OMIC*m* Age

This report calculates biological age by examining age-associated methylation patterns at approximately one million locations on your DNA, using the novel OMICm Age algorithm.

Developed By TruDiagnostic's Bioinformatics & Research Department
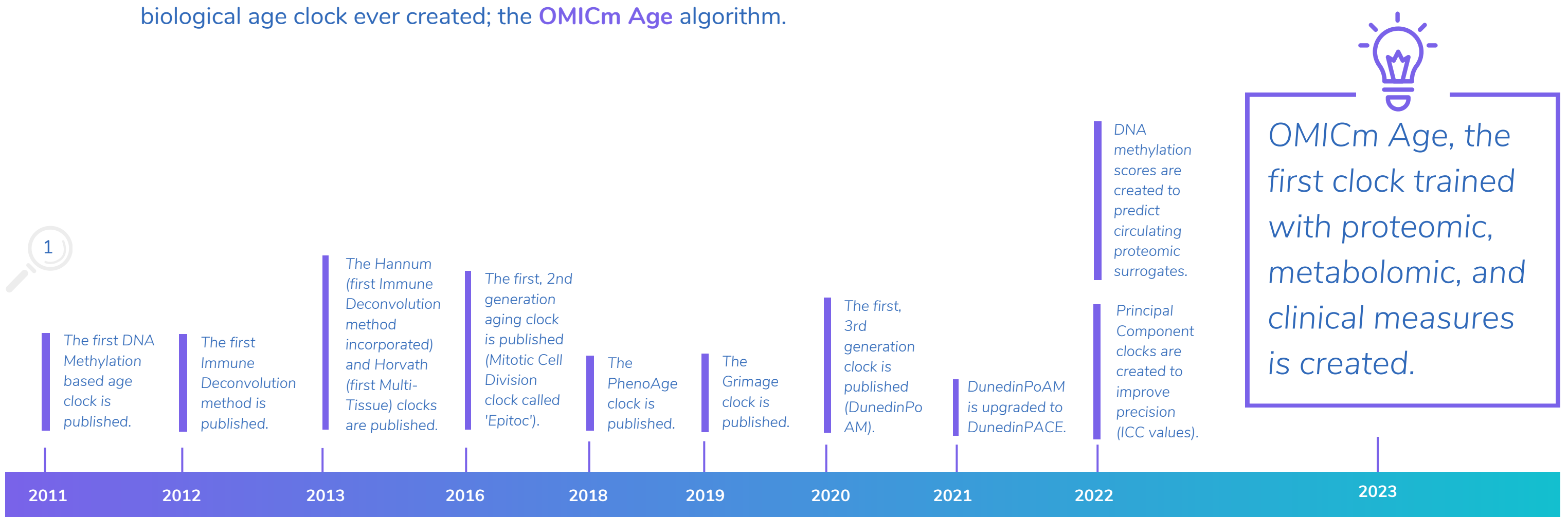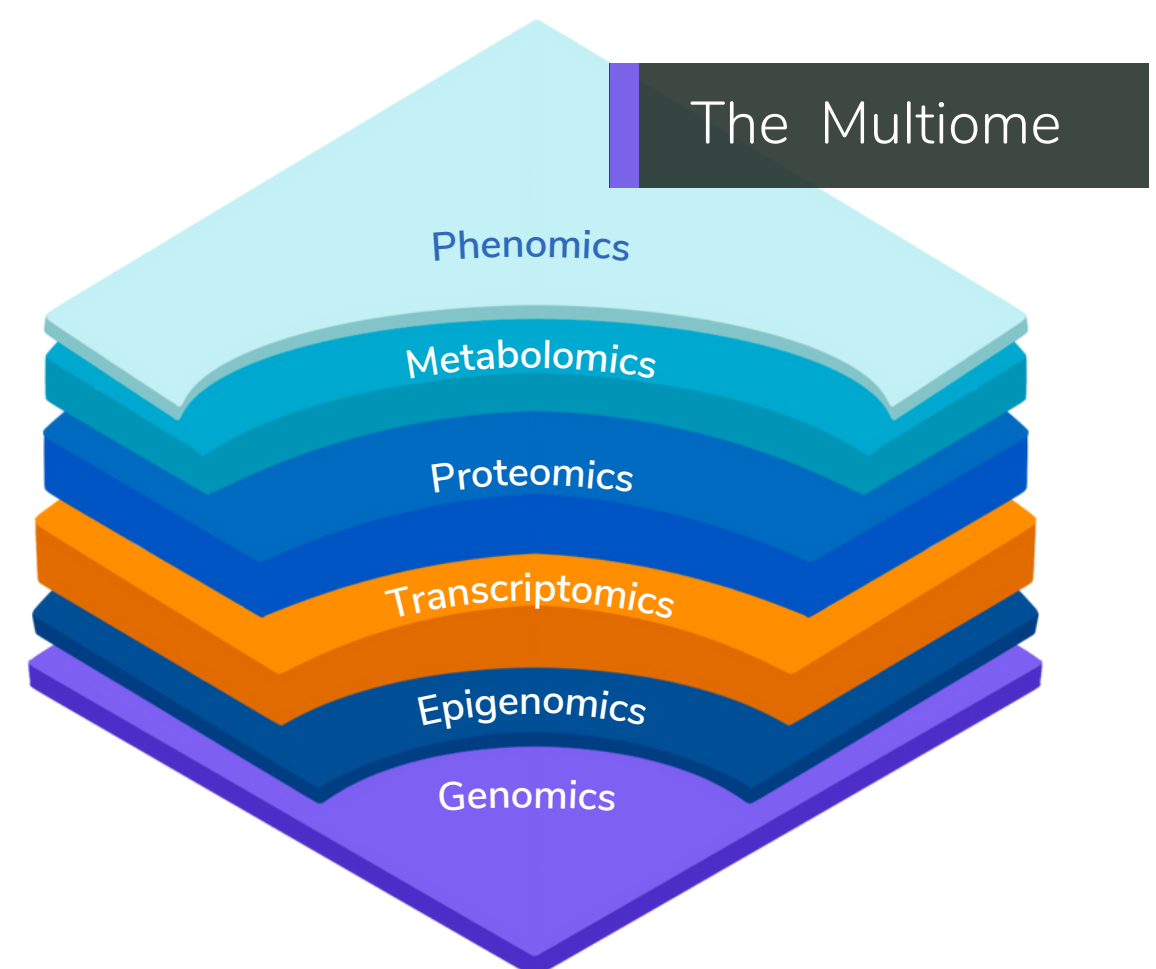*© TruDiagnostic, Updated 2023*

A NEW AGING ALGORITHM

Raising the bar on measuring aging.

When TruDiagnostic was founded in 2020, we set out on a mission to create the best scientific algorithm (clock) that analyzes epigenetic patterns to accurately quantify biological age. To do this, we needed an extensive amount of data, which is why we partnered with researchers from Harvard University and Partners Biobank.

This biobank included thousands of samples saved from over the last 50 years. With these samples, **we were able to collect the extensive amount of interconnected biodata needed to create the most accurate predictors of biological aging**.

This process has taken us almost three years to finalize, but we are proud to announce the completion of the best biological age clock ever created; the **OMICm Age** algorithm.

The Multiome

- Phenomics
- Metabolomics
- Proteomics
- Transcriptomics
- Epigenomics
- Genomics

OMICm Age, the first clock trained with proteomic, metabolomic, and clinical measures is created.

