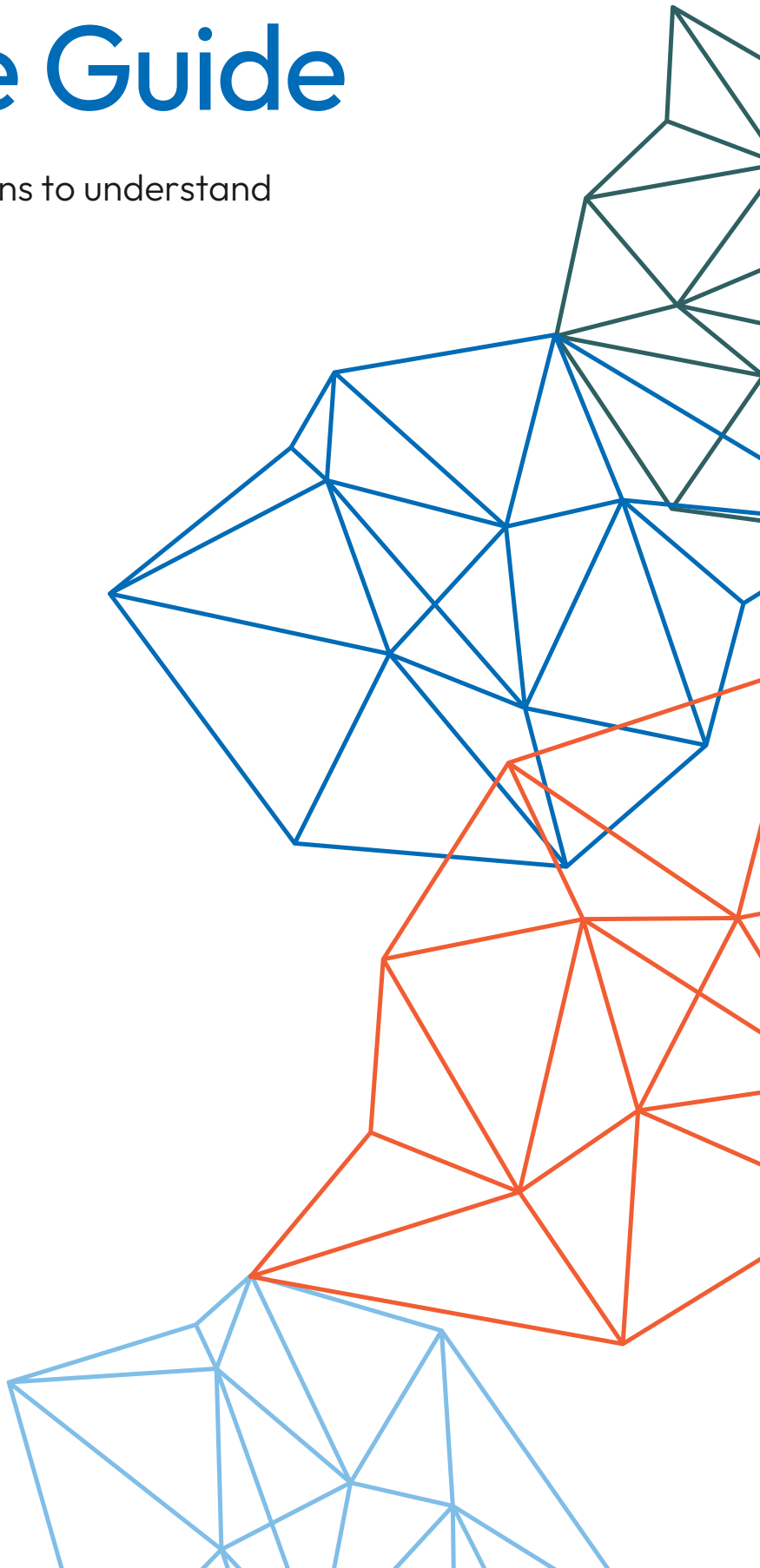
Biomarker
Reference Guide

A guide for patients and clinicians to understand health through biomarkers



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About Voloridge Health

Voloridge Health, LLC develops advanced tools to provide predictive and personalized insights that empower individuals and organizations with data-driven clarity, enabling longer, healthier lives. To learn more visit www.voloridgehealth.com.

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Contents

This guide presents blood biomarker and related information solely for informational and educational purposes. The information provided is derived from applying data science to a population dataset with limitations regarding the population demographics such as age, gender, race, ethnic background, potential bias in the population, and other factors that influence the data. This guide is not intended to serve as medical advice, diagnoses, or treatment for any disease or condition. The information provided here does not consider your individual health conditions, medical history, or specific circumstances, and should not be used as a substitute for consultation with a qualified healthcare professional. Individuals or entities using this information are doing so at their own risk as the providers do not make claims to its accuracy or the benefits of using such information. For more information on the data set used in preparing this information please visit UK Biobank website: www.ukbiobank.ac.uk.

Purpose and Background

Introduction

Blood test results can be overwhelming. You are often presented with significant information, yet not enough to truly understand what is important. Voloridge Health (VH) created this guide as a resource to help individuals and their care providers interpret lab test data. The guide contains ranges of values for biomarkers and age-related diseases. These ranges aim to provide clarity when reviewing blood test results.

This guide explores seven common age-associated, disease-related outcomes related to cardiac, metabolic, lung, liver, kidney, cognitive, and all-cause mortality. The VH team chose these outcomes based on the prevalence and individual impacts on aging and mortality.

What is a biomarker?

The first step to understanding your bloodwork is recognizing what a blood test is collecting and measuring. A biomarker, or biological marker, is a measurable indicator of a biological process or condition in your body.[1] One of the most common ways to measure certain biomarkers is through blood tests, if the biomarker is present in your blood.

Biomarkers offer insights into your health, including early detection of diseases. A simple blood test can provide valuable information about your risk for heart (cardiac) disease, liver disease, mortality, and more.[2] Understanding what biomarkers reveal about your personal health is the key to an accurate interpretation of your blood test results. To assist with this challenge, we present information in this guide in the form of risk multipliers and Voloridge™ Modeled Range values or VMR™ values.

[1] Califf, Robert M. "Biomarker definitions and their applications." Experimental biology and medicine 243, no. 3 (2018): 213-221.

[2] Kristensen, Michael, Anne Kristine Servais Iversen, Thomas Alexander Gerds, Rebecca Østervig, Jakob Danker Linnet, Charlotte Barfod, Kai Henrik Wiborg Lange et al. "Routine blood tests are associated with short term mortality and can improve emergency department triage: a cohort study of> 12,000 patients." Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 25 (2017): 1-8.

What is a risk multiplier?

A risk multiplier represents the association between biomarker values and future incidence of a disease. The biomarker range associated with the lowest incidence is assigned a risk multiplier of 1. After that, if for example a biomarker range has a 40% increase in incidence, it would have a value of 1.4. All risk multiplier values are separated by gender and represent relative incidence of the disease compared to others your age.

What is a VMR value?

Reference ranges typically provided with blood test results are population based. In contrast, the Voloridge™ Modeled Range™ or VMR™ is the range of a single biomarker's values associated with the lowest future incidence of diseases. Because there are multiple disease groups, the VMRs are based on a weighted average incidence of the major disease groups addressed in this guide. Because the VMRs are calculated directly by Voloridge Health's models based on a specific data set, and not designed to be medical recommendations, these values may differ from what you see as reference ranges with a blood test result.

What makes Voloridge Health different?

Many traditional models focus on an individual predictor and its relationship to a single outcome. An example of this is measuring cholesterol and its relationship to heart disease. Furthermore, ranges typical in medical literature are based on clinical recommendations and/or population averages rather than connecting biomarkers with longer-term health outcome probabilities. In contrast, Voloridge Health examines many health predictors across multiple potential disease outcomes together. Our VMR values are based on real data associations between biomarker ranges and 15-year disease outcomes. By evaluating each health predictor in an unbiased manner, we derive a fully data-driven, long-term view of health risks. This guide is designed to help you see patterns single-variable studies might miss, supporting a proactive and holistic approach to healthcare.

Predictive strength

Another way Voloridge Health evaluates how biomarkers can predict health is with a predictive strength value. This metric demonstrates how strongly each biomarker correlates with a specific disease. In the *VMR Values by Disease* section of this guide, the biomarkers are colored with a gradient as illustrated in the graphic below. White represents a lower strength, while green represents a higher strength.

Additionally, you can find all biomarkers and their predictive strength values in the *Predictive Strength Values* section. We scale predictive strength from zero (no predictive strength) to 10, the highest predictive strength. A value of 7 would have 70% of the predictive strength of a value of 10.

Disease definitions

Some diseases are defined by comparing specific biomarker levels to established thresholds. For example, type 2 diabetes is typically diagnosed if Hemoglobin A1C levels are at or above 6.5 percent.[3] In this case, a risk multiplier is no longer meaningful, given the likelihood someone is diagnosed with such a disease is nearly 100 percent if their biomarker value passes that threshold. However, for the purpose of this guide, values are provided for such biomarkers regardless of these definitions, to maintain consistency and show data trends.

[3]Chatterjee, Sudesna, Kamlesh Khunti, and Melanie J. Davies. "Type 2 diabetes." The lancet 389, no. 10085 (2017): 2239-2251.

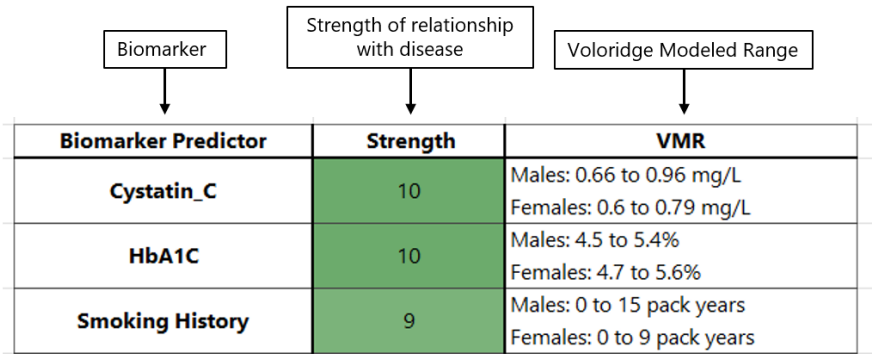
Most Predictive Biomarkers by Disease

This section provides VMR™ values for our models' most predictive biomarkers in each of the seven categories listed below. The VMR values apply to clinically relevant age ranges for each disease. You can use them as a reference to compare your own blood test results, but it is imperative to review all interpretation and treatment decisions with your physician.

Cardiac	Metabolic	Lung
Liver	Kidney	Cognitive
All-cause mortality		

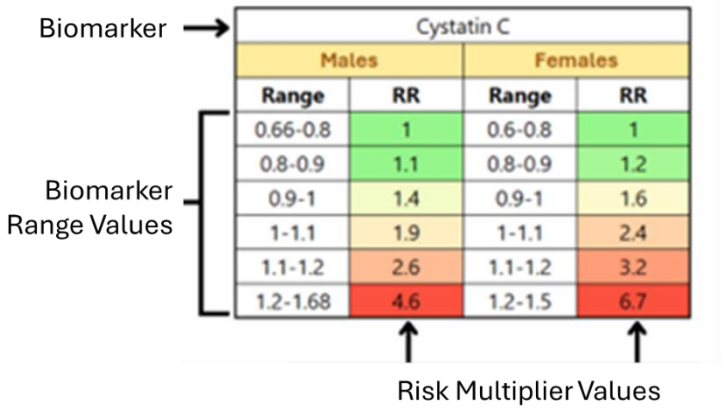
About this section

This section provides two parts. The first part includes a description of the disease category and a table portraying the strength values for our model's most predictive biomarkers for that disease, as well as the VMR for each biomarker. Note that VMR in this section are overall ranges, rather than values for a specific disease.



Biomarker Predictor	Strength	VMR
Cystatin_C	10	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
HbA1C	10	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Smoking History	9	Males: 0 to 15 pack years Females: 0 to 9 pack years

The second part includes disease-specific risk multipliers for each of the included biomarkers.



Cystatin C			
Males		Females	
Range	RR	Range	RR
0.66-0.8	1	0.6-0.8	1
0.8-0.9	1.1	0.8-0.9	1.2
0.9-1	1.4	0.9-1	1.6
1-1.1	1.9	1-1.1	2.4
1.1-1.2	2.6	1.1-1.2	3.2
1.2-1.68	4.6	1.2-1.5	6.7

Cardiac

For cardiac health we model and predict the 15-year probability of a Major Adverse Cardiac Event (MACE). We define MACE as all myocardial infarctions (or heart attacks), all strokes (hemorrhagic and ischemic) and complications following these events. Below are values of our model's most predictive biomarkers for MACE in males and females aged 55 to 70 with no prior history of MACE.

