation in aging and diseases

IgG glycans in health and disease: Prediction, intervention, prognosis, and therapy

Influencing factors

Immunoglobulin G galactosylation and sialylation are associated with pregnancy-induced improvement of rheumatoid arthritis and the postpartum flare: results from a large prospective cohort study

Periodic Changes in the N-Glycosylation of Immunoglobulin G During the Menstrual Cycle

Immunoglobulin G glycome composition in transition from premenopause to postmenopause

Effects of estradiol on biological age measured using the glycan age index

Estrogens regulate glycosylation of IgG in women and men

The effect of n-3 polyunsaturated fatty acids-enriched hen eggs consumption on IgG and total plasma protein N-glycosylation in healthy individuals and cardiovascular patients

The use of a systems approach to increase NAD+ in human participants

Extensive weight loss reduces glycan age by altering IgG N-glycosylation

Effects of testosterone and metformin on the GlycanAge index of biological age and the composition of the IgG glycome

Regular moderate physical exercise decreases Glycan Age index of biological age and reduces inflammatory potential of Immunoglobulin G

N-glycosylation profiling of plasma provides evidence for accelerated physiological aging in post-traumatic stress disorder

Not-So-Sweet Dreams: Plasma and IgG N-Glycome in the Severe Form of the Obstructive Sleep Apnea

Intense Physical Exercise Induces an Anti-inflammatory Change in IgG N-Glycosylation Profile

Physical Exercise Induces Significant Changes in Immunoglobulin G N-Glycan Composition in a Previously Inactive, Overweight Population

Diseases

N-glycosylation of immunoglobulin G predicts incident hypertension

The Association Between Glycosylation of Immunoglobulin G and Hypertension: A Multiple Ethnic Cross-Sectional Study

Immunoglobulin G N-Glycosylation Signatures in Incident Type 2 Diabetes and Cardiovascular Disease

Glycosylation Profile of Immunoglobulin G Is Cross-Sectionally Associated With Cardiovascular Disease Risk Score and Subclinical Atherosclerosis in Two Independent Cohorts

IgG N-Glycosylation Is Altered in Coronary Artery Disease

IgG glycan patterns are associated with type 2 diabetes in independent European populations

The changes of immunoglobulin G N-glycosylation in blood lipids and dyslipidaemia

Association between galactosylation of immunoglobulin G and improvement of rheumatoid arthritis during pregnancy is independent of sialylation

IgG Fc galactosylation predicts response to methotrexate in early rheumatoid arthritis

Low galactosylation of IgG associates with higher risk for future diagnosis of rheumatoid arthritis during 10 years of follow-up

Inflammatory bowel disease associates with proinflammatory potential of the immunoglobulin G glycome

Glycosylation of Immunoglobulin G Associates With Clinical Features of Inflammatory Bowel Diseases

A unique serum IgG glycosylation signature predicts development of Crohn's disease and is associated with pathogenic antibodies to mannose glycan

Association of Systemic Lupus Erythematosus With Decreased Immunosuppressive Potential of the IgG Glycome

N-glycosylation patterns of plasma proteins and immunoglobulin G in chronic obstructive pulmonary disease

Estrogens regulate glycosylation of IgG in women and men

Immunoglobulin G glycome composition in transition from premenopause to postmenopause

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