Timeline:

- **2011** — The first DNA Methylation based age clock is published.
- **2012** — The first Immune Deconvolution method is published.
- **2013** — The Hannum (first Immune Deconvolution method incorporated) and Horvath (first Multi-Tissue) clocks are published.
- **2016** — The first, 2nd generation aging clock is published (Mitotic Cell Division clock called 'Epitoc').
- **2018** — The PhenoAge clock is published.
- **2019** — The Grimage clock is published.
- **2020** — The first, 3rd generation clock is published (DunedinPoAM).
- **2021** — DunedinPoAM is upgraded to DunedinPACE.
- **2022** — DNA methylation scores are created to predict circulating proteomic surrogates. Principal Component clocks are created to improve precision (ICC values).
- **2023**

OUR APPROACH
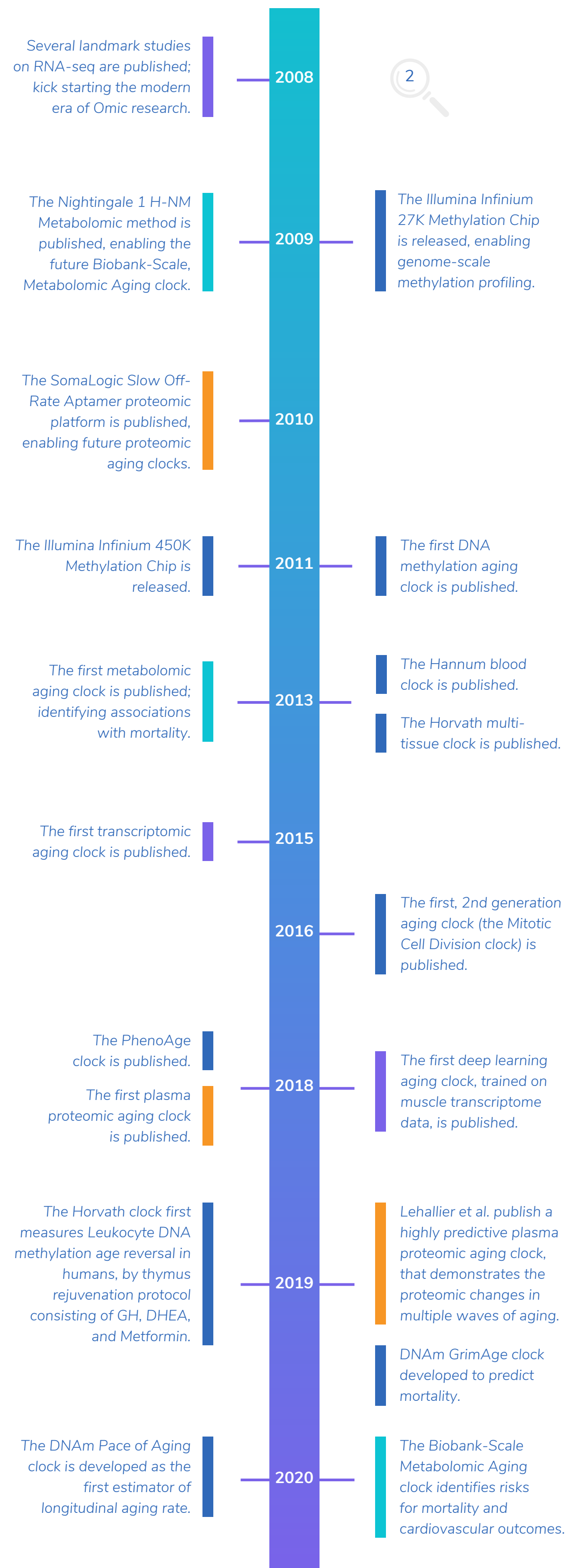# Multi Omics & Biological Aging.

When the Human Genome Project (an initiative to map the entire human genome) was first announced decades ago, many people thought the results would inform us about everything related to human biology. While it was a great project, the actionable health information gained from its efforts left many people disappointed. One reason why is that genetic composition is only one small piece of the puzzle.
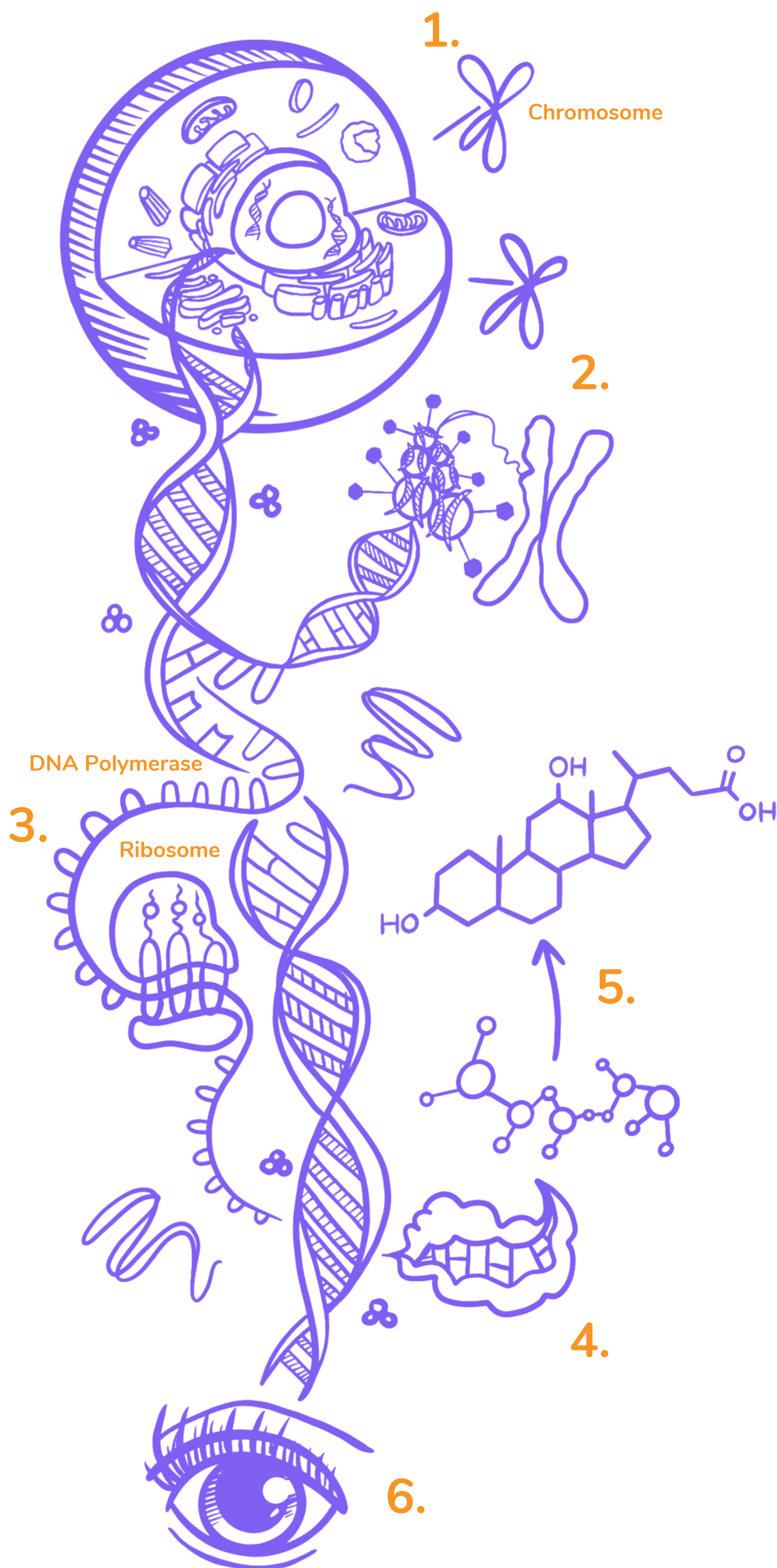
We now know that **the functionality of your body, as well as your health outcomes (phenotypes), are a result of much more than just your DNA**. Your epigenetics and transcriptome, the peptides and proteins in your body (proteome), and the metabolites from your body's processes and environmental exposures are all crucial factors in how your biology operates. This large picture of interconnected cellular processes is often called the multiome (Multi Omics) and it is a combination of all the different measurements we can perform on the body.

Thus, to create the best biological age clock, we didn't want to just measure epigenetics. We wanted to measure the entire multiome. So, we did! **In 5,000 people, we used advanced analysis techniques to quantify all biomarkers that make up the multiome. Proteins, metabolites, and DNA methylation altogether were measured in only 1500 subjects. We used these individuals to train the epigenetic biomarker proxies (EBPs) for proteins and metabolites and, later on, we quantified these EBP in the ~ 5000 subjects with DNA methylation**. We used Whole Exome Sequencing, Untargeted Plasma Proteomics, Plasma Metabolomics, as well as Clinical Data and Outcome Data for our large group (cohort). Together, this novel data allows for an unmatched resolution in quantifying the whole body's aging process. It also allows us to view aging throughout the multiome, through the lens of DNA methylation.