Biomarker Predictor	Strength	VMR
Cystatin_C	10	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
HbA1C	10	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Smoking History	9	Males: 0 to 15 pack years Females: 0 to 9 pack years
HDL	8	Males: 49 to 78 mg/dL Females: 63 to 108 mg/dL
White blood cell count	8	Males: 3.7 to 6.4 × 1000 cells/µL Females: 3.4 to 6.0 × 1000 cells/µL
CRP	8	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
BMI	8	Males: 21.2 to 26.5 Females: 19.3 to 25.4
Systolic Blood Pressure	7	Males: 100 to 142 mmHg Females: 87 to 126 mmHg
LDL/ApoB ratio	7	Males: 1.35 to 1.55 Females: 1.39 to 1.64
Apolipoprotein B	6	Males: 81 to 119 mg/dL Females: 74 to 129 mg/dL
Triglycerides	6	Males: 67 to 165 mg/dL Females: 47 to 120 mg/dL
LDL	5	Males: 110 to 166 mg/dL Females: 110 to 178 mg/dL
Lipoprotein (a)	3	Males: 5.2 to 144.2 nmol/L Females: 3.9 to 186.1 nmol/L

* LDL and Lipoprotein(a) are included as they commonly are associated with MACE. However, they were not top predictive biomarkers.

Cardiac

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

Cystatin C

Males		Females	
Range	RR	Range	RR
0.66-0.8	1	0.6-0.8	1
0.8-0.9	1	0.8-0.9	1.1
0.9-1	1.2	0.9-1	1.3
1-1.1	1.4	1-1.1	1.6
1.1-1.2	1.6	1.1-1.2	2
1.2-1.68	1.9	1.2-1.5	2.6

A1C

Males		Females	
Range	RR	Range	RR
4.38-4.8	1	4.43-4.8	1.1
4.8-5.4	1.1	4.8-5.4	1
5.4-5.7	1.3	5.4-5.7	1.1
5.7-6	1.5	5.7-6	1.2
6-6.3	1.5	6-6.3	1.5
6.3-7	2	6.3-7	1.8
7-9.34	2.5	7-8.43	3

Smoking History

Males		Females	
Range	RR	Range	RR
0.0-10	1	0.0-10	1
10-20	1.1	10-20	1.3
20-30	1.2	20-30	1.5
30-40	1.5	30-40	2
40-99.0	1.6	40-66.75	2.2

HDL

Males		Females	
Range	RR	Range	RR
26.57-35	2.1	32.29-35	2.7
35-42	1.8	35-42	2.1
42-50	1.5	42-50	1.7
50-60	1.3	50-60	1.4
60-75	1.2	60-75	1.1
75-91.69	1	75-108.43	1

White blood cell count

Males		Females	
Range	RR	Range	RR
3.4-4	1	3.35-4	1
4-6	1.1	4-6	1.1
6-8	1.3	6-8	1.3
8-9.5	1.5	8-9.5	1.6
9.5-11	1.8	9.5-11	1.9
11-13.43	1.9	11-13.05	2.8

CRP

Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1.1	0.5-1	1.1
1-1.7	1.3	1-1.7	1.2
1.7-3	1.4	1.7-3	1.4
3-6	1.6	3-6	1.7
6-29.67	1.9	6-27.63	2

BMI

Males		Females	
Range	RR	Range	RR
19.51-21	1	18.22-20	1.1
21-23	1.3	20-22	1
23-26	1.4	22-26	1.3
26-29	1.6	26-29	1.4
29-32	1.9	29-33	1.7
32-35	2.2	33-36	1.9
35-43.6	2.3	36-46.21	2.3

Systolic BP

Males		Females	
Range	RR	Range	RR
92.7-100	1	86.4-100	1.1
100-110	1	100-110	1
110-120	1.1	110-120	1.3
120-130	1.2	120-130	1.3
130-150	1.4	130-150	1.6
150-170	1.7	150-170	2
170-179.1	2.1	170-177.3	2.5

LDL / ApoB Ratio

Males		Females	
Range	RR	Range	RR
1.04-1.15	1.7	1.09-1.15	2.2
1.15-1.24	1.5	1.15-1.24	1.6
1.24-1.3	1.4	1.24-1.3	1.4
1.3-1.4	1.2	1.3-1.4	1.2
1.4-1.5	1	1.4-1.5	1
1.5-1.62	1.1	1.5-1.64	1

Apolipoprotein B

Males		Females	
Range	RR	Range	RR
48.8-60	1.1	51.1-60	1.4
60-80	1	60-80	1.2
80-120	1	80-120	1
120-140	1.1	120-140	1.2
140-160	1.4	140-160	1.4
160-172.0	1.5	160-175.7	1.6

Metabolic

For metabolic health we model and predict **type 2 diabetes,** a chronic disease characterized by high levels of glucose in the blood. This is a result of the body developing a resistance to insulin, or the pancreas fails to produce enough insulin. This results in the body's inability to process and use sugar (glucose) properly. High blood sugar increases risk for heart attack, stroke, dementia, kidney disease, vision loss, and infections.

Below are values for our model's most predictive biomarkers for developing type 2 diabetes in males and females aged 40 to 70.

Biomarker Predictor	Strength	VMR
HbA1C	10	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
BMI	9	Males: 21.2 to 26.5 Females: 19.3 to 25.4
HDL	7	Males: 49 to 78 mg/dL Females: 63 to 108 mg/dL
SHBG	6	Males: 34 to 72 nmol/L Females: 47 to 141 nmol/L
LDL/ApoB ratio	6	Males: 1.35 to 1.55 Females: 1.39 to 1.64
Triglycerides	5	Males: 67 to 165 mg/dL Females: 47 to 120 mg/dL
GGT	5	Males: 11.9 to 29.4 U/L Females: 8.9 to 18.6 U/L
Urate	5	Males: 4.7 to 6.4 mg/dL Females: 2.8 to 4.7 mg/dL
ALT	5	Males: 15.3 to 26.9 U/L Females: 13.5 to 20.5 U/L
CRP	5	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
Cystatin_C	4	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
White blood cell count	4	Males: 3.7 to 6.4 × 1000 cells/µL Females: 3.4 to 6.0 × 1000 cells/µL

Metabolic

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

A1C

Males		Females	
Range	RR	Range	RR
4.38-4.8	1	4.43-4.8	1
4.8-5.4	1.6	4.8-5.4	1.2
5.4-5.7	4.1	5.4-5.7	3
5.7-6	11	5.7-6	9.4
6-6.3	30	6-6.3	29
6.3-7	49	6.3-7	63
7-9.34	55	7-8.43	74

BMI

Males		Females	
Range	RR	Range	RR
19.51-21	1	18.22-20	1
21-23	1.3	20-22	1.1
23-26	1.7	22-26	2.1
26-29	3.1	26-29	4.7
29-32	5.7	29-33	8.7
32-35	9	33-36	14
35-43.6	15	36-46.21	23

HDL

Males		Females	
Range	RR	Range	RR
26.57-35	6.1	32.29-35	17
35-42	4.2	35-42	11
42-50	2.6	42-50	6.7
50-60	1.7	50-60	3.6
60-75	1.1	60-75	1.9
75-91.69	1	75-108.43	1

SHBG

Males		Females	
Range	RR	Range	RR
10.7-20	4.4	13.16-20	14
20-30	2.6	20-30	8.3
30-40	1.9	30-40	5
40-60	1.4	40-60	2.5
60-80	1	60-80	1.3
80-102.63	1.2	80-120	1
		120-187.91	1.2

LDL / ApoB Ratio

Males		Females	
Range	RR	Range	RR
1.04-1.15	7.6	1.09-1.15	12
1.15-1.24	4.6	1.15-1.24	6.3
1.24-1.3	2.9	1.24-1.3	3.7
1.3-1.4	1.7	1.3-1.4	1.9
1.4-1.5	1	1.4-1.5	1.1
1.5-1.62	1.3	1.5-1.64	1

Triglycerides

Males		Females	
Range	RR	Range	RR
44.82-80	1	41.89-80	1
80-110	1.3	80-110	1.4
110-150	1.6	110-150	2.4
150-200	2.1	150-200	3.6
200-300	2.7	200-300	5.3
300-623.62	3.7	300-471.46	8.3

GGT

Males		Females	
Range	RR	Range	RR
11.89-20	1	8.9-20	1
20-30	1.6	20-30	2.3
30-40	2.4	30-40	3.7
40-60	3.1	40-60	4.5
60-90	3.7	60-90	4.9
90-150	4	90-150	5.5
150-314.82	5	150-216.7	5.4

Urate

Males		Females	
Range	RR	Range	RR
3.16-4	1.3	2.24-3	1
4-5	1	3-5	1.4
5-7	1.1	5-6	3
7-8	1.5	6-7	5.3
8-9	1.9	7-8	7.2
9-9.61	2.6	8-8.27	9.8

ALT

Males		Females	
Range	RR	Range	RR
8.24-12	1.1	6.53-12	1
12-20	1	12-20	1.4
20-30	1.5	20-30	2.5
30-45	2.5	30-45	4.3
45-60	3.6	45-60	5.3
60-99.45	4.6	60-79.01	6.1

CRP

Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1.4	0.5-1	1.5
1-1.7	1.8	1-1.7	2.2
1.7-3	2.2	1.7-3	3.4
3-6	2.9	3-6	5.1
6-29.67	3.1	6-27.63	7.7

Cognitive

For cognitive health we model and predict **dementia** which is an age-related condition resulting from accumulated damage to the brain and nerve cells, leading to cognitive and physical decline. This interferes with memory, mood, and the ability to function independently in daily life.

Below are values for our model's most predictive biomarkers for developing dementia in males and females aged 60 to 70.

Biomarker Predictor	Strength	VMR
Grip Strength	10	Males: 97 to 139 lbs Females: 56 to 88 lbs
HbA1C	9	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Smoking History	9	Males: 0 to 15 pack years Females: 0 to 9 pack years
LDL/ApoB ratio	8	Males: 1.35 to 1.55 Females: 1.39 to 1.64
Cystatin_C	8	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
Hemoglobin	7	Males: 13.8 to 15.8 g/dL Females: 12.5 to 14.4 g/dL
Urea	7	Males: 11.5 to 19.1 mg/dL Females: 11.0 to 18.6 mg/dL
Vitamin D	6	Males: 18 to 46 ng/mL Females: 17 to 45 ng/mL
CRP	6	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
HDL	6	Males: 49 to 78 mg/dL Females: 63 to 108 mg/dL
LDL	5	Males: 110 to 166 mg/dL Females: 110 to 178 mg/dL

Cognitive

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

Grip Strength			
Males		Females	
Range	RR	Range	RR
33.06-45	4	12.12-20	2.6
45-60	3.1	20-30	2
60-80	2.1	30-40	1.7
80-100	1.6	40-55	1.3
100-120	1.2	55-65	1.1
120-138.85	1	65-88.16	1

A1C			
Males		Females	
Range	RR	Range	RR
4.38-4.8	1.1	4.43-4.8	1.3
4.8-5.4	1.1	4.8-5.4	1.1
5.4-5.7	1	5.4-5.7	1
5.7-6	1.2	5.7-6	1.1
6-6.3	1.6	6-6.3	1.2
6.3-7	1.9	6.3-7	2.1
7-9.34	2.5	7-8.43	2.5

Smoking History			
Males		Females	
Range	RR	Range	RR
0.0-10	1.1	0.0-10	1
10-20	1	10-20	1
20-30	1.3	20-30	1.2
30-40	1.4	30-40	1.5
40-99.0	1.9	40-66.75	1.9

LDL / ApoB Ratio			
Males		Females	
Range	RR	Range	RR
1.04-1.15	2.3	1.09-1.15	2.5
1.15-1.24	1.6	1.15-1.24	1.9
1.24-1.3	1.4	1.24-1.3	1.7
1.3-1.4	1.2	1.3-1.4	1.3
1.4-1.5	1.1	1.4-1.5	1.1
1.5-1.62	1	1.5-1.64	1

Cystatin C			
Males		Females	
Range	RR	Range	RR
0.66-0.8	1.3	0.6-0.8	1.1
0.8-0.9	1.1	0.8-0.9	1
0.9-1	1	0.9-1	1.2
1-1.1	1.1	1-1.1	1.3
1.1-1.2	1.3	1.1-1.2	1.3
1.2-1.68	1.9	1.2-1.5	2.1

Hemoglobin			
Males		Females	
Range	RR	Range	RR
11.69-12.5	2.4	10.27-11.5	1.9
12.5-13	1.9	11.5-12	1.7
13-14	1.4	12-13	1.2
14-15.5	1	13-14.5	1
15.5-17	1	14.5-15.5	1.1
17-17.58	1.1	15.5-15.92	1.1

Urea			
Males		Females	
Range	RR	Range	RR
7.48-10	2	7.11-10	1.7
10-12	1.4	10-12	1.3
12-15	1.1	12-15	1.1
15-20	1	15-20	1
20-24	1.2	20-24	1
24-30.36	1.5	24-27.41	1.7

Vitamin D			
Males		Females	
Range	RR	Range	RR
4.6-8	1.7	4.64-8	1.6
8-12	1.5	8-12	1.4
12-20	1.1	12-20	1.1
20-30	1	20-30	1
30-40	1.1	30-40	1.1
40-45.6	1.2	40-44.8	1.1

CRP			
Males		Females	
Range	RR	Range	RR
0.14-0.5	1.5	0.13-0.5	1.5
0.5-1	1.1	0.5-1	1.1
1-1.7	1	1-1.7	1
1.7-3	1.1	1.7-3	1
3-6	1.1	3-6	1.1
6-29.67	1.3	6-27.63	1.3

HDL			
Males		Females	
Range	RR	Range	RR
26.57-35	1.5	32.29-35	2.1
35-42	1.2	35-42	1.5
42-50	1	42-50	1.2
50-60	1	50-60	1
60-75	1	60-75	1
75-91.69	1.2	75-108.43	1

Kidney

For kidney health we model and predict acute renal disease. Acute renal disease results in the loss of kidney function. These functions include filtering the blood and removing waste (detox), regulating fluids, electrolytes and blood pressure, assisting in red blood cell production, and activating vitamin D.

Below are values for our model's most predictive biomarkers or inputs for developing acute kidney disease in males and females aged 55 to 70.

Biomarker Predictor	Strength	VMR
Cystatin_C	10	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
BMI	7	Males: 21.2 to 26.5 Females: 19.3 to 25.4
HbA1C	7	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Creatinine	7	Males: 0.76 to 1.06 mg/dL Females: 0.57 to 0.82 mg/dL
Urea	6	Males: 11.5 to 19.1 mg/dL Females: 11.0 to 18.6 mg/dL
Urate	6	Males: 4.7 to 6.4 mg/dL Females: 2.8 to 4.7 mg/dL
Smoking History	5	Males: 0 to 15 pack years Females: 0 to 9 pack years
CRP	5	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
LDL/ApoB ratio	5	Males: 1.35 to 1.55 Females: 1.39 to 1.64
Hemoglobin	5	Males: 13.8 to 15.8 g/dL Females: 12.5 to 14.4 g/dL
RDW	5	Males: 11.9 to 13.7% Females: 11.9 to 13.6%
HDL	5	Males: 49 to 78 mg/dL Females: 63 to 108 mg/dL

Kidney

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

Cystatin C			
Males		Females	
Range	RR	Range	RR
0.66-0.8	1	0.6-0.8	1
0.8-0.9	1.1	0.8-0.9	1.2
0.9-1	1.4	0.9-1	1.6
1-1.1	1.9	1-1.1	2.4
1.1-1.2	2.6	1.1-1.2	3.2
1.2-1.68	4.6	1.2-1.5	6.7

BMI			
Males		Females	
Range	RR	Range	RR
19.51-21	1.1	18.22-20	1.3
21-23	1	20-22	1
23-26	1.1	22-26	1.1
26-29	1.3	26-29	1.5
29-32	1.8	29-33	2.1
32-35	2.4	33-36	3
35-43.6	3.7	36-46.21	4.8

A1C			
Males		Females	
Range	RR	Range	RR
4.38-4.8	1.1	4.43-4.8	1.4
4.8-5.4	1	4.8-5.4	1
5.4-5.7	1.2	5.4-5.7	1.1
5.7-6	1.5	5.7-6	1.5
6-6.3	1.9	6-6.3	2
6.3-7	2.5	6.3-7	3.2
7-9.34	3.4	7-8.43	4.8

Creatinine			
Males		Females	
Range	RR	Range	RR
0.6-0.7	1.4	0.47-0.6	1.2
0.7-0.8	1.1	0.6-0.7	1
0.8-1	1	0.7-0.8	1.1
1-1.2	1.4	0.8-0.9	1.4
1.2-1.4	2.2	0.9-1	1.9
1.4-1.59	4	1-1.21	3.7

Urea			
Males		Females	
Range	RR	Range	RR
7.48-10	1.6	7.11-10	1.4
10-12	1.1	10-12	1.1
12-15	1	12-15	1
15-20	1.1	15-20	1.1
20-24	1.5	20-24	1.7
24-30.36	2.9	24-27.41	3.9

Urate			
Males		Females	
Range	RR	Range	RR
3.16-4	1.3	2.24-3	1
4-5	1	3-5	1
5-7	1.1	5-6	1.4
7-8	1.5	6-7	2.2
8-9	2.2	7-8	3.3
9-9.61	3.5	8-8.27	5.7

Smoking History			
Males		Females	
Range	RR	Range	RR
0.0-10	1	0.0-10	1
10-20	1.1	10-20	1.3
20-30	1.4	20-30	1.8
30-40	1.7	30-40	2.2
40-99.0	2.1	40-66.75	2.8

CRP			
Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1.2	0.5-1	1.2
1-1.7	1.3	1-1.7	1.4
1.7-3	1.6	1.7-3	1.9
3-6	2	3-6	2.4
6-29.67	2.4	6-27.63	3.5

LDL / ApoB Ratio			
Males		Females	
Range	RR	Range	RR
1.04-1.15	2.6	1.09-1.15	3.6
1.15-1.24	1.9	1.15-1.24	2.3
1.24-1.3	1.5	1.24-1.3	1.8
1.3-1.4	1.2	1.3-1.4	1.3
1.4-1.5	1	1.4-1.5	1
1.5-1.62	1.3	1.5-1.64	1.1

Hemoglobin			
Males		Females	
Range	RR	Range	RR
11.69-12.5	2.9	10.27-11.5	3.1
12.5-13	2.2	11.5-12	2
13-14	1.4	12-13	1.3
14-15.5	1	13-14.5	1
15.5-17	1	14.5-15.5	1.1
17-17.58	1.4	15.5-15.92	1.7

Liver

For liver health we model and predict non-cancerous, non-acute and non-viral associated liver diseases resulting in the loss of liver function. Liver functions include filtering harmful substances from the blood (toxins, drugs, alcohol, bacteria), metabolizing and storing energy (protein, carbohydrate, fats), blood clotting, bile production for digestion, storing vitamins and minerals, and producing immune factors.

Below are values for our model's most predictive biomarkers or inputs for developing liver disease in males and females aged 40 to 70.

Biomarker Predictor	Strength	VMR
GGT	10	Males: 11.9 to 29.4 U/L Females: 8.9 to 18.6 U/L
AST	9	Males: 18.7 to 30.6 U/L Females: 17.7 to 28.2 U/L
ALT	8	Males: 15.3 to 26.9 U/L Females: 13.5 to 20.5 U/L
BMI	6	Males: 21.2 to 26.5 Females: 19.3 to 25.4
IGF-1	6	Males: 135 to 241 mg/dL Females: 139 to 246 mg/dL
ALK	5	Males: 39 to 84 U/L Females: 37 to 85 U/L
CRP	5	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
HDL	4	Males: 49 to 78 mg/dL Females: 63 to 108 mg/dL
Urate	4	Males: 4.7 to 6.4 mg/dL Females: 2.8 to 4.7 mg/dL
HbA1C	4	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Cystatin_C	4	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L

Liver

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

GGT

Males		Females	
Range	RR	Range	RR
11.89-20	1	8.9-20	1
20-30	1.3	20-30	1.4
30-40	1.7	30-40	2
40-60	2.2	40-60	2.7
60-90	3.1	60-90	3.7
90-150	4.5	90-150	5
150-314.82	10	150-216.7	9.6

AST

Males		Females	
Range	RR	Range	RR
14.9-17	1.1	13.4-17	1.1
17-20	1	17-20	1
20-28	1	20-28	1.1
28-36	1.4	28-36	1.6
36-45	2.3	36-45	2.9
45-82.3	5.9	45-67.1	6.3

ALT

Males		Females	
Range	RR	Range	RR
8.24-12	1.2	6.53-12	1
12-20	1	12-20	1.1
20-30	1.2	20-30	1.7
30-45	1.9	30-45	3.1
45-60	3.3	45-60	4.9
60-99.45	6.1	60-79.01	7.5

BMI

Males		Females	
Range	RR	Range	RR
19.51-21	1.1	18.22-20	1
21-23	1	20-22	1
23-26	1.3	22-26	1.4
26-29	1.7	26-29	2.2
29-32	2.6	29-33	3.2
32-35	3.5	33-36	4.2
35-43.6	4.7	36-46.21	6

IGF-1

Males		Females	
Range	RR	Range	RR
67.01-85	5.7	65.1-85	3
85-100	2.7	85-100	1.9
100-120	1.8	100-120	1.5
120-150	1.3	120-150	1.3
150-250	1	150-250	1
250-297.71	1.1	250-298.91	1

ALK

Males		Females	
Range	RR	Range	RR
38.9-60	1	36.75-60	1
60-80	1.1	60-80	1.2
80-100	1.3	80-100	1.5
100-120	1.6	100-120	1.8
120-140	2	120-140	2.2
140-170.9	4	140-182.1	4

CRP

Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1.5	0.5-1	1.3
1-1.7	1.8	1-1.7	1.8
1.7-3	2.1	1.7-3	2.4
3-6	2.8	3-6	3
6-29.67	3.1	6-27.63	4.1

HDL

Males		Females	
Range	RR	Range	RR
26.57-35	2.2	32.29-35	4
35-42	1.6	35-42	2.9
42-50	1.2	42-50	2.3
50-60	1	50-60	1.5
60-75	1	60-75	1.1
75-91.69	1.6	75-108.43	1

Urate

Males		Females	
Range	RR	Range	RR
3.16-4	1.4	2.24-3	1
4-5	1	3-5	1.4
5-7	1.2	5-6	2.1
7-8	1.6	6-7	2.9
8-9	2	7-8	4
9-9.61	3.1	8-8.27	5.3

A1C

Males		Females	
Range	RR	Range	RR
4.38-4.8	1.2	4.43-4.8	1.1
4.8-5.4	1	4.8-5.4	1
5.4-5.7	1.1	5.4-5.7	1.2
5.7-6	1.4	5.7-6	1.4
6-6.3	1.9	6-6.3	1.9
6.3-7	2.2	6.3-7	2.8
7-9.34	2.6	7-8.43	3.2

Lung (Respiratory)

For lung health we model and predict chronic obstructive pulmonary disease (COPD), a class of progressive lung disease resulting in difficulty breathing, and negatively impacts overall health.

Below are values for our model's most predictive biomarkers or inputs for developing COPD in males and females aged 50 to 70.

Biomarker Predictor	Relative Strength	VMR
Smoking History	10	Males: 0 to 15 pack years Females: 0 to 9 pack years
White blood cell count	5	Males: 3.7 to 6.4 × 1000 cells/µL Females: 3.4 to 6.0 × 1000 cells/µL
CRP	4	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
Cystatin_C	3	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
BMI	3	Males: 21.2 to 26.5 Females: 19.3 to 25.4
HbA1C	3	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
RDW	2	Males: 11.9 to 13.7% Females: 11.9 to 13.6%
LDL/ApoB ratio	2	Males: 1.35 to 1.55 Females: 1.39 to 1.64
MCV	2	Males: 87.9 to 95.6 fL Females: 89.5 to 96.7 fL
Grip Strength	2	Males: 97 to 139 lbs Females: 56 to 88 lbs

Lung (Respiratory)

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

Smoking History			
Males		Females	
Range	RR	Range	RR
0.0-10	1	0.0-10	1
10-20	2.3	10-20	3.1
20-30	4	20-30	5.6
30-40	6.1	30-40	8.6
40-99.0	8.8	40-66.75	12

White blood cell count			
Males		Females	
Range	RR	Range	RR
3.4-4	1	3.35-4	1
4-6	1.1	4-6	1.2
6-8	1.8	6-8	2
8-9.5	2.9	8-9.5	3.3
9.5-11	4.2	9.5-11	4.9
11-13.43	5.9	11-13.05	7.8

CRP			
Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1.4	0.5-1	1.2
1-1.7	1.8	1-1.7	1.6
1.7-3	2.4	1.7-3	2
3-6	3.2	3-6	2.6
6-29.67	4.1	6-27.63	3.4

Cystatin C			
Males		Females	
Range	RR	Range	RR
0.66-0.8	1	0.6-0.8	1
0.8-0.9	1.2	0.8-0.9	1.3
0.9-1	1.5	0.9-1	1.8
1-1.1	1.9	1-1.1	2.4
1.1-1.2	2.4	1.1-1.2	2.9
1.2-1.68	3.2	1.2-1.5	4

BMI			
Males		Females	
Range	RR	Range	RR
19.51-21	1.6	18.22-20	1.4
21-23	1	20-22	1
23-26	1.1	22-26	1
26-29	1.2	26-29	1.4
29-32	1.6	29-33	1.7
32-35	2.1	33-36	2
35-43.6	3	36-46.21	2.9

A1C			
Males		Females	
Range	RR	Range	RR
4.38-4.8	1	4.43-4.8	1
4.8-5.4	1.2	4.8-5.4	1
5.4-5.7	1.7	5.4-5.7	1.3
5.7-6	2.3	5.7-6	1.7
6-6.3	2.7	6-6.3	2.2
6.3-7	2.5	6.3-7	2.2
7-9.34	2.7	7-8.43	2.2

RDW			
Males		Females	
Range	RR	Range	RR
11.94-13	1	11.87-13	1
13-13.5	1.1	13-13.5	1.2
13.5-14	1.4	13.5-14	1.4
14-14.5	1.8	14-14.5	1.7
14.5-15	2.1	14.5-15	2
15-17.6	2.5	15-18.79	2.4

LDL / ApoB Ratio			
Males		Females	
Range	RR	Range	RR
1.04-1.15	2.1	1.09-1.15	2.8
1.15-1.24	1.8	1.15-1.24	2.1
1.24-1.3	1.5	1.24-1.3	1.7
1.3-1.4	1.1	1.3-1.4	1.3
1.4-1.5	1	1.4-1.5	1
1.5-1.62	1.1	1.5-1.64	1

MCV			
Males		Females	
Range	RR	Range	RR
76.81-83	1.4	72.77-83	1.2
83-90	1	83-90	1
90-95	1.1	90-95	1.1
95-100	1.5	95-100	1.6
100-104.3	2.4	100-102.9	2.6

Grip Strength			
Males		Females	
Range	RR	Range	RR
33.06-45	3	12.12-20	2.8
45-60	2.2	20-30	2
60-80	1.8	30-40	1.6
80-100	1.4	40-55	1.3
100-120	1.2	55-65	1.1
120-138.85	1	65-88.16	1

All-Cause Mortality

All-cause mortality refers to death due to any cause. It includes death from the other age-related conditions in this guide but not limited to them. We predict 15-year all-cause mortality in our models.