In our initial publication regarding the research and findings used to develop our OMICm Age algorithm, we **showed that this clock is better at predicting health and aging outcomes** than any other methylation age clock to date.

Legend:
- Epigenomics
- Proteomics
- Transcriptomics
- Metabolomics

Timeline:

2008 — Several landmark studies on RNA-seq are published; kick starting the modern era of Omic research.

2009 — The Nightingale 1 H-NM Metabolomic method is published, enabling the future Biobank-Scale, Metabolomic Aging clock. | The Illumina Infinium 27K Methylation Chip is released, enabling genome-scale methylation profiling.

2010 — The SomaLogic Slow Off-Rate Aptamer proteomic platform is published, enabling future proteomic aging clocks.

2011 — The Illumina Infinium 450K Methylation Chip is released. | The first DNA methylation aging clock is published.

2013 — The first metabolomic aging clock is published; identifying associations with mortality. | The Hannum blood clock is published. The Horvath multi-tissue clock is published.

2015 — The first transcriptomic aging clock is published.

2016 — The first, 2nd generation aging clock (the Mitotic Cell Division clock) is published.

2018 — The PhenoAge clock is published. The first plasma proteomic aging clock is published. | The first deep learning aging clock, trained on muscle transcriptome data, is published.

2019 — The Horvath clock first measures Leukocyte DNA methylation age reversal in humans, by thymus rejuvenation protocol consisting of GH, DHEA, and Metformin. | Lehallier et al. publish a highly predictive plasma proteomic aging clock, that demonstrates the proteomic changes in multiple waves of aging. DNAm GrimAge clock developed to predict mortality.

2020 — The DNAm Pace of Aging clock is developed as the first estimator of longitudinal aging rate. | The Biobank-Scale Metabolomic Aging clock identifies risks for mortality and cardiovascular outcomes.

1.

Chromosome

DNA Polymerase

3.

Ribosome

2.

5.

4.

6.

1. Genomics

The study of the genes housed in our DNA.
Our DNA, located in the nucleus of our cells, contains sections of instructions (genes) that tell a cell how to behave. Your genetics stay the same from conception to death.

2. Epigenomics

The study of how our genes are modified.
Epigenetic molecules interact with our DNA, either amplifying or silencing certain instructions. These interactions change throughout your lifetime.

3. Transcriptomics

The study of how our genes turn into actionable RNA. During transcription, molecules called RNA copy the instructions of our DNA; skipping over or boosting sections based on the epigenetic patterns at that location.

4. Proteomics

The study of how proteins function. Proteins are created by RNA, and perform most of the work within a cell. Antibodies, enzymes, and hormones are all types of protein functions.

5. Metabolomics

The study of the chemical processes produced by protein interactions. Metabolites are a by-product of proteins hard at work, and are used to help break down food, drugs, chemicals, or the body's own tissue.

6. Phenomics

The study of observable traits such as eye, skin, and hair color. Epigenetics can curate those instructions, and the resulting proteins and metabolites impact your biology to result in a physical expression.

Your Results.

DISCLAIMER: *The population graph and percentile for OMICmAge are based on observed and validated data patterns from thousands of research participants involved in our Harvard University study.*

OMIC*m* Age

47.25
YEARS OLD

Your OMICm Age is

HIGHER THAN

your calendar age by **3.89** years.

Biological Age

47.25

43.36
Calendar Age
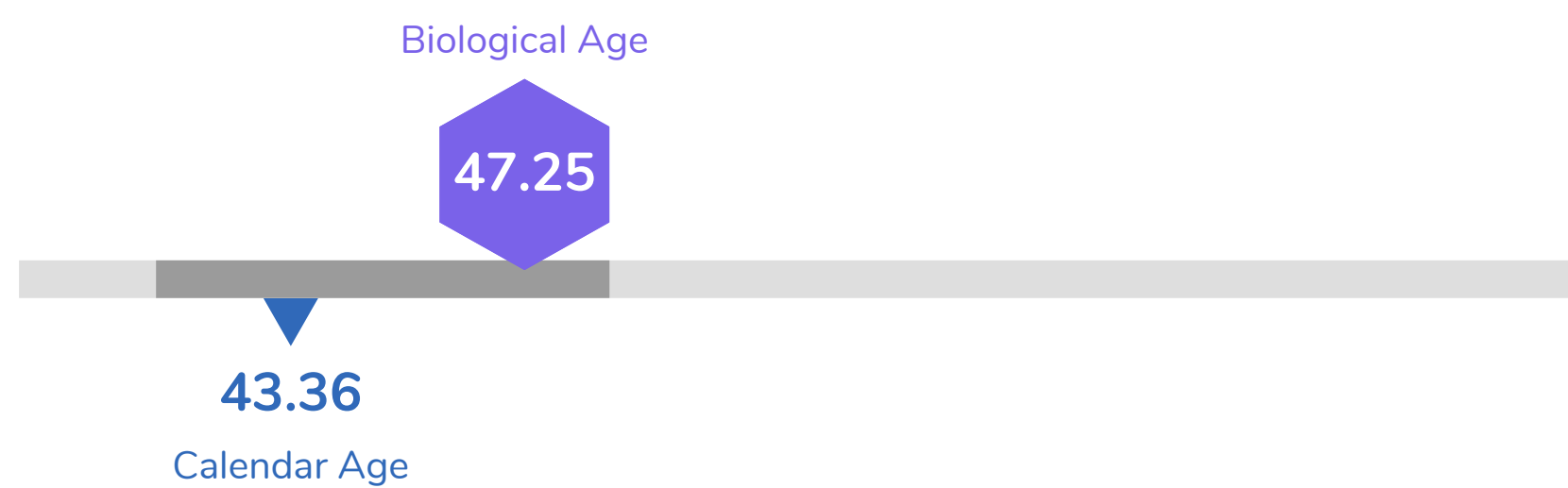
POPULATION COMPARISON

Your OMICm Age is in the **82nd** percentile.

0%   **82%**   100%

This means that your OMICm Age is higher than 82% of the population at your same chronological age and sex.

OMICm Age / CHRONOLOGICAL AGE

Biological Sex
— Male
— Female

RESULTS OVER TIME

49.817   45.785   48.317   47.25

May   Jun   Jul   Aug   Sep   Oct
COLLECTION DATE
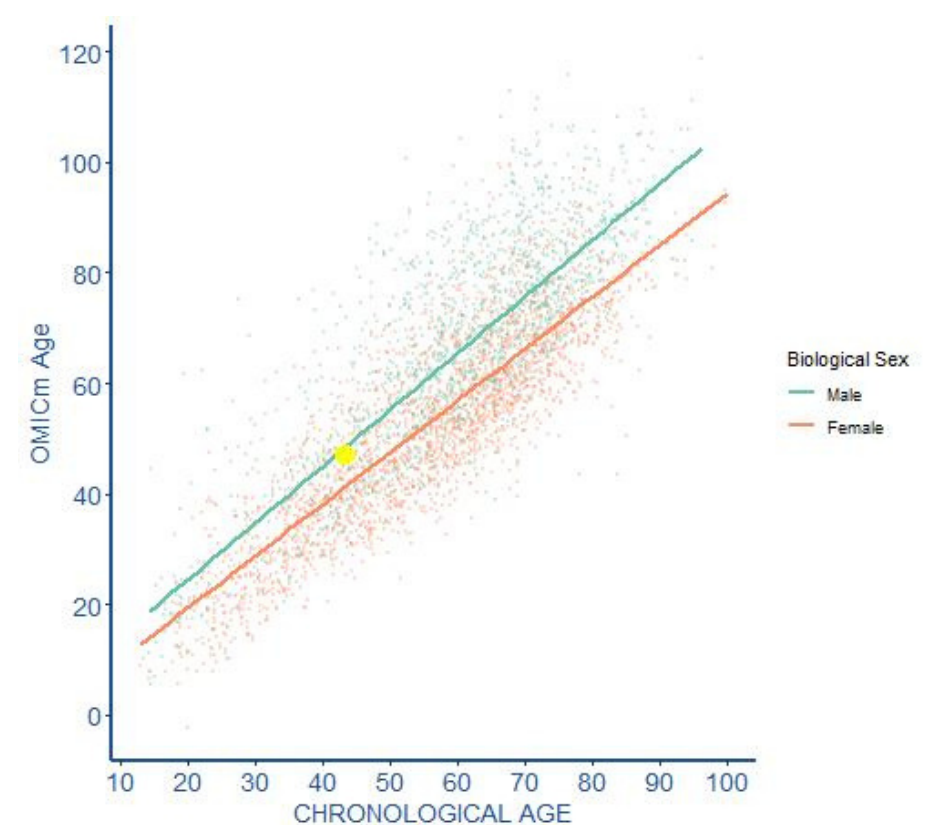
OMICm Age

Your Risk of Disease

Aging has been scientifically proven to be the number one risk factor for major chronic diseases worldwide. Accelerated aging (having an older biological age than your calendar age) increases your risk of disease with each year, and having a younger biological age decreases these risks.

Your OMICm Biological Age can represent an increase or decrease risk of death, cancer, heart disease, stroke, type 2 diabetes, COPD, and depression.

DISCLAIMER: *The following, personalized risk scores are calculated based on observed and validated data patterns from thousands of research participants in our Harvard University study.*

DEATH

43.16%
Disease Risk

At your OMICm Age of **47**, you have a **43.16% higher** risk of death compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **12.71%**

COPD

9.21%
Disease Risk

At your OMICm Age of **47**, you have a **9.21% higher** risk of COPD compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **2.47%**

CANCER

12.38%
Disease Risk

At your OMICm Age of **47**, you have a **12.38% higher** risk of cancer compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **3.35%**

DEPRESSION

9.21%
Disease Risk

At your OMICm Age of **47**, you have a **9.21% higher** risk of depression compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **2.48%**

STROKE

17.45%
Disease Risk

At your OMICm Age of **47**, you have a **17.45% higher** risk of stroke compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **4.79%**

HEART DISEASE

21.03%
Disease Risk

At your OMICm Age of **47**, you have a **21.03% higher** risk of heart disease compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **5.83%**

TYPE 2 DIABETES

18.37%
Disease Risk

At your OMICm Age of **47**, you have a **18.35% higher** risk of type 2 diabetes compared to people of your same chronological age.

Reducing your OMICm Age by 1 year would result in reducing your relative risk by **5.07%**

Your Epigenetic Biomarker Proxies

Please remember that the Epigenetic Biomarker Proxies (EBPs) shown below are surrogate predictors from DNA methylation alone. The EBPs are NOT meant to be a replacement for the direct laboratory measurements. While some may offer additional value beyond the direct laboratory measurement (such as DNAmCRP and brain health outcomes[1]), they are a proxy. As research evolves, new insights will add even more context to these EBPs .

0% ▬▬▬▬▬▬▬▬▬ **66%** ▬ 100%

On the percentile bar, **green** indicates a positive impact on health, while **red** signifies a negative impact. It's important to note that in some cases, the colors might be switched for certain EBPs. This occurs because lower values may have a negative effect on health, and higher values may have a positive effect.

ACTIONABLE EBPS

Listed in order of impact on biological age*

These are the Epigenetic Biomarker Proxies (EBPs) in which your DNAm predicted you were in the top 20% of the population for an EBP we would want to be low for ideal aging or in the bottom 20% of the population for an EBP we would want to be high for ideal aging. As each of these are included as features in OMICm Age, if you were to improve these features, we would expect you would improve your age.

*DISCLAIMER: Related diseases associated with an EBP are **NOT** a diagnosis. These are diseases that are correlated to that EBP. The percentiles are based on observed and validated data patterns from thousands of research participants involved in our TruDiagnostic cohort.*

DNAm Albumin

Protein albumin produced by the liver and plays 2 important roles: carrying hormones, vitamins, and enzymes throughout the body and keeping fluids from leaking out of vessels.

4.2 g/dL

0% ▬ **10%** ▬▬▬▬▬▬▬ 100%
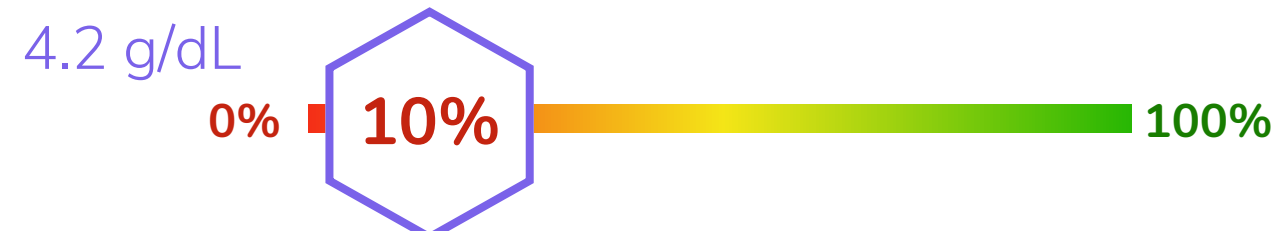
Your DNAm Albumin is higher than **10%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Increasing B12, vitamin C, folate, and iron intake
- Regular exercise
- Adequate sleep
- Omega-3 fatty acids

Related Diseases:

- Cancer
- Depression
- Stroke

DNAm Blood Urea Nitrogen

BUN test measures the amount of blood urea nitrogen; a waste product of proteins broken down by the liver and removed by the kidneys from blood into urine

22 mg/dL

0%   **90%**   100%

Your DNAm Blood Urea Nitrogen is higher than **90%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Proper hydration
- Consuming protein in moderation

Related Diseases:

- Stroke
- Type-2 Diabetes

DNAm Insulin-like Growth Factor-Binding Protein 2

IGFBP-2 is an insulin-like growth factor binding proteins (IGFBPs) that modulates IGF-I actions. It plays an important role in the regulation of several cellular processes and has been suggested to be a biomarker of metabolic disease and diabetes.

73

0%   **87%**   100%

Your DNAm Insulin-like Growth Factor-Binding Protein 2 is higher than **5%** of the population at your same calendar age and sex.

Recommendations for Improvement:

- Consuming protein in moderation
- Caloric restriction
- Regular exercise
- Balanced diet
- Stress management
- Adequate sleep

Related Diseases:

- COPD
- Stroke
- Cancer
- Depression

DNAm Ribonuclease pancreatic

Pancreatic ribonuclease/ ribonuclease A (RNase A)/ ribonuclease 1 (RNase1) is an enzyme that catalyzes the breakdown of RNA and plays a role in the digestion of RNA.

0.3

0%   **100%**   100%

Your DNAm Ribonuclease pancreatic is higher than **100%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Regular exercise
- Balanced diet
- Stress management

Related Diseases:

- Depression
- Type-2 Diabetes
- Cancer
- COPD

DNAm Creatinine

Creatinine test measures the creatinine, a waste product that comes from the normal wear and tear on muscles of the body.

1.6 mg/dL

0%   **95%**   100%

Your DNAm Creatinine is higher than **95%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Proper hydration
- Consuming protein in moderation
- Review medications to see if they impact creatinine levels

Related Diseases:

- COPD
- Stroke
- Type-2 Diabetes

DNAm 4-Methoxyphenol Sulfate

Methoxyphenols are potential biomarkers of inhalation of woodsmoke and are present in dark-aged beers. 4-methoxyphenol is a polymerization inhibitor. 4-methoxyphenol has demonstrated anti-tumor properties.

0.0

0%   **90%**   100%

Your DNAm4-Methoxyphenol Sulfate is higher than **90%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Avoid woodsmoke exposure
- Avoid dark, aged beers

Related Diseases:

- No data

DNAm Carotene Diol

Carotene-3,3-diol (Lutein) is a naturally occurring carotenoid synthesized by plants. Studies show it plays a role in cognitive function and eye health and plays a role in protecting tissues from oxidative stress and inflammation.

-0.1

0%   **20%**   100%

Your DNAm Carotene Diol is higher than **20%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Increasing carotenoid-rich foods like carrots, kale, and spinach.
- Carotene diol supplementation

Related Diseases:

- Cancer
- Depression

DNAm Mimecan

Mimecan/osteoglycin, is an extra cellular matrix component that affects the regulation of collagen fibrillogenesis and angiogenesis. Studies have shown mimecan is associated with a vulnerable plaque phenotype and may predict future cardiovascular death and arterial stiffness.