Below are values for our model's most predictive biomarkers or inputs for experiencing death in males and females aged 55 to 70.

Biomarker Predictor	Relative Strength	VMR
Smoking History	10	Males: 0 to 15 pack years Females: 0 to 9 pack years
Cystatin_C	9	Males: 0.66 to 0.96 mg/L Females: 0.6 to 0.79 mg/L
RDW	7	Males: 11.9 to 13.7% Females: 11.9 to 13.6%
Urea	6	Males: 11.5 to 19.1 mg/dL Females: 11.0 to 18.6 mg/dL
CRP	6	Males: 0.43 to 1.27 mg/L Females: 0.42 to 1.27 mg/L
BMI	6	Males: 21.2 to 26.5 Females: 19.3 to 25.4
White blood cell count	6	Males: 3.7 to 6.4 × 1000 cells/µL Females: 3.4 to 6.0 × 1000 cells/µL
HbA1C	6	Males: 4.5 to 5.4% Females: 4.7 to 5.6%
Creatinine	6	Males: 0.76 to 1.06 mg/dL Females: 0.57 to 0.82 mg/dL
Hemoglobin	6	Males: 13.8 to 15.8 g/dL Females: 12.5 to 14.4 g/dL
MCV	5	Males: 87.9 to 95.6 fL Females: 89.5 to 96.7 fL
GGT	5	Males: 11.9 to 29.4 U/L Females: 8.9 to 18.6 U/L

All-Cause Mortality

The tables below contain disease-specific risk multipliers for each of the included biomarkers.

Smoking History

Males		Females	
Range	RR	Range	RR
0.0-10	1	0.0-10	1
10-20	1.2	10-20	1.4
20-30	1.6	20-30	1.8
30-40	1.8	30-40	2.3
40-99.0	2.5	40-66.75	3.2

Cystatin C

Males		Females	
Range	RR	Range	RR
0.66-0.8	1	0.6-0.8	1
0.8-0.9	1	0.8-0.9	1.1
0.9-1	1.1	0.9-1	1.3
1-1.1	1.3	1-1.1	1.6
1.1-1.2	1.7	1.1-1.2	2
1.2-1.68	2.6	1.2-1.5	3.1

RDW

Males		Females	
Range	RR	Range	RR
11.94-13	1	11.87-13	1
13-13.5	1.1	13-13.5	1.1
13.5-14	1.3	13.5-14	1.2
14-14.5	1.5	14-14.5	1.4
14.5-15	1.8	14.5-15	1.6
15-17.6	2.6	15-18.79	2.5

Urea

Males		Females	
Range	RR	Range	RR
7.48-10	2.2	7.11-10	1.5
10-12	1.3	10-12	1.1
12-15	1	12-15	1
15-20	1	15-20	1
20-24	1.1	20-24	1.1
24-30.36	1.9	24-27.41	2.2

CRP

Males		Females	
Range	RR	Range	RR
0.14-0.5	1	0.13-0.5	1
0.5-1	1	0.5-1	1
1-1.7	1.1	1-1.7	1.1
1.7-3	1.3	1.7-3	1.2
3-6	1.7	3-6	1.5
6-29.67	2.2	6-27.63	2

BMI

Males		Females	
Range	RR	Range	RR
19.51-21	1.3	18.22-20	1.4
21-23	1	20-22	1
23-26	1	22-26	1
26-29	1.1	26-29	1.1
29-32	1.3	29-33	1.2
32-35	1.6	33-36	1.4
35-43.6	2.2	36-46.21	2.1

White blood cell count

Males		Females	
Range	RR	Range	RR
3.4-4	1.3	3.35-4	1.3
4-6	1	4-6	1
6-8	1.2	6-8	1.1
8-9.5	1.5	8-9.5	1.4
9.5-11	2	9.5-11	1.9
11-13.43	2.5	11-13.05	2.8

A1C

Males		Females	
Range	RR	Range	RR
4.38-4.8	1.2	4.43-4.8	1.2
4.8-5.4	1	4.8-5.4	1
5.4-5.7	1.1	5.4-5.7	1
5.7-6	1.4	5.7-6	1.3
6-6.3	1.7	6-6.3	1.6
6.3-7	1.9	6.3-7	1.9
7-9.34	2.4	7-8.43	2.4

Creatinine

Males		Females	
Range	RR	Range	RR
0.6-0.7	1.8	0.47-0.6	1.2
0.7-0.8	1.2	0.6-0.7	1
0.8-1	1	0.7-0.8	1
1-1.2	1	0.8-0.9	1
1.2-1.4	1.4	0.9-1	1.2
1.4-1.59	2.5	1-1.21	2

Hemoglobin

Males		Females	
Range	RR	Range	RR
11.69-12.5	2.6	10.27-11.5	2.5
12.5-13	1.9	11.5-12	1.6
13-14	1.3	12-13	1.1
14-15.5	1	13-14.5	1
15.5-17	1	14.5-15.5	1.2
17-17.58	1.4	15.5-15.92	1.7

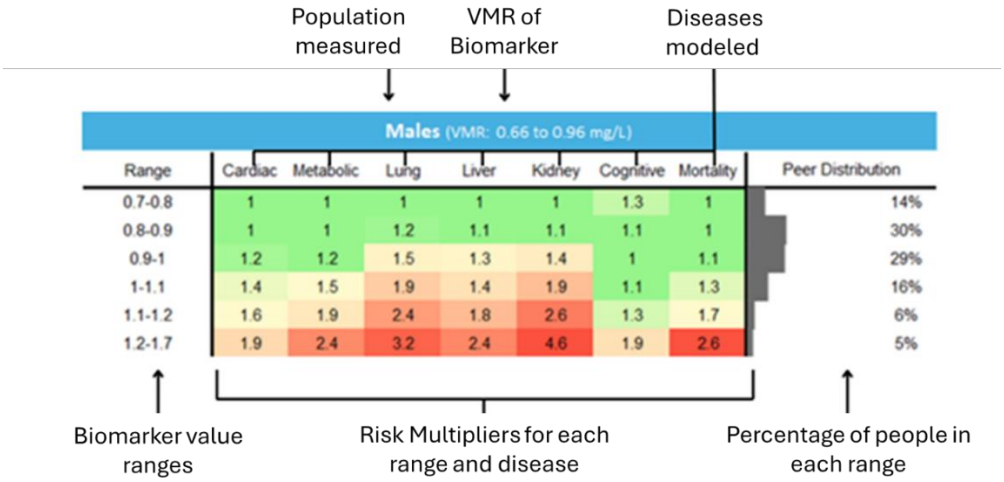
Risk Multipliers by Biomarker

Depending on your health goals, it may be more helpful to view risk multipliers by each biomarker. The first table below shows each of the biomarkers and links to the associated table of values.

BMI	Alkaline Phosphatase (ALP) (U/L)	Sex Hormone Binding Globulin (SHBG)
Waist Circumference	Alanine Transaminase (ALT)	Insulin-Like Growth Factor 1 (IGF-1)
Grip Strength	Aspartate Aminotransferase (AST)	Vitamin D
Systolic Blood Pressure	Gamma-Glutamyl Transferase (GGT)	C-Reactive Protein (CRP)
Resting Heart Rate	Creatinine	Hemoglobin
HDL Cholesterol	Cystatin C	Red Blood Cell Count (RBC)
LDL Cholesterol (mg/L)	Urate	Mean Corpuscular Volume (MCV)
Triglycerides	Urea	Red Blood Cell Distribution Width (RDW)
Lipoprotein (a) (mg/dL)	Hemoglobin A1c (HbA1c)	White Blood Cell (WBC)
LDL/Apolipoprotein B Ratio (LAR)	Testosterone	Smoke Pack Years

About this section

This section provides ranges for the select biomarkers and metrics listed above. The percentage column shows the prevalence in that range from the UK Biobank for ages 40 to 70, and the following columns show the associated risk multipliers for each disease. The VMR™ values for males and females for each biomarker are shown above the tables as well.



BMI (kg/m2)

Males (VMR: 21.2 TO 26.5 kg)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
19.5-21	1	1	1.6	1.1	1.1	1.6	1.3	2%
21-23	1.3	1.3	1	1	1	1.2	1	7%
23-26	1.4	1.7	1.1	1.3	1.1	1	1	26%
26-29	1.6	3.1	1.2	1.7	1.3	1	1.1	31%
29-32	1.9	5.7	1.6	2.6	1.8	1.1	1.3	19%
32-35	2.2	9	2.1	3.5	2.4	1.2	1.6	9%
35-43.6	2.3	15	3	4.7	3.7	1.6	2.2	6%

Females (VMR: 19.3 to 25.4 kg/m^2)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
18.2-20	1.1	1	1.4	1	1.3	1.5	1.4	3%
20-22	1	1.1	1	1	1	1.1	1	10%
22-26	1.3	2.1	1	1.4	1.1	1	1	36%
26-29	1.4	4.7	1.4	2.2	1.5	1.1	1.1	22%
29-33	1.7	8.6	1.7	3.2	2.1	1.1	1.2	17%
33-36	1.9	14	2	4.2	3	1.2	1.4	6%
36-46.2	2.3	22.8	2.9	6	4.8	1.5	2.1	6%

Waist Circumference (inches)

Males (VMR: 28.4 to 34.8 inches)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
28.346-33.071	1	1	1	1	1	1.2	1	11%
33.071-35.039	1.1	1.5	1	1.3	1.1	1.1	1	11%
35.039-37.795	1.2	2.2	1.1	1.6	1.3	1	1.1	26%
37.795-40.945	1.4	4	1.5	2.4	1.6	1.1	1.3	30%
40.945-43.819	1.5	6.7	2.1	3.3	2.2	1.2	1.5	12%
43.819-53.15	1.8	11.8	3.2	4.8	3.4	1.6	2.1	10%

Females (VMR: 24.4 to 31.7 inches)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
24.409-27.559	1	1	1	1	1	1.3	1.1	9%
27.559-29.528	1.3	1.3	1.1	1.1	1	1.1	1	17%
29.528-32.677	1.3	2.3	1.2	1.6	1.2	1	1	23%
32.677-36.22	1.5	5.3	1.6	2.4	1.6	1.1	1.1	25%
36.22-40.157	1.9	11.1	2.1	3.7	2.2	1.2	1.4	16%
40.157-49.213	2.4	23.4	3.2	6	4.3	1.6	2	10%

Grip Strength (lbs.)

Males (VMR: 97 to 139 lbs)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
33-45	1.7	2.3	3	2	2.8	4	2.5	2%
45-60	1.4	1.9	2.2	1.7	2	3.1	2	6%
60-80	1.2	1.4	1.8	1.4	1.5	2.1	1.5	28%
80-100	1.1	1.2	1.4	1.1	1.3	1.6	1.2	40%
100-120	1	1	1.2	1	1.1	1.2	1.1	20%
120-139	1.1	1	1	1	1	1	1	4%

Females (VMR: 56 to 88 lbs)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
12-20	2	2.5	2.8	2.1	2.6	2.6	2	2%
20-30	1.5	2	2	1.8	1.9	2	1.7	5%
30-40	1.3	1.5	1.6	1.5	1.4	1.7	1.4	14%
40-55	1.2	1.2	1.3	1.2	1.2	1.3	1.2	38%
55-65	1	1	1	1.1	1	1.1	1	26%
65-88	1	1	1	1	1	1	1	16%

Systolic Blood Pressure (mmHg)

Males (VMR: 100 to 142 mmHg)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
93-100	1	1	1.5	1.1	1.4	1.4	1.5	3%
100-110	1	1	1.2	1	1.1	1.2	1.1	11%
110-120	1.1	1.1	1.1	1	1	1.2	1	22%
120-130	1.2	1.2	1.1	1.1	1	1	1	25%
130-150	1.4	1.4	1	1.3	1.1	1.1	1.1	30%
150-170	1.7	1.6	1	1.4	1.3	1	1.1	8%
170-179	2.1	1.9	1	1.5	1.6	1.1	1.3	1%

Females (VMR: 87 to 126 mmHg)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
86-100	1.1	1	1.3	1	1	1	1.1	10%
100-110	1	1.5	1.1	1	1	1	1	19%
110-120	1.3	2	1.1	1.2	1	1.1	1	23%
120-130	1.3	2.4	1.1	1.2	1.1	1	1	20%
130-150	1.6	2.6	1	1.2	1.1	1.1	1	22%
150-170	2	2.9	1	1.3	1.4	1.1	1	6%
170-177	2.5	3.2	1.1	1.3	1.7	1	1.2	1%

Resting Heart Rate (bpm)

Males (VMR: 43 to 67 beats/min)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
43-50	1.2	1	1	1	1	1	1	5%
50-60	1	1.1	1	1.2	1	1.1	1	22%
60-70	1	1.4	1.2	1.5	1.1	1	1.1	34%
70-80	1.1	2	1.6	1.9	1.3	1.2	1.3	24%
80-90	1.2	2.5	1.9	2.4	1.6	1.2	1.6	10%
90-108	1.3	3	2.2	3	2	1.5	2	5%