-0.1

0%   **100%**   100%

Your DNAm Mimecan is higher than **100%** of the population at your same calendar age and sex

Recommendations for Improvement:

- Antioxidants
- Monitor and manage blood pressure and cholesterol levels
- Regular exercise
- Balanced diet
- Stress management

Related Diseases:

- Cancer
- Stroke

ADDITIONAL EBPS

DNAm Serum Paraoxonase/arylesterase 1

Serum paraoxonase/arylesterase 1 (PON1) is an enzyme encoded by the PON1 gene and secreted mainly by the liver. PON1 is a major anti-atherosclerotic component of high-density lipoprotein (HDL) and protects against vascular disease by metabolizing oxidized lipids.

-0.6

0%   **43%**   100%

Your DNAm Serum Paraoxonase/arylesterase 1 is higher than 43% of the population at your same calendar age and sex
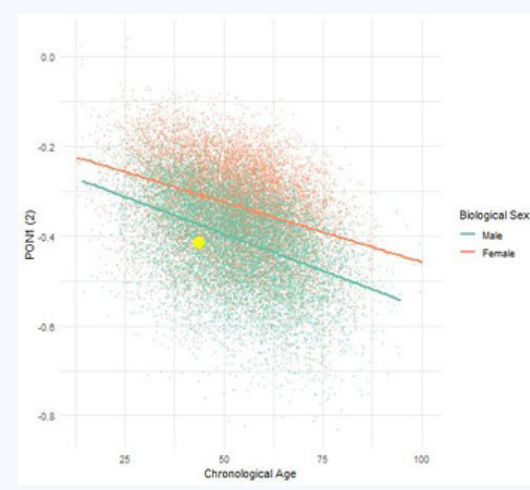
DNAm Red Blood Cell Distribution Width

RDW test measures the differences in red blood cell size and volume.

12%

0%   **5%**   100%

Your DNAm Red Blood Cell Distribution Width is higher than 5% of the population at your same calendar age and sex
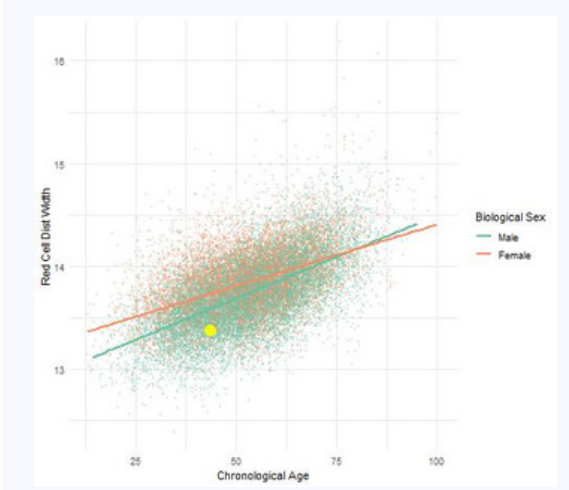
DNAm Inter-alpha-trypsin Inhibitor Heavy Chain H3

Inter-alpha (globulin) inhibitor 3 (ITIH3), one of the constituents of plasma serine protease inhibitors, is related to the pro-inflammatory process. Data suggests it is upregulated as a compensatory mechanism in high states of inflammation and not itself a biomarker of inflammation.

12 fL

0%   **40%**   100%

Your DNAm Inter-alpha-trypsin Inhibitor Heavy Chain H3 is higher than 40% of the population at your same calendar age and sex
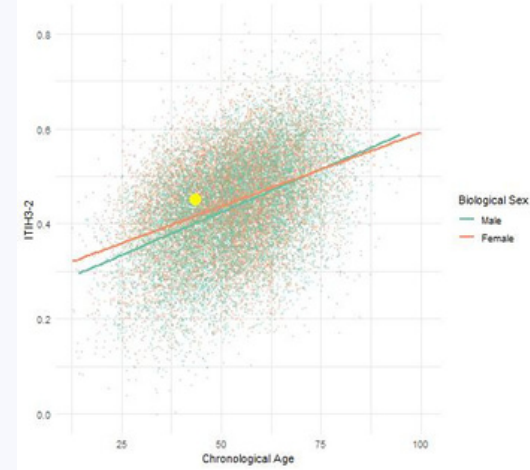
DNAm Ribitol

Ribitol is a pentose alcohol formed by the reduction of ribose and is an integral part of riboflavin (vitamin B2) and flavin mononucleotide. It has been a blood-based biomarker of diabetic retinopathy and is associated with insulin secretion and diabetes pathways with high concentrations linked to CKD.

0.0

0%   **9%**   100%

Your DNAm Ribitol is higher than 9% of the population at your same calendar age and sex
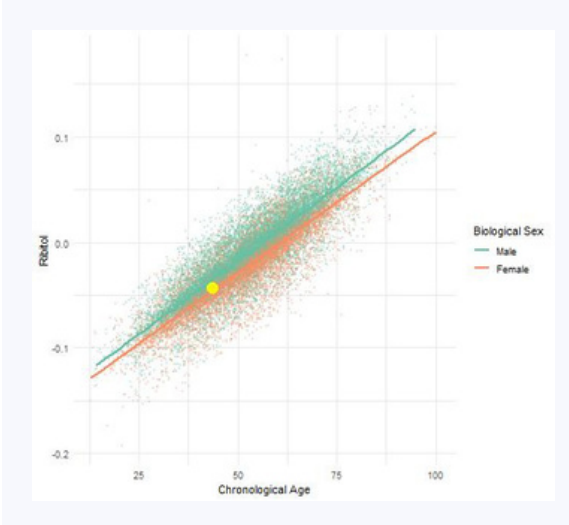
DNAm Vanillactic Acid

Vanillactic acid is an acidic catecholamine metabolite and potentially toxic. Elevated levels can be a biomarker of chronic kidney disease, associated with worse outcomes in liver failure, and linked to higher systolic blood pressure in females.

0.3

0%   **12%**   100%

Your DNAm Vanillactic Acid is higher than 12% of the population at your same calendar age and sex
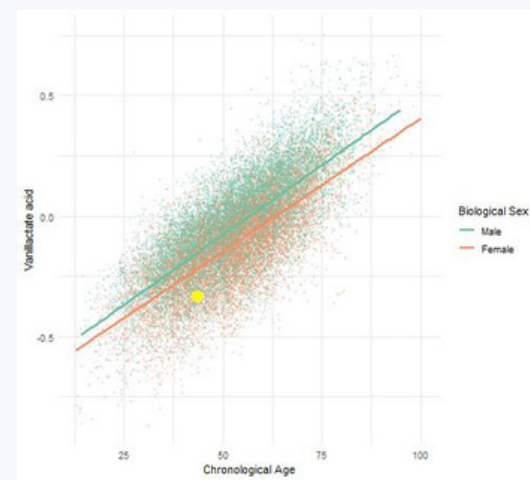
DNAm Fasting Glucose

test measures the amount of glucose (sugar) in the blood after a person has not consumed calories in at least 8 hours.

114 mg/dL

0%   **20%**   100%

Your DNAm Fasting Glucose is higher than 20% of the population at your same calendar age and sex
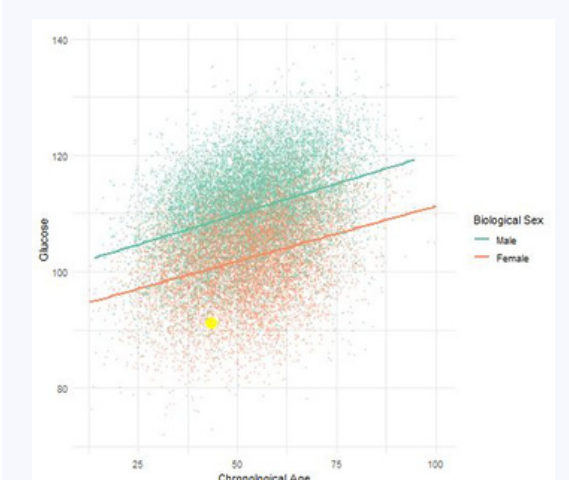
DNAm Phenylacetyl-Glutamine

Phenylacetylglutamine is a metabolite formed when phenylacetate and glutamine come together, an amino acid acetylation product after beta-oxidation of phenylacetate.