Females (VMR: 53 to 72 beats/min)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
47-50	1.6	1.2	1	1	1.2	1	1.2	2%
50-60	1.2	1	1	1.1	1.1	1.1	1	16%
60-70	1	1.1	1.1	1.2	1	1	1	37%
70-80	1	1.6	1.3	1.4	1.2	1	1.2	29%
80-90	1.2	2.3	1.6	1.9	1.6	1.2	1.5	12%
90-106	1.3	3.1	1.8	2.3	2	1.2	1.8	5%

HDL Cholesterol (mg/dL)

Males (VMR: 49 to 78 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
27-35	2.1	6.1	1.6	2.2	2.3	1.5	1.7	8%
35-42	1.8	4.2	1.3	1.6	1.6	1.2	1.3	20%
42-50	1.5	2.6	1.1	1.2	1.3	1	1.1	29%
50-60	1.3	1.7	1	1	1.1	1	1	25%
60-75	1.2	1.1	1	1	1	1	1	14%
75-92	1	1	1.4	1.6	1.3	1.2	1.4	3%

Females (VMR: 63 to 108 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
32-35	2.7	16.9	3.1	4	3.7	2.1	2.8	1%
35-42	2.1	11.2	2.1	2.9	2.6	1.5	1.8	5%
42-50	1.7	6.7	1.6	2.3	1.9	1.2	1.3	15%
50-60	1.4	3.6	1.3	1.5	1.3	1	1.1	28%
60-75	1.1	1.9	1.1	1.1	1.1	1	1	33%
75-108	1	1	1	1	1	1	1	17%

LDL Cholesterol (mg/dL)

Males (VMR: 110 to 166 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
68-90	1	1.9	2.1	2	2.4	2.6	2	3%
90-100	1	1.3	1.8	1.5	1.6	1.8	1.6	4%
100-120	1	1.2	1.4	1.2	1.3	1.3	1.3	16%
120-150	1.1	1	1.2	1	1.1	1.2	1.1	38%
150-175	1.2	1	1.1	1	1	1.1	1	25%
175-200	1.4	1	1.1	1	1	1	1	11%
200-230	1.6	1.1	1	1.1	1	1	1.1	4%

Females (VMR: 110 to 178 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
71-90	1.4	1.3	1.5	1.4	2.3	1.5	1.9	3%
90-100	1.3	1.1	1.2	1	1.5	1.1	1.4	4%
100-120	1	1	1.2	1.2	1.3	1.1	1.2	16%
120-150	1.1	1	1	1.1	1.1	1	1	36%
150-175	1.1	1.2	1	1.2	1.1	1.1	1	24%
175-200	1.4	1.3	1	1.3	1	1.2	1	11%
200-241	1.5	1.4	1	1.2	1.2	1.2	1.1	5%

Triglycerides

Males (VMR: 67 TO 165 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
45-80	1	1	1	1	1	1.4	1.1	11%
80-110	1.1	1.3	1	1.1	1	1.1	1	17%
110-150	1.1	1.6	1	1.2	1	1	1	22%
150-200	1.2	2.1	1	1.3	1.2	1.1	1	20%
200-300	1.4	2.7	1.1	1.5	1.2	1	1	20%
300-624	1.5	3.7	1.2	1.9	1.5	1.1	1.2	10%

Females (VMR: 47 to 120 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
42-80	1	1	1	1	1	1.2	1	21%
80-110	1.1	1.4	1.3	1.2	1	1.1	1	24%
110-150	1.2	2.4	1.4	1.6	1.2	1	1	24%
150-200	1.4	3.6	1.6	2	1.4	1.1	1.1	16%
200-300	1.7	5.3	1.8	2.4	1.6	1	1.2	12%
300-471	1.8	8.3	2.3	3.5	1.9	1.1	1.4	4%

Lipoprotein (a) (mg/dL)

Males (VMR: 5 to 144 nmol/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
4-10	1	1.2	1.1	1.2	1.1	1.1	1.1	28%
10-20	1.1	1	1	1	1	1.1	1	22%
20-40	1.1	1	1.1	1	1	1	1	16%
40-80	1.1	1.2	1.1	1.2	1.1	1.1	1.1	14%
80-150	1.3	1.1	1	1.1	1	1	1	15%
150-186	1.4	1	1.2	1	1.1	1.1	1.1	6%

Females (VMR: 4 to 186 nmol/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
4-10	1	1.1	1.1	1.1	1.1	1	1.1	25%
10-20	1	1	1	1	1	1	1	22%
20-40	1.1	1	1	1	1	1	1	17%
40-80	1.2	1.1	1	1	1	1.2	1	15%
80-150	1.2	1.2	1	1.1	1	1	1	14%
150-186	1.3	1.1	1.2	1.1	1.1	1.2	1.1	7%

LDL/Apolipoprotein B Ratio (LAR)

Males (VMR: 1.35 to 1.55)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
1.04-1.15	1.7	7.6	2.1	2.4	2.6	2.3	2	5%
1.15-1.24	1.5	4.6	1.8	1.9	1.9	1.6	1.5	17%
1.24-1.3	1.4	2.9	1.5	1.5	1.5	1.4	1.3	22%
1.3-1.4	1.2	1.7	1.2	1.1	1.2	1.2	1.1	40%
1.4-1.5	1	1	1	1	1	1.1	1	14%
1.5-1.62	1.1	1.3	1.1	1.5	1.3	1	1.3	2%

Females (VMR: 1.39 to 1.64)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
1.09-1.15	2.2	11.7	2.8	3.6	3.6	2.5	2.4	2%
1.15-1.24	1.6	6.3	2.1	2.3	2.3	1.9	1.6	9%
1.24-1.3	1.4	3.7	1.7	1.7	1.8	1.7	1.4	16%
1.3-1.4	1.2	1.9	1.3	1.3	1.3	1.3	1.1	45%
1.4-1.5	1	1.1	1	1	1	1.1	1	25%
1.5-1.64	1	1	1	1.1	1.1	1	1.1	4%

Alkaline Phosphatase (ALP) (U/L)

Males (VMR: 38.9 to 84.3 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
39-60	1	1	1	1	1	1.1	1	13%
60-80	1.1	1.1	1.2	1.1	1	1	1	39%
80-100	1.2	1.3	1.6	1.3	1.2	1.1	1.2	31%
100-120	1.4	1.6	2.1	1.6	1.4	1.2	1.5	12%
120-140	1.6	1.8	2.4	2	1.7	1.6	1.8	4%
140-171	1.6	2	2.4	4	2.2	1.9	2.5	2%

Females (VMR: 36.8 to 85.3 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
37-60	1	1	1	1	1	1.1	1	15%
60-80	1	1.4	1.1	1.2	1	1	1	33%
80-100	1.1	1.9	1.3	1.5	1.2	1	1.1	30%
100-120	1.2	2.4	1.7	1.8	1.4	1.1	1.2	15%
120-140	1.5	3	1.9	2.2	1.7	1.1	1.4	5%
140-182	1.6	3.6	2.1	4	2.2	1.3	1.9	3%

Alanine Transaminase (ALT) (U/L)

Males (VMR: 15.3 to 26.9 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
8-12	1.1	1.1	1.6	1.2	1.3	1.7	1.5	3%
12-20	1	1	1.2	1	1	1.3	1.1	29%
20-30	1	1.5	1	1.2	1	1.1	1	38%
30-45	1.1	2.5	1	1.9	1.1	1.2	1	21%
45-60	1.2	3.6	1.2	3.3	1.2	1	1.2	6%
60-99	1.3	4.6	1.2	6.1	1.6	1.4	1.6	3%

Females (VMR: 13.5 to 20.5 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
7-12	1.1	1	1.2	1	1.1	1.5	1.2	13%
12-20	1	1.4	1	1.1	1	1.3	1	50%
20-30	1.1	2.5	1	1.7	1.1	1.2	1	25%
30-45	1.2	4.3	1	3.1	1.3	1.2	1.1	8%
45-60	1.3	5.3	1	4.9	1.5	1.4	1.2	2%
60-79	1.1	6.1	1.3	7.5	1.7	1	1.5	1%

Aspartate Aminotransferase (AST) (U/L)

Males (VMR: 18.7 to 30.6 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
15-17	1.3	1.5	1.8	1.2	1.6	1.4	1.6	2%
17-20	1.1	1.1	1.4	1	1.2	1.1	1.2	8%
20-28	1	1	1.1	1	1	1	1	51%
28-36	1	1.2	1	1.4	1	1	1	27%
36-45	1.1	1.7	1.1	2.3	1.3	1.1	1.2	8%
45-82	1.3	2.7	1.5	5.9	1.8	1.5	1.9	4%

Females (VMR: 17.7 to 28.2 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
13-17	1.4	1.4	1.6	1.1	1.6	1.2	1.4	7%
17-20	1	1	1.2	1	1.1	1	1.1	18%
20-28	1	1	1	1.1	1	1.1	1	54%
28-36	1	1.4	1	1.6	1.2	1.3	1.1	15%
36-45	1.2	2	1.1	2.8	1.4	1.6	1.3	3%
45-67	1.4	3	1.5	6.3	2.2	1.6	1.8	2%

Gamma-Glutamyl Transferase (GGT) (U/L)

Males (VMR: 11.9 to 29.4 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
12-20	1	1	1	1	1	1.1	1	14%
20-30	1.1	1.6	1.1	1.3	1	1	1	29%
30-40	1.2	2.4	1.2	1.7	1.2	1	1.1	20%
40-60	1.3	3.1	1.4	2.2	1.3	1.1	1.2	19%
60-90	1.4	3.7	1.6	3.1	1.5	1.1	1.4	10%
90-150	1.4	4	1.8	4.5	1.7	1.3	1.6	5%
150-315	1.4	5	2	10	2.5	2	2.4	3%

Females (VMR: 8.9 to 18.6 U/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
9-20	1	1	1	1	1	1	1	45%
20-30	1.2	2.3	1.3	1.4	1.3	1	1.1	28%
30-40	1.4	3.7	1.6	2	1.5	1.1	1.3	11%
40-60	1.5	4.5	1.7	2.7	1.8	1.2	1.4	9%
60-90	1.7	4.9	1.8	3.7	2.1	1.3	1.6	4%
90-150	1.6	5.4	1.9	5	2.5	1.4	1.8	2%
150-217	1.6	5.4	2.1	9.6	3.1	1.5	2.4	1%

Creatinine (mg/dL)

Males (VMR: 0.76 to 1.06 mg / dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.6-0.7	1.2	1.9	2	2	1.4	1.7	1.8	4%
0.7-0.8	1	1.3	1.4	1.3	1.1	1.3	1.2	16%
0.8-1	1	1	1.1	1	1	1.1	1	55%
1-1.2	1.1	1	1	1	1.4	1	1	21%
1.2-1.4	1.4	1.4	1.3	1.3	2.2	1.3	1.4	3%
1.4-1.6	1.8	2.1	1.8	2.1	4	2	2.5	1%

Females (VMR: 0.57 TO 0.82 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.5-0.6	1.2	1.5	1.3	1.2	1.2	1.1	1.2	13%
0.6-0.7	1	1.1	1	1	1	1	1	33%
0.7-0.8	1	1	1	1	1.1	1	1	32%
0.8-0.9	1.1	1.1	1	1	1.4	1	1	15%
0.9-1	1.2	1.3	1.2	1.2	1.9	1.1	1.2	5%
1-1.2	1.7	1.9	1.7	1.5	3.7	1.6	2	3%

Cystatin C (mg/L)

Males (VMR: 0.66 to 0.96 mg/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.7-0.8	1	1	1	1	1	1.3	1	14%
0.8-0.9	1	1	1.2	1.1	1.1	1.1	1	30%
0.9-1	1.2	1.2	1.5	1.3	1.4	1	1.1	29%
1-1.1	1.4	1.5	1.9	1.4	1.9	1.1	1.3	16%
1.1-1.2	1.6	1.9	2.4	1.8	2.6	1.3	1.7	6%
1.2-1.7	1.9	2.4	3.2	2.4	4.6	1.9	2.6	5%

Females (VMR: 0.6 to 0.79 mg/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.6-0.8	1	1	1	1	1	1.1	1	32%
0.8-0.9	1.1	1.3	1.3	1.2	1.2	1	1.1	31%
0.9-1	1.3	1.8	1.8	1.5	1.6	1.2	1.3	21%
1-1.1	1.6	2.5	2.4	1.9	2.4	1.3	1.6	10%
1.1-1.2	2	3.2	2.9	2.3	3.2	1.3	2	4%
1.2-1.5	2.6	4.3	4	2.8	6.7	2.1	3.2	3%

Urate (mg/dL)

Males (VMR: 4.7 to 6.4 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
3-4	1.1	1.3	1.5	1.4	1.3	1.6	1.4	4%
4-5	1	1	1.1	1	1	1.2	1.1	18%
5-7	1	1	1	1.2	1.1	1	1	60%
7-8	1.1	1.5	1.2	1.6	1.5	1	1.1	13%
8-9	1.3	1.9	1.4	2	2.2	1.2	1.4	4%
9-10	1.5	2.6	1.8	3.1	3.5	1.6	2.2	1%

Females (VMR: 2.8 to 4.6 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
2-3	1.1	1	1	1	1	1.3	1.1	6%
3-5	1	1.4	1	1.4	1	1	1	64%
5-6	1.2	3	1.1	2.1	1.4	1	1.1	21%
6-7	1.4	5.3	1.4	2.9	2.2	1	1.3	7%
7-8	1.8	7.2	1.7	4	3.3	1.1	1.9	2%
8-8	2.2	9.8	2.1	5.4	5.7	1.7	2.8	0.7%

Urea (mg/dL)

Males (VMR: 11.5 to 19.1 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
7-10	1.3	1.3	2.8	2.3	1.6	2	2.2	4%
10-12	1.1	1.1	1.6	1.1	1.1	1.4	1.3	11%
12-15	1	1	1.1	1	1	1.1	1	32%
15-20	1.1	1	1	1	1.1	1	1	42%
20-24	1.2	1.1	1.1	1	1.5	1.2	1.1	9%
24-30	1.6	1.6	1.5	1.5	2.9	1.5	1.9	3%

Females (VMR: 11 to 18.6 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
7-10	1.2	1.2	1.6	1.3	1.4	1.7	1.5	8%
10-12	1.1	1.1	1.2	1	1.1	1.3	1.2	16%
12-15	1	1	1	1	1	1.1	1	35%
15-20	1	1.1	1	1	1.2	1	1	34%
20-24	1.2	1.4	1.2	1.2	1.7	1	1.1	6%
24-27	1.7	2.1	1.6	1.8	3.9	1.7	2.2	2%

Hemoglobin A1C (HbA1c)

Males (VMR: 4.5 to 5.4%)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
4.4-4.8	1	1	1	1.2	1.1	1.1	1.2	5%
4.8-5.4	1.1	1.6	1.2	1	1	1	1	48%
5.4-5.7	1.3	4.1	1.7	1.1	1.2	1	1.2	26%
5.7-6	1.5	11.5	2.3	1.4	1.5	1.2	1.4	11%
6-6.3	1.5	29.7	2.7	1.8	1.9	1.6	1.7	4%
6.3-7	2	48.9	2.5	2.2	2.5	1.9	1.9	3%
7-9.3	2.5	55.5	2.7	2.6	3.4	2.5	2.4	3%

Females (VMR: 4.7 TO 5.6%)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
4.4-4.8	1	1	1	1.1	1.4	1.3	1.2	5%
4.8-5.4	1	1.2	1	1	1	1.1	1	50%
5.4-5.7	1.1	3	1.3	1.2	1.1	1	1	28%
5.7-6	1.2	9.4	1.7	1.4	1.5	1.1	1.3	11%
6-6.3	1.5	29.1	2.2	1.9	2	1.2	1.6	3%
6.3-7	1.8	63.2	2.2	2.8	3.2	2.1	1.9	2%
7-8.4	3	73.8	2.2	3.2	4.8	2.5	2.4	2%

Testosterone (ng/dL)

Males (VMR: 311 to 585 ng/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
113-180	1.3	4.5	1.6	1.7	1.9	1.5	1.6	4%
180-250	1	3.2	1.2	1.4	1.5	1.1	1.2	14%
250-300	1.1	2.3	1	1.1	1.2	1.1	1.1	18%
300-400	1	1.6	1	1	1.1	1	1	37%
400-500	1	1.2	1.1	1	1	1	1	19%
500-699	1	1	1.2	1.3	1.1	1.1	1.2	8%

Females (VMR: 10 to 50 ng/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
10-12	1.2	1	1.2	1	1.1	1.2	1.1	3%
12-20	1	1	1	1.1	1	1	1	20%
20-40	1	1	1	1.1	1	1	1	53%
40-60	1.1	1.2	1	1.2	1.1	1	1.1	19%
60-105	1.2	1.5	1.2	1.6	1.3	1.2	1.3	5%

Sex Hormone Binding Globulin (SHBG) (nmol/L)

Males (VMR: 34 to 72 nmol/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
11-20	1.2	4.4	1	1.6	1.6	1.4	1.2	8%
20-30	1.1	2.6	1	1.2	1.3	1.1	1	23%
30-40	1.1	1.9	1	1	1.1	1	1	27%
40-60	1	1.4	1.1	1	1	1.2	1	32%
60-80	1	1	1.2	1.2	1	1.3	1.2	8%
80-103	1.1	1.2	1.7	2.2	1.3	1.6	1.6	2%

Females (VMR: 47 to 141 nmol/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
13-20	1.5	13.6	1.5	3.2	2.2	1.4	1.4	3%
20-30	1.4	8.3	1.2	2.4	1.6	1.1	1.1	9%
30-40	1.2	5	1.1	1.8	1.4	1	1.1	14%
40-60	1.1	2.4	1	1.4	1.1	1	1	30%
60-80	1	1.3	1	1.1	1	1.1	1	22%
80-120	1	1	1.1	1	1	1.1	1.1	18%
120-188	1.1	1.2	1.3	1.3	1.3	1.4	1.3	5%

Insulin-Like Growth Factor 1 (IGF)-1 (ng/mL)

Males (VMR: 135 to 241 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
67-85	1.2	3.2	2.2	5.7	2.3	1.7	2.2	2%
85-100	1.2	2.1	1.8	2.7	1.6	1.3	1.5	3%
100-120	1.1	1.6	1.6	1.8	1.3	1	1.2	8%
120-150	1	1.2	1.3	1.3	1.1	1	1	22%
150-250	1	1	1	1	1	1	1	63%
250-298	1.3	1.3	1.1	1.1	1.5	1.6	1.4	3%

Females (VMR: 139 to 246 mg/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
65-85	1.5	2.6	2	3	2.2	1.4	1.6	3%
85-100	1.4	1.8	1.7	2	1.6	1.2	1.3	5%
100-120	1	1.5	1.3	1.5	1.2	1	1.1	11%
120-150	1	1.2	1.2	1.3	1.1	1	1	24%
150-250	1	1	1	1	1	1	1	55%
250-299	1.2	1.2	1	1	1.6	1.5	1.6	3%

Vitamin D (ng/mL)

Males (VMR: 17.7 to 45.6 ng/mL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
5-8	1.6	3.9	2.1	2.1	1.8	1.7	2	7%
8-12	1.4	2.9	1.5	1.6	1.5	1.5	1.5	14%
12-20	1.3	2.3	1.2	1.4	1.2	1.2	1.2	34%
20-30	1.2	1.7	1	1.1	1	1	1	33%
30-40	1.2	1.4	1	1	1	1.1	1	10%
40-46	1	1	1.2	1.2	1.1	1.2	1	1%

Females (VMR: 17.4 to 44.8 ng/mL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
5-8	1.7	4.6	2	1.9	2.2	1.6	1.9	7%
8-12	1.3	3.3	1.5	1.6	1.6	1.4	1.4	14%
12-20	1.2	2.4	1.2	1.3	1.2	1.1	1.2	34%
20-30	1.1	1.7	1	1.1	1	1	1	34%
30-40	1	1.3	1.1	1.1	1.1	1.1	1	10%
40-45	1	1	1.3	1	1.4	1.1	1.2	1%

C-Reactive Protein (CRP) (mg/L)

Males (VMR: 0.43 to 1.27 mg/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.1-0.5	1	1	1	1	1	1.5	1	17%
0.5-1	1.2	1.4	1.4	1.5	1.2	1	1	24%
1-1.7	1.3	1.8	1.8	1.8	1.3	1	1.1	21%
1.7-3	1.4	2.2	2.4	2.2	1.6	1	1.3	19%
3-6	1.6	2.9	3.2	2.8	2	1.2	1.7	13%
6-29.7	1.8	3.1	4.1	3.1	2.4	1.3	2.2	8%

Females (VMR: 0.42 to 1.27 mg/L)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0.1-0.5	1	1	1	1	1	1.5	1	18%
0.5-1	1.1	1.5	1.2	1.3	1.2	1.1	1	21%
1-1.7	1.2	2.2	1.6	1.8	1.4	1	1.1	18%
1.7-3	1.4	3.4	2	2.4	1.9	1	1.2	18%
3-6	1.7	5.1	2.6	3	2.4	1.1	1.5	15%
6-27.6	2	7.7	3.4	4.1	3.5	1.3	2	10%

Hemoglobin (g/dL)

Males (VMR: 13.8 to 15.8 g/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
11.7-12.5	1.5	1.8	2	2.1	2.9	2.4	2.6	2%
12.5-13	1.2	1.5	1.4	1.6	2.2	1.9	1.9	2%
13-14	1	1.1	1.2	1.1	1.4	1.4	1.3	12%
14-15.5	1	1	1	1	1	1	1	55%
15.5-17	1.2	1.2	1.1	1.2	1	1	1	28%
17-17.6	1.3	1.7	1.7	1.9	1.4	1.1	1.4	2%

Females (VMR: 12.5 to 14.4 g/dL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
10.3-11.5	1.7	2	1.8	1.4	3.2	1.9	2.5	3%
11.5-12	1.3	1.4	1.4	1.2	2	1.7	1.6	3%
12-13	1	1	1	1	1.3	1.2	1.1	23%
13-14.5	1	1	1.1	1.1	1	1	1	58%
14.5-15.5	1.2	1.5	1.5	1.4	1.1	1.1	1.2	12%
15.5-15.9	1.6	2.4	2.7	2	1.7	1.1	1.7	1%

Red Blood Cell Count (RBC) (million/mcL)

Males (VMR: 4.4 to 5 x 1000 cells/uL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
3.6-4	1.3	1.3	1.8	2.2	2.4	2.1	2.4	3%
4-4.5	1	1	1.2	1.2	1.3	1.4	1.3	22%
4.5-5	1	1.1	1	1	1	1	1	52%
5-5.5	1.1	1.4	1	1.1	1	1	1	21%
5.5-5.8	1.2	2	1.3	1.5	1.3	1.1	1.3	2%

Females (VMR: 3.9 to 4.4 x 1000 cells/uL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
3.4-3.7	1.3	1.5	1.6	1.4	2.2	1.6	2	3%
3.7-4	1.1	1	1.1	1	1.3	1.3	1.2	13%
4-4.5	1	1.4	1	1.1	1	1	1	56%
4.5-5	1.1	2.2	1.2	1.3	1	1	1	26%
5-5.3	1.5	3.8	1.6	1.7	1.4	1	1.3	2%

Mean Corpuscular Volume (MCV) (fL)

Males (VMR: 88 to 95.6 fL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
77-83	1.3	2	1.4	1.4	1.6	1.4	1.5	3%
83-90	1	1.3	1	1.1	1.1	1	1	33%
90-95	1	1	1.1	1	1	1	1	46%
95-100	1.1	1	1.5	1.5	1.2	1.2	1.2	16%
100-104	1.2	1.1	2.4	3.2	1.8	2	2.3	3%

Females (VMR: 89.4 to 96.7 fL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
73-83	1.2	3.3	1.2	1.6	1.8	1.4	1.4	4%
83-90	1.1	1.7	1	1.1	1.1	1	1	35%
90-95	1	1.1	1.1	1	1	1	1	45%
95-100	1.1	1	1.6	1.1	1.2	1.2	1.3	14%
100-103	1.5	1.3	2.6	2.2	2.2	1.8	2.4	2%

Red Blood Cell Distribution Width (RDW)

Males (VMR: 11.94 to 13.74%)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
11.9-13	1	1	1	1	1	1	1	31%
13-13.5	1.1	1	1.2	1	1.1	1	1.1	30%
13.5-14	1.2	1.1	1.4	1.1	1.2	1	1.3	21%
14-14.5	1.2	1.2	1.8	1.3	1.5	1.1	1.5	10%
14.5-15	1.4	1.4	2.1	1.6	1.9	1.4	1.8	4%
15-17.6	1.5	1.6	2.6	2.2	2.5	1.7	2.6	4%

Females (VMR: 11.87 TO 13.58%)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
11.9-13	1	1	1	1	1	1.1	1	31%
13-13.5	1	1.1	1.2	1	1.1	1	1.1	27%
13.5-14	1.1	1.2	1.4	1.2	1.2	1	1.2	20%
14-14.5	1.2	1.5	1.7	1.3	1.5	1.1	1.4	11%
14.5-15	1.5	1.9	2	1.4	2	1.1	1.6	5%
15-18.8	1.6	2.4	2.4	1.8	2.8	1.7	2.5	6%

White Blood Cell Count (WBC) (/µl)

Males (VMR: 3.7 to 6.4 x 1000 cells/uL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
3.4-4	1	1	1	1	1.2	1.4	1.3	2%
4-6	1.1	1.1	1.1	1	1	1	1	32%
6-8	1.3	1.8	1.8	1.2	1.2	1.2	1.2	44%
8-9.5	1.5	2.5	2.9	1.5	1.6	1.3	1.5	15%
9.5-11	1.8	3.2	4.2	1.8	2	1.5	2	5%
11-13.4	2	3.3	5.9	2	2.4	1.6	2.5	3%

Females (VMR: 3.4 to 6.1 x 1000 cells/uL)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
3.4-4	1	1	1	1	1.1	1	1.3	3%
4-6	1.1	1.2	1.2	1.1	1	1	1	32%
6-8	1.3	2.1	2	1.3	1.3	1.2	1.1	43%
8-9.5	1.6	3.6	3.3	1.7	1.8	1.3	1.4	15%
9.5-11	1.9	4.9	4.9	2.1	2.4	1.4	1.9	5%
11-13	2.8	6.8	7.8	2.3	3.4	1.9	2.8	2%

Smoke Pack Years (years)[4]

Males (VMR: 0 to 15 pack years)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0-10	1	1	1	1	1	1.1	1	61%
10-20	1.1	1.2	2.3	1.2	1.1	1	1.2	13%
20-30	1.2	1.5	4	1.6	1.4	1.3	1.6	10%
30-40	1.5	1.7	6.1	1.7	1.7	1.4	1.8	7%
40-99	1.6	2.1	8.8	2	2.1	1.8	2.5	10%

Females (VMR: 0 to 9 pack years)

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
0-10	1	1	1	1	1	1	1	74%
10-20	1.3	1.1	3.1	1.4	1.3	1	1.4	10%
20-30	1.5	1.4	5.6	1.7	1.8	1.2	1.8	7%
30-40	2	1.8	8.6	1.9	2.2	1.5	2.3	5%
40-67	2.2	2.2	11.6	2.2	2.8	2	3.2	4%

4 Smoke Pack Years refers to the number of years a person has smoked if they smoked one pack of cigarettes each day for a year.