0.2

0%   **8%**   100%

Your DNAm Phenylacetyl-Glutamine is higher than 8% of the population at your same calendar age and sex
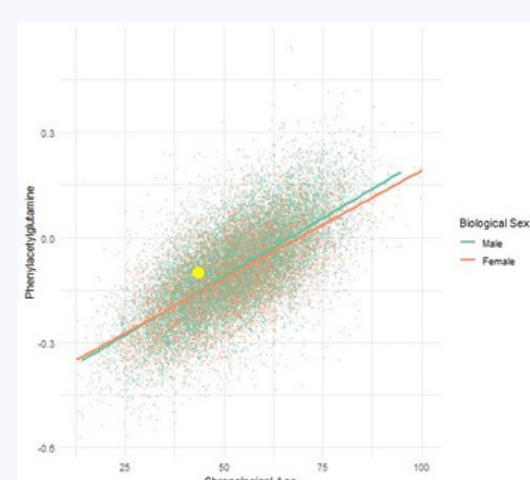
DNAm Uridine

Uridine is an important building block used in the creation of RNA that plays a role in the synthesis of glycogen. It may support brain health, synaptic connections, and cholinergic function.

0.15

0%   **51%**   100%

Your DNAm Uridine is higher than 51% of the population at your same calendar age and sex

DNAm 1-margaroyl-glycerophospholipid (GPE) (17:0)*

Lysophosphatidylcholine (LPC) is mainly derived from the turnover of phosphatidylcholine in circulation by phospholipase A2 (PLA2). It has been positively associated with cardiovascular and neurodegenerative diseases. Elevated LPC content in modified low-density lipoprotein (LDL) and oxidized LDL plays a role in atherosclerotic plaque development and endothelial dysfunction.

0.1

0%   **52%**   100%

Your DNAm 1-margaroyl-glycerophospholipid (GPE) (17:0)* is higher than 52% of the population at your same calendar age and sex
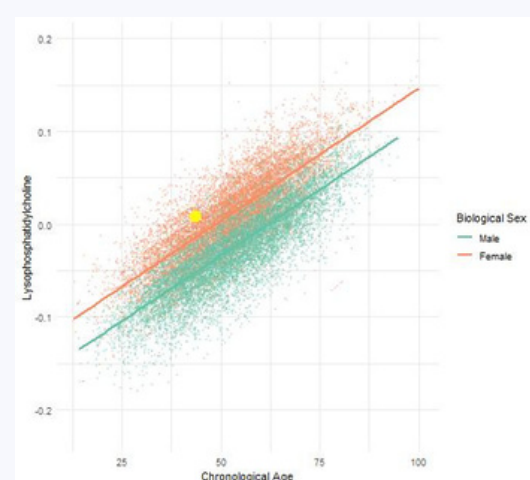
DNAm Hemoglobin
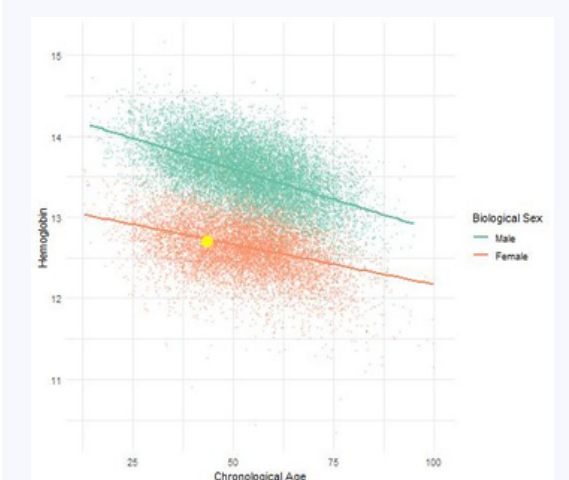
IHemoglobin test measures the amount of hemoglobin, a protein in red blood cells that transports oxygen.

13 g/dL

0%   **83%**   100%

Your DNAm Hemoglobin is higher than 83% of the population at your same calendar age and sex
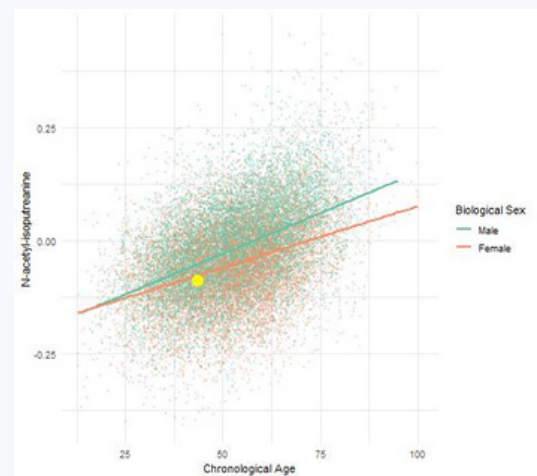
P. 10/10

DNAm N-acetyl-isoputreanine

Isoputreanine belongs to the class of organic compounds called gamma amino acids and derivatives. Studies link higher levels of this metabolite with better cognition.
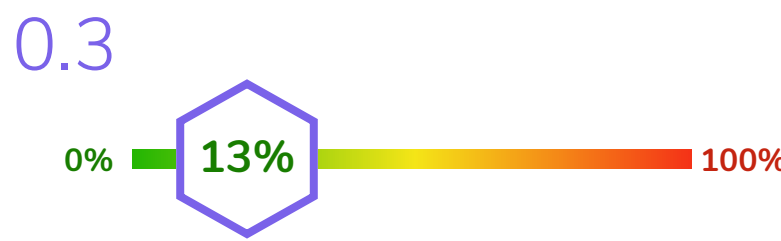
-0.05

0% **55%** 100%
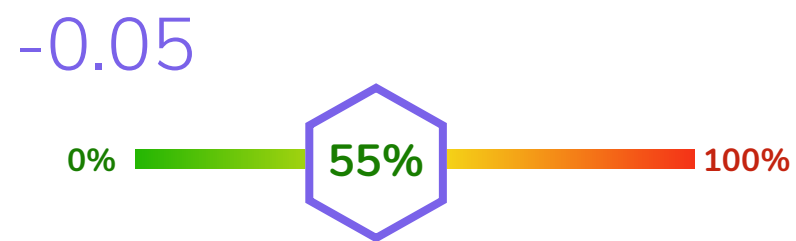
Your DNAm N-acetyl-isoputreanine is higher than 55% of the population at your same calendar age and sex

DNAm Gluconate

Gluconic acid occurs naturally in fruit, honey, and wine and has been identified as a lifestyle-related biomarker that may be a target to reduce stroke risk in black adults.

0.3

0% **13%** 100%

Your DNAm Gluconate is higher than 13% of the population at your same calendar age and sex
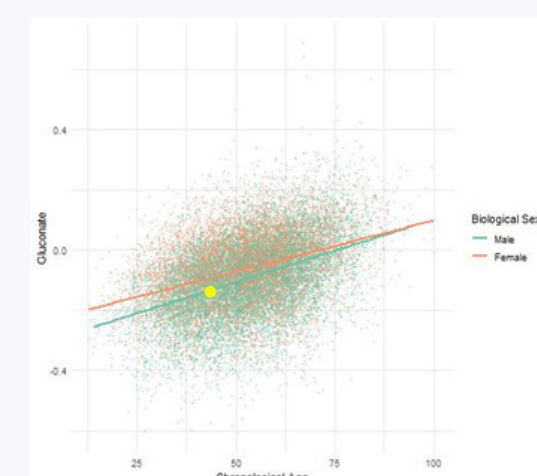
DNAm HbA1c

The HbA1c test measures the amount of glucose attached to hemoglobin.