Predictive Strength Values

This section includes all biomarker predictive strength values for each disease.

	Cardiac (MACE)	Metabolic (T2D)	Lung (COPD)	Liver	Kidney	Cognitive (Dementia)	All Cause Mortality
Smoking History	9	3	10	4	5	9	10
BMI	8	9	3	6	7	5	6
Diastolic	5	2	1	2	1	3	1
Systolic	7	2	1	1	2	1	1
Grip Strength	5	2	2	2	4	10	5
Resting Heart Rate	4	3	2	3	3	3	5
HDL	8	7	2	4	5	6	5
LDL	5	1	1	1	3	5	3
Triglycerides	6	5	1	4	2	3	2
Apolipoprotein B	6	1	1	1	2	4	2
Lipoprotein (a)	3	1	0	1	0	1	1
Albumin	5	1	2	2	3	3	5
ALP	5	2	2	5	3	4	5
ALT	2	5	1	8	2	3	3
AST	3	3	1	9	3	4	4
GGT	5	5	2	10	4	4	5
Bilirubin (Total)	3	1	2	1	2	2	3
Protein (Total)	2	1	1	2	2	2	3
Calcium	2	1	1	1	1	3	2
Creatinine	5	2	2	3	7	6	6
Cystatin C	10	4	3	4	10	8	9
Urate	5	5	1	4	6	4	5
Urea	5	1	2	3	6	7	6
Glucose	7	6	1	3	5	8	5
HbA1C	10	10	3	4	7	9	6
Testosterone	2	3	1	2	2	3	3
SHBG	3	6	1	4	3	3	3
IGF-1	4	3	2	6	3	5	4
Vitamin D	5	3	2	3	3	6	5
CRP	8	5	4	5	5	6	6
Red Blood cell count	3	3	1	2	4	6	6
Hemoglobin	5	2	2	2	5	7	6
Hematocrit	4	2	2	2	4	6	5
MCV	3	2	2	3	3	5	5
MCH	3	2	2	3	3	5	5
MCHC	1	0	1	1	2	3	2
RDW	5	2	2	2	5	5	7
White blood cell count	8	4	5	3	4	4	6

Our Findings

1. Frequently monitored biomarkers are not top predictors for cardiac disease in our analysis.

These four common biomarkers are routinely monitored by physicians. However, they did not emerge from our models as top predictors for Major Adverse Cardiac Event (MACE) for neither males nor females.

Biomarker	Strength	VMR (Male)	VMR (Female)
Systolic*	7	100 to 142 mmHg	87 to 126 mmHg
Triglycerides	6	67 to 165 mg/dL	47 to 120mg/dL
Diastolic*	5	64 to 83 mmHg	50 to 77 mmHg
LDL*	5	110 to 166 mg/dL	110 to 178 mg/dL

*Individuals are removed from our analysis if they report taking medications intended to directly modify the biomarker, including statins for cholesterol, or anti-hypertensives for blood pressure.

For comparison, below are the most predictive biomarkers in our model inputs for MACE:

Biomarker	Strength	VMR (Male)	VMR (Female)
Cystatin C	10	.66 to .96 mg/L	.6 to .79 mg/L
HbA1C	10	4.5 to 5.4%	4.7 to 5.6%
Smoking History	9	0 to 15 pack years	0 to 9 pack years
HDL	8	49 to 78mg/dL	63 to 108 mg/dL

2. Cystatin C is one of the most predictive markers for several diseases.

Cystatin C is a protein found in the blood measuring kidney function. It is not commonly monitored[5]. However, our models found Cystatin C in the top predictive biomarkers for every disease analyzed.

Below are the six diseases where Cystatin C was a top predictor, ordered by strength of association. The "Rank" column shows where on the list Cystatin C ranks in comparison to the other biomarkers.

Disease	Strength	Rank
Kidney	10	1
Cardiac (MACE)	10	1
All Cause Mortality	9	2
Cognitive (Dementia)	8	5
Liver	4	11
Lung (COPD)	3	4

[5] Cleveland Clinic. 2022. "Blood Tests: Types, Results & How They Work." Cleveland Clinic. December 6, 2022. https://my.clevelandclinic.org/health/diagnostics/24508-blood-tests.

3. Lipoprotein(a) is not predictive of any major diseases on our list.

Lipoprotein(a) did not emerge as a top predictor for any disease on our list - despite being heavily monitored and a recommended test by physicians. In fact, our models found it to be especially unpredictive of all diseases, as shown in the table of risk multipliers below. Only cardiac (MACE) had an association with the highest values of Lipoprotein (a) but was modest in comparison with the associations of other biomarkers.

Males

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality
4-10	1	1.2	1.1	1.2	1.1	1.1	1.1
10-20	1.1	1	1	1	1	1.1	1
20-40	1.1	1	1.1	1	1	1	1
40-80	1.1	1.2	1.1	1.2	1.1	1.1	1.1
80-150	1.3	1.1	1	1.1	1	1	1
150-186	1.4	1	1.2	1	1.1	1.1	1.1

Females

Range	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality
4-10	1	1.1	1.1	1.1	1.1	1	1.1
10-20	1	1	1	1	1	1	1
20-40	1.1	1	1	1	1	1	1
40-80	1.2	1.1	1	1	1	1.2	1
80-150	1.2	1.2	1	1.1	1	1	1
150-186	1.3	1.1	1.2	1.1	1.1	1.2	1.1

4. Quitting smoking leads to substantial risk reduction.

Smoking places enormous strains on the body in many ways including the impairment of cardiovascular and lung functions. It is never too late to quit using tobacco. The sooner a person quits smoking, the greater the individual reduction in cancer and other diseases.

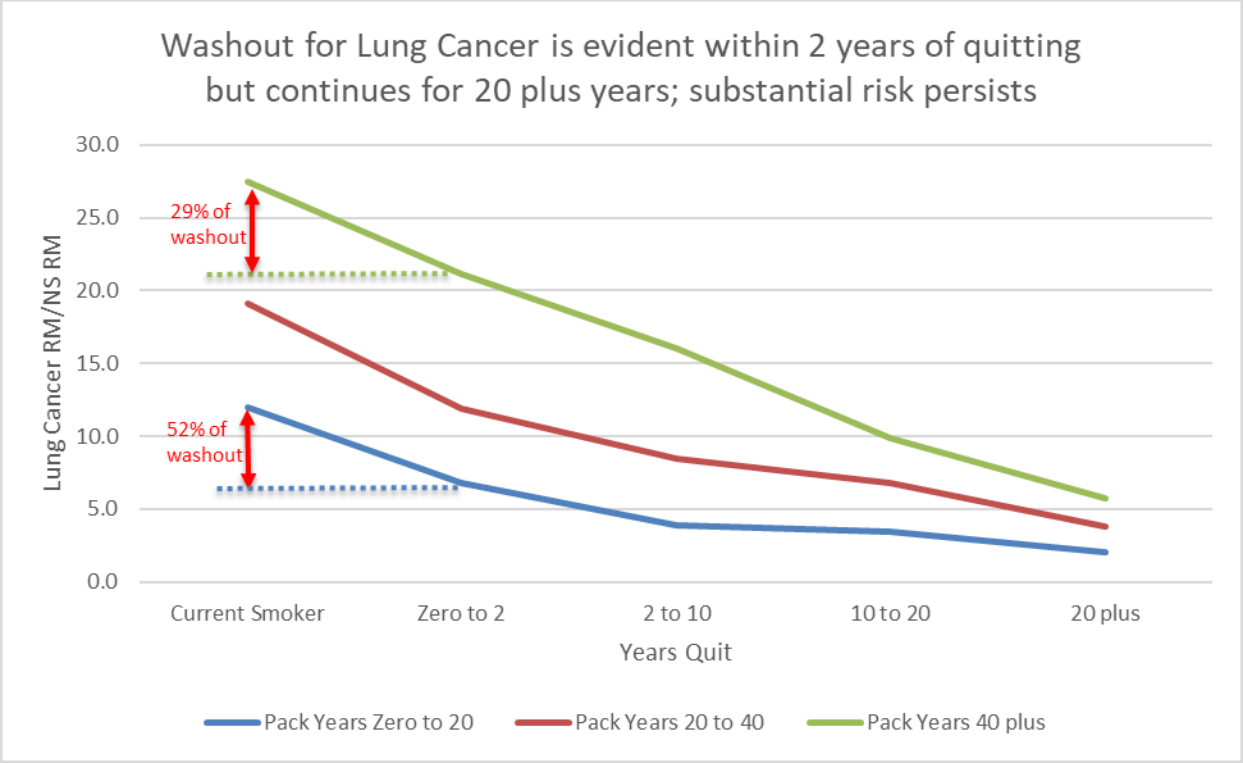
Our initial findings are consistent with the literature from the American Cancer Society *How to Quit Using Tobacco* report[6]. We found substantial improvements in COPD and lung cancer risks after two years of quitting despite the "smoke pack" history. Reductions in the first years were strong across both COPD and lung cancer. The more packs per year history, the more opportunity for risk multiplier improvements.

We found smokers who quit had risk multiplier improvements in COPD and lung cancer ranging from 23% to 51% in the first two years of quitting, and up to 83% reduction in the risk multiplier after 20 years. In comparison, the charts and graphs below show a non-smoker has a risk multiplier value of 0.27 for lung cancer and 0.38 for COPD.

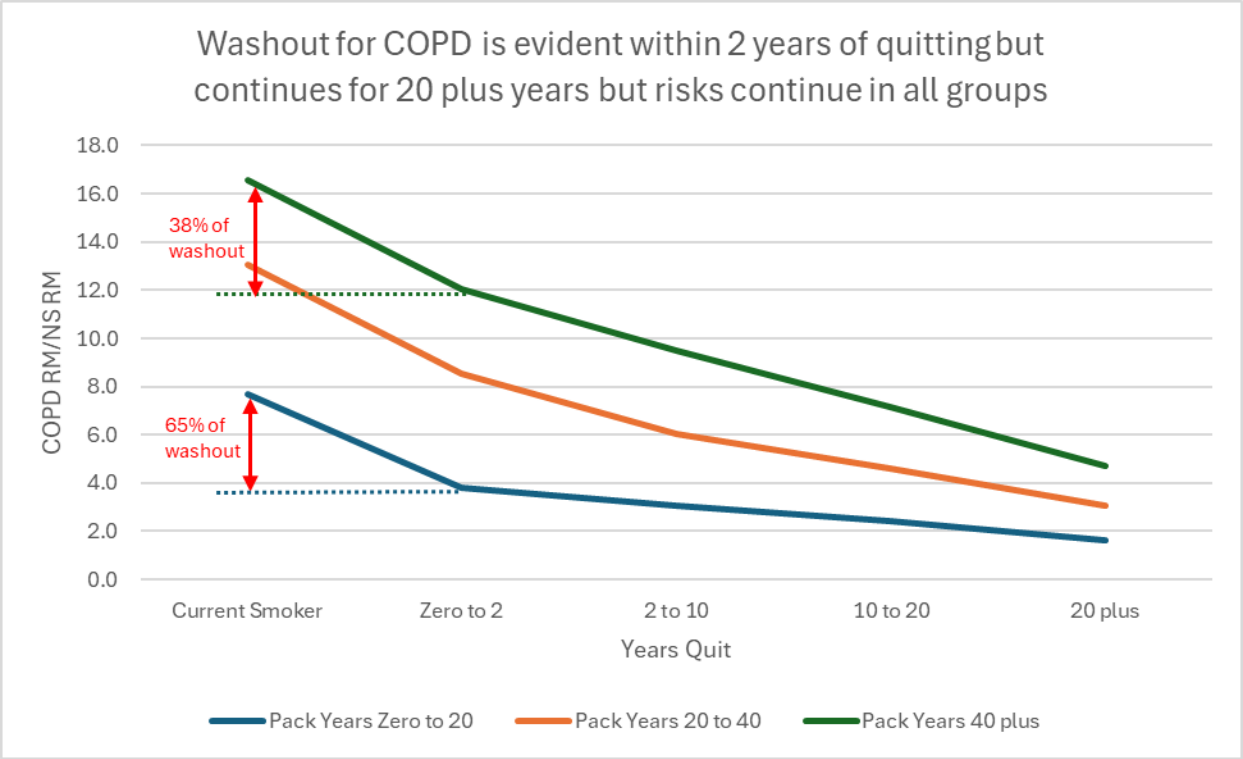
			Years Quit			
Lung Cancer Risk Multiplier/ Never Smoker Risk Multiplier		Current Smoker	Zero to 2	2 to 10	10 to 20	20 plus
Pack Years	Zero to 20	12.01	6.76	3.92	3.47	2.00
	20 to 40	19.11	11.86	8.50	6.76	3.81
	40 plus	27.46	21.14	16.00	9.91	5.77

			Years Quit			
COPD Risk Multiplier/ Never Smoker Risk Multiplier		Current Smoker	Zero to 2	2 to 10	10 to 20	20 plus
Pack Years	Zero to 20	7.70	3.79	3.05	2.45	1.63
	20 to 40	13.07	8.52	6.02	4.60	3.08
	40 plus	16.57	12.04	9.52	7.15	4.71

[6] www.cancer.org/content/dam/CRC/PDF/Public/9545.00.pdf



When comparing smokers to "never smokers" the early washout (resolution of the negative impacts of smoking) in the first two years is very strong for the lighter smoking history.