6.3%

0% **8%** 100%
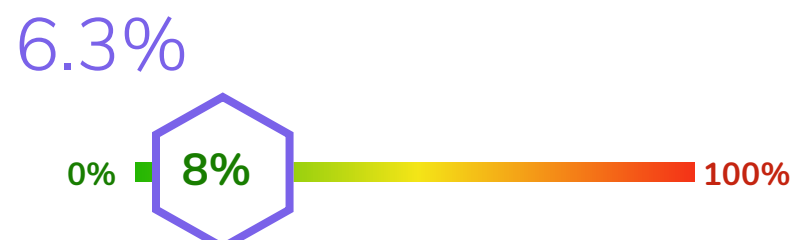
Your DNAm HbA1c is higher than 8% of the population at your same calendar age and sex
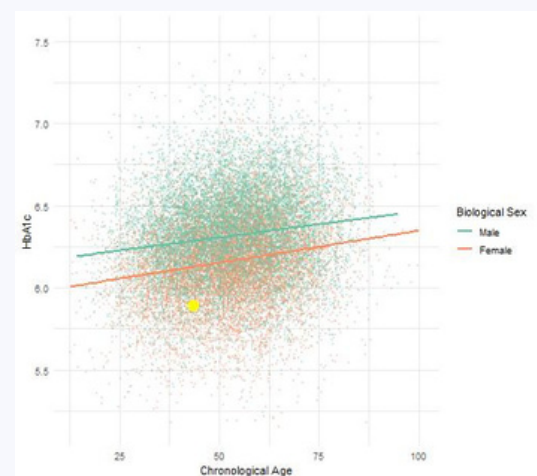
DNAm 4-hydroxyphenylacetylglutamine

4-Hydroxyphenylacetylglutamic acid is a metabolite that belongs to the class of organic compounds known as glutamic acid and derivatives. It may serve as a novel biomarker of type 2 diabetes with polyneuropathy and link to systolic blood pressure in women.

22 mg/d-0.5

0% **32%** 100%
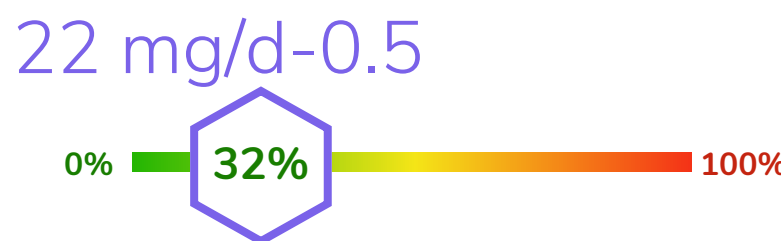
Your DNAm 4-hydroxyphenylacetylglutamine is higher than 32% of the population at your same calendar age and sex
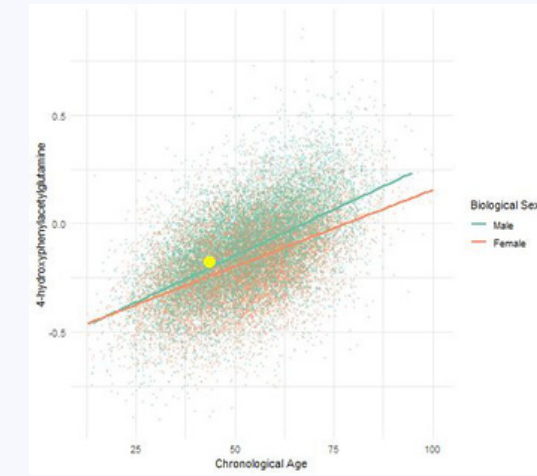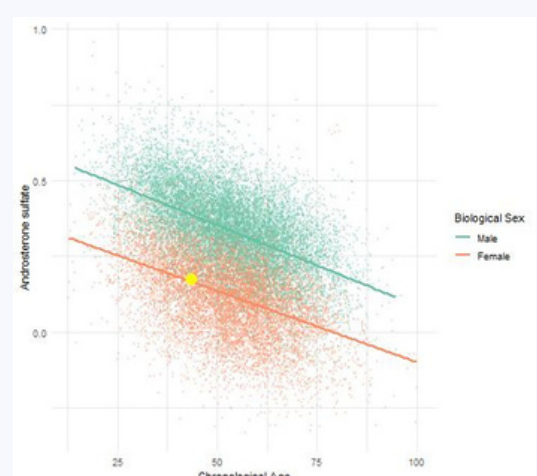
DNAm Androsterone Sulfate

Androsterone sulfate (Andros-S) is the most abundant 5-alpha-reduced androgen metabolite in serum and is downstream of testosterone.
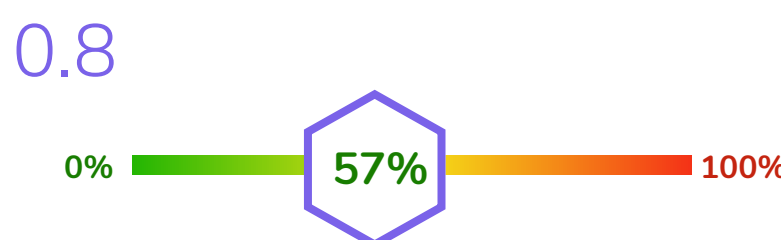
0.2

0% **57%** 100%
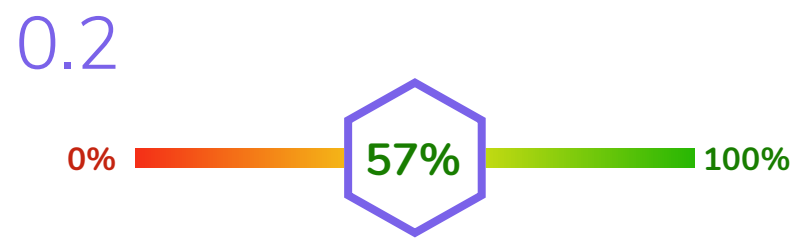
Your DNAm Androsterone Sulfate is higher than 57% of the population at your same calendar age and sex
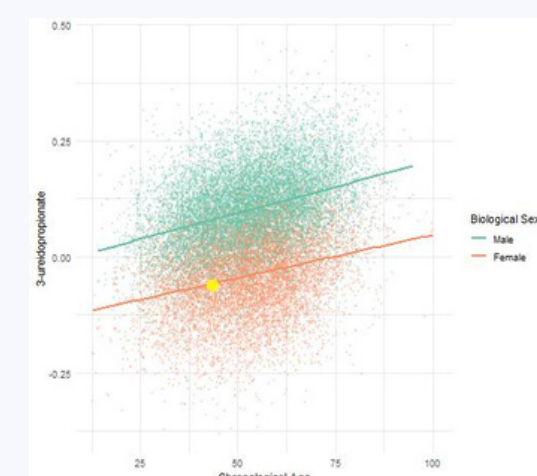
DNAm 3-Ureidopropionate

Ureidopropionic acid is a urea derivative of beta-alanine and a major metabolite associated with the risk of developing mobility disability. High levels are found in individuals with ureidopropionase deficiency.
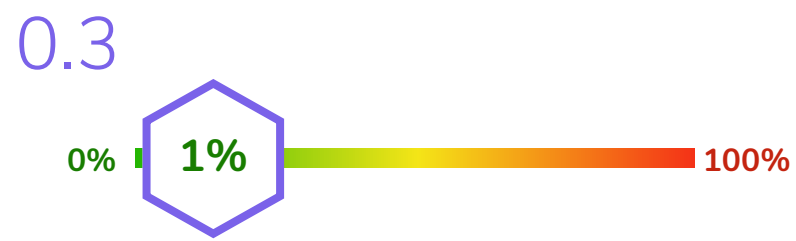
0.8

0% **57%** 100%

Your DNAm 3-Ureidopropionate is higher than 57% of the population at your same calendar age and sex

DNAm Matrix-remodeling-associated protein 5

Matrix-remodeling-associated proteins are capable of degrading all kinds of extracellular matrix proteins and processing many bioactive molecules. They are thought to play a major role in cell proliferation, migration (adhesion/dispersion), differentiation, angiogenesis, apoptosis, and host defense.
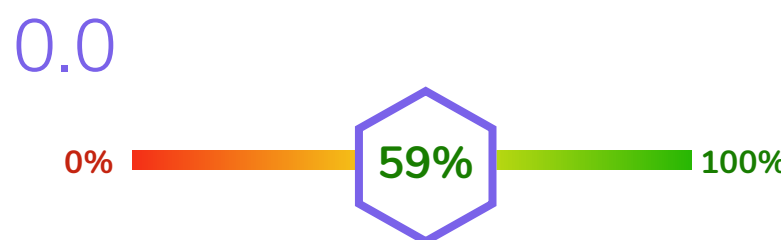
0.3

0% **1%** 100%

Your DNAm Matrix-remodeling-associated protein 5 is higher than 1% of the population at your same calendar age and sex
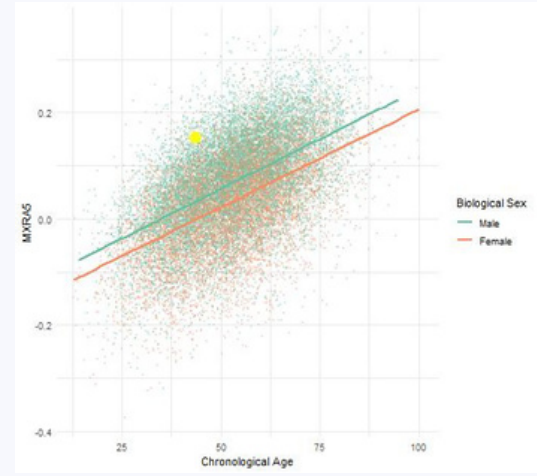
DNAm Bone Morphogenetic protein 1

Bone morphogenetic protein 1 (BMP1), induces bone and cartilage development, plays a role in promoting formation of functional HDL and reverse cholesterol transport. BMP1 can also activate TGF-β, a key regulator of the extracellular matrix, influencing tissue repair, fibrosis, and wound healing.

0.0

0% **59%** 100%

Your DNAm Bone Morphogenetic protein 1 is higher than 59% of the population at your same calendar age and sex
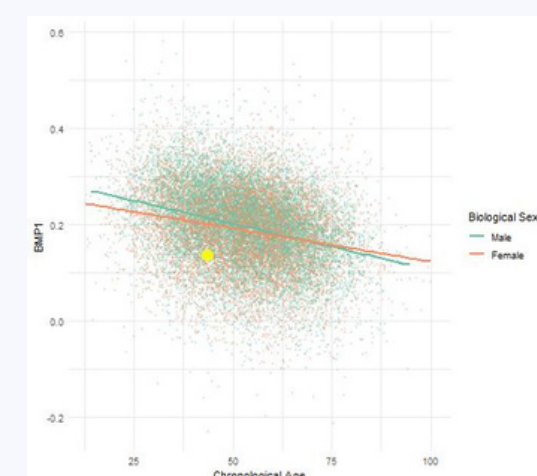
DNAm Versican core protein

Versican is an extracellular matrix protein which has been shown to increase during inflammation in a number of different diseases such as cardiovascular and lung disease, autoimmune diseases, and several different cancers.
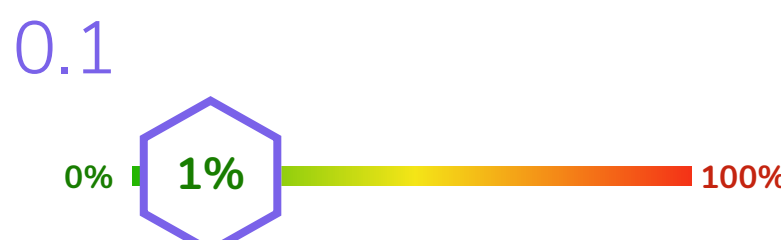
-0.1

0% **1%** 100%
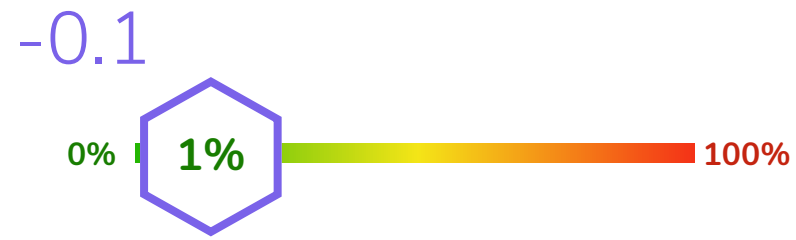
Your DNAm Versican core protein is higher than 1% of the population at your same calendar age and sex.
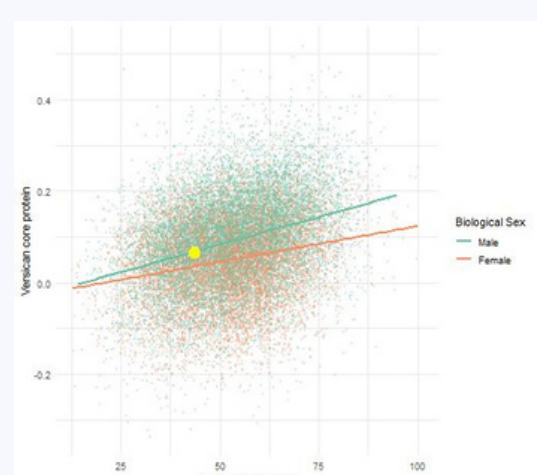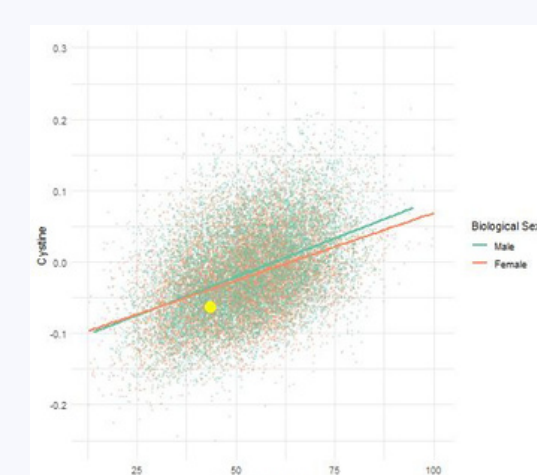
DNAm Cystine

Cysteine is the primary sulfur-containing amino acid important for making protein and for other metabolic functions. It's found in beta-keratin and important for making collagen.

0.1

0% **1%** 100%

Your DNAm Cystine is higher than 1% of the population at your same calendar age and sex

JANE DOE | ID # ABC123
COLLECTED: 06/01/2020 | REPORTED: 07/01/2020

DNAm Hematocrit

A hematocrit test measures the percent by volume of red blood cells in the blood.

41 L/L

0% — **64%** — 100%

Your DNAm Hematocrit is higher than 64% of the population at your same calendar age and sex

DNAm Histone H2B type 1-K

Histone H2B type 1-K is a core component of the nucleosome, proteinsthat play a role in DNA transcription regulation, DNA repair, DNA replication, and chromosomal stability by wrapping and compacting DNA into chromatin, limiting accessibility to cellular machinery. H2B Type 1-K has been shown to accumulate in senescent fibroblasts with persistent DNA damage.

114 mg/dL

0% — **40%** — 100%

Your Histone H2B type 1-K is higher than 40% of the population at your same calendar age and sex

DNAm 1-Stearoyl-2-adrenoyl-GPC (18:0/22:4)*

1-stearoyl-2-adrenoyl-GPC is a choline ether phospholipid (ePC) found in serum or plasma.

0.09

0% — **60%** — 100%

Your DNAm 1-Stearoyl-2-adrenoyl-GPC (18:0/22:4)* is higher than 60% of the population at your same calendar age and sex

DNAm Alkaline Phosphatase

ALP measures the amount of an enzyme called alkaline phosphatase present in the blood, evaluating the quantity produced by the liver and bones.

71 U/L

0% — **5%** — 100%

Your DNAm Alkaline Phosphatase is higher than 5% of the population at your same calendar age and sex

DNAm Carboxypeptidase B2

CPB2 is synthesized by the liver and circulates in the plasma as a plasminogen-bound zymogen. Activated CPB2 reduces fibrinolysis. Lower CPB2 has been suggested as a biomarker of peripheral artery disease and may be a biomarker of chronic hepatitis and thrombotic risk.

0.05

0% — **100%** — 100%

Your DNAm Carboxypeptidase B2 is higher than 100% of the population at your same calendar age and sex