5. Nutraceuticals correlate with risk multipliers.

During the UK Biobank research we examined correlations of reported uses of several products. Our research is ongoing regarding these products and their impact on specific disease outcomes. Below are early results of correlations and risk multipliers for several products and the categories in this guide. We continue to refine this work and will report additional findings soon.

Nutraceuticals are the formulation of nutrients directed toward prevention and treatment of diseases (i.e. anemia, vitamin deficiencies), in addition to diet supplementation offering purported preventive health care choices for consumers. While the effects of many of these products on health and disease remain unclear, ongoing and future research will further shed light on their benefits and risks. Generally, nutraceuticals are not involved in clinical trials and approved by the FDA for statements related to improved health. For a comprehensive review please reference Nutrients, 2022 Nov 3;14(21):4637. https://www.mdpi.com/2072-6643/14/21/4637

Males

Biomarker	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
Vitamin C Supplement	0.99	0.9	0.95	1.01	0.95	0.95	0.96	9%
Multivitamins Supplement	0.94	0.87	0.87	1	0.88	0.9	0.89	18%
Calcium Supplement	1.05	0.98	1.17	1.09	1.13	1.19	1.2	3%
Fish Oil Supplement	0.94	0.85	0.81	0.89	0.81	0.85	0.81	30%
Glucosamine Supplement	0.89	0.77	0.71	0.83	0.74	0.84	0.72	16%
Selenium Supplement	0.88	0.77	0.73	0.89	0.84	0.83	0.86	2%
Zinc Supplement	0.92	0.89	0.83	0.89	0.87	0.82	0.87	3%
Garlic Supplement	0.89	0.71	0.76	0.72	0.65	0.85	0.74	2%

Females

Biomarker	Cardiac	Metabolic	Lung	Liver	Kidney	Cognitive	Mortality	Peer Distribution
Vitamin C Supplement	0.97	0.86	0.91	0.92	0.89	1.01	0.98	9%
Multivitamins Supplement	0.98	0.85	0.86	0.92	0.92	1	0.92	25%
Calcium Supplement	0.89	0.75	0.98	0.92	0.93	1.05	0.99	11%
Fish Oil Supplement	0.91	0.77	0.76	0.84	0.79	0.98	0.86	33%
Glucosamine Supplement	0.85	0.78	0.71	0.87	0.76	0.86	0.78	22%
Selenium Supplement	0.97	0.78	0.81	0.97	0.84	0.95	0.98	3%
Zinc Supplement	1.06	0.81	0.91	0.9	0.83	0.89	0.85	5%
Garlic Supplement	0.84	0.74	0.79	0.7	0.81	0.93	0.88	2%

This document is intended for educational and informational purposes only. It does not constitute medical advice, diagnosis, or treatment of any disease or condition, and should not be relied upon as a substitute for professional medical judgment.

Always consult with a qualified healthcare provider or physician before making any decisions related to your health, medical condition, or use of biomarker testing.

The information presented herein is based on current scientific knowledge and research at the time of publication. No guarantees are made regarding the accuracy, completeness, or applicability of the content to individual circumstances.

Use of this document does not establish a doctor-patient relationship. Any reliance on the information is at your own risk.

Appendix A. Methods

Strength

The prediction strength metric is calculated by applying a non-linear (spline) correlation of each biomarker against a gender and age normalized dependent variable for each disease. The result of the normalization is a dependent variable with the form of a "risk multiplier" averaging a value of 1.0 for every age and gender combination. This is achieved by generating a set of weights using a bivariate tensor product spline fitting the relationship between age and each disease outcome for each gender. For each biomarker, we take the absolute value of the correlation, then average across men and women to create a gender-neutral metric. Next the value is divided by the maximum strength across all biomarkers, and then multiplied by 10, resulting in the final value for the metric where the strength is normalized for each individual disease outcome. The final presentation of the prediction strength metric is the result of sorting the individual biomarker averaged values, in descending order, and removing biomarkers redundant in the analysis based on similarity to others (e.g., ApoA, weight, Glucose, Cholesterol).

The normalization method discussed above avoids deceptive correlations with biomarkers correlating to outcomes simply because they correlate to age. Many of the outcomes also correlate highly with age.

VMR™ Values

The Voloridge Modeled Range™ or VMR™, is the range of values of a marker yielding the lowest overall 15-year association with the seven disease outcomes. This does not represent a risk category, nor should it be interpreted as a recommendation of any kind. It is simply representing associations in the UK Biobank database of 500,000 participants and between their biomarker values and their 15-year outcomes. To determine the VMR, we begin by fitting a univariate spline for each of the seven targets against a biomarker. The seven splines are averaged into one final curve with respect to the biomarker. We define the VMR as the biomarker values corresponding to a risk of no more than 20% above the minimum mean risk. Additional constraints ensure the optimal range does not raise the risk for any individual disease beyond the greater of 0.9 or 30% above each disease's minimum risk. We further restrict the range by placing limits at the top and bottom 1 percent of the biomarker distribution.

Population

The values in this report are calculated using data from the UK Biobank. While useful for its large amounts of data, the UK Biobank's generalizability to the greater population is limited due to selection biases. The data come from primarily white, male and female, and more

socioeconomically advantaged populations. However, research suggests the data may be generalizable to the larger population with regards to disease.[7]

In addition to biases inherent in the dataset, a common filter is applied to all disease models. This common filter limits the model inputs to a population between the ages of 40 to 70 containing data for height and weight and is observed in the dataset for at least 12 years. Participants who died within those 12 years are included. Additional filters are added to each disease model to exclude people with a prior diagnosis of each specific disease. For example, the Cardiac (MACE) model excludes anyone with prior MACE. Because the age bias for dementia is so strong, there is an extra filter which excludes people who died at any point without getting dementia. Additional age filters are placed on each disease to ensure the age distribution is balanced between genders for each disease target.

Age filters are applied for each disease. The database used had a uniform distribution of individuals aged 40 to 70. For some disease outcomes, (e.g. liver disease and metabolic, type 2 diabetes), this entire age range was utilized. For the remainder of the disease outcomes, a more limited age range was utilized as risk multipliers are not as clinically relevant on age groups with lower incidence of the disease. In our analysis for Cognitive (dementia), only 60- to 70-year-olds were included as this subgroup contained 86 percent of all cases in the database. For mortality, we analyzed 55- to 70-year-olds, as this age range included 87 percent of deaths in the database. For Cardiac (MACE), we analyzed 55- to 70-year-olds with no prior MACE, which included 82 percent of MACE events. Similarly, for Lung (COPD), we analyzed 50- to 70-year-olds with no prior COPD, which included 92 percent of measured Lung events. Finally, for kidney disease we analyzed 55- to 70-year-olds with no prior acute kidney disease, which included 86 percent of instances of the disease. For Metabolic (Type 2 diabetes), an additional filter requiring Hemoglobin A1C to be less than 6.0 was applied. This is due to the measure serving as the primary marker for diagnosis of the disease. This was done to avoid the inclusion of people who already had type 2 diabetes but were not yet diagnosed.

[7] Fry, Anna, Thomas J. Littlejohns, Cathie Sudlow, Nicola Doherty, Ligia Adamska, Tim Sprosen, Rory Collins, and Naomi E. Allen. "Comparison of sociodemographic and health-related characteristics of UK Biobank participants with those of the general population." American journal of epidemiology 186, no. 9 (2017): 1026-1034.

Appendix B. Biomarker Glossary

This glossary is intended to give short descriptions of each biomarker included in this guide. Additional research may be needed to fully understand their effects on your health.

A comprehensive definition for each test can be found at MedlinePlus: Medical Tests

Hemoglobin A1c (HbA1c) is an indirect indicator of your average blood sugar (glucose) level over the past two to three months. Glucose attaches to the hemoglobin protein on the red blood cells. The higher the HbA1c percentage, the more glucose attached to the hemoglobin. Elevated HbA1c levels are associated with metabolic syndrome, prediabetes, and diabetes. Because it is not as affected by occasional fluctuations in blood glucose, HbA1c can detect diabetes before a fasting blood glucose level can.

**Please be aware that HbA1c can be inaccurate for various medical conditions such as if a person is anemic or has factors influencing blood volume.

Alkaline Phosphatase (ALP) is an enzyme found in many parts of your body. Monitoring this biomarker helps diagnose diseases of the liver or bones and measure how well your liver is working. Each part of your body produces a different type of ALP. Most ALP is found in your liver, bones, kidneys, and digestive system. Abnormal levels of ALP in your blood may be a sign of a wide range of health conditions, including liver disease, bone disorders, and chronic kidney disease.

Alanine Transaminase (ALT) is an enzyme found mostly in the liver. An ALT test measures the amount of ALT in the blood. When liver cells are damaged, they release ALT into the bloodstream. High levels of ALT in your blood may be a sign of a liver injury or disease. Some types of liver disease cause high ALT levels before you have symptoms of the disease. Thus, ALT blood tests may help diagnose certain liver diseases early.

Aspartate Aminotransferase (AST) Aspartate Aminotransferase (AST) is an enzyme found mostly in the liver but also found in muscles and other organs in your body. When cells containing AST are damaged, they release the AST into your blood. An AST blood test measures the amount of AST in your blood. The test is commonly used to help diagnose liver damage or disease.

Body Mass Index (BMI) is quick calculation using a person's height and weight to estimate if they are within a healthy weight range. It does not directly measure body fat but gives an idea of whether someone might be underweight, normal weight, overweight, or obese.

C-Reactive Protein (CRP) is a protein your liver makes. Normally, you have low levels of CRP in your blood. Your liver releases more CRP into your bloodstream if you have inflammation in your body. High levels of CRP may mean you have a serious health condition causing inflammation. Inflammation is your body's way of protecting your tissues and helping them heal from an injury, infection, or other disease. If inflammation lasts too long, it can damage healthy tissues. This is called chronic (long-term) inflammation. Chronic infections, certain autoimmune disorders, and

other diseases can cause harmful chronic inflammation. Chronic inflammation also occurs if your tissues are repeatedly injured or irritated, for example from smoking or chemicals in the environment.

Creatinine is a normal waste product in your body. It's made when you use your muscles and some of the muscle tissue breaks down. Normally, your kidneys filter creatinine from your blood and remove it from your body in your urine. If there is a problem with your kidneys, creatinine can build up in your blood and less may be released in urine. If blood and/or urine creatinine levels are not normal, it may be a sign of kidney disease.

Cystatin C is protein found in the blood that helps measure kidney function. It is produced at a steady rate by most cells in the body and then filtered out by the kidneys. By measuring how much cystatin C is in the blood, clinicians can estimate how well the kidneys are working. When kidney function is good, cystatin C levels are low because the kidneys filter it out efficiently. High levels can suggest the kidneys are not filtering well, which may indicate kidney disease. Cystatin C is especially useful because it is less affected by factors like muscle mass, potentially making it a more accurate measure of kidney health than other tests, like creatinine.

Gamma-Glutamyl Transferase (GGT) is an enzyme found throughout your body, but it is mainly found in your liver. Enzymes are proteins that speed up certain chemical reactions in your body. Thousands of enzymes play an important role in all of your body functions. If your liver or bile duct is damaged, GGT may leak into your bloodstream. High levels of GGT in your blood may be a sign of liver disease or damage to the bile ducts. Bile ducts are tubes carrying bile in and out of the liver. Bile is an important fluid for digestion made by the liver. While GGT can't diagnose the specific cause of liver disease, levels that are out of range can indicate your liver is being damaged.

Grip Strength is a simple measure of how much force you generate when you squeeze with your hand. It is tested by squeezing a device called a dynamometer, which records the strength of your grip. This measurement is not just about hand strength; it is also a quick indicator of overall muscle strength and health. Studies show lower grip strength often is linked to a higher risk of certain health issues, like heart disease or mobility problems, especially in older adults. Tracking grip strength helps clinicians assess muscle health, recovery progress, or the risk of future health conditions.

HDL Cholesterol (high-density lipoprotein) is often called the "good" cholesterol because it helps remove other forms of cholesterol from the bloodstream. HDL transports excess cholesterol (a waxy, fat-like substance found in your blood) from the arteries back to the liver, where it is processed and eliminated from the body, reducing the risk of cholesterol buildup which can lead to heart disease or stroke. The ideal HDL levels vary by age and gender.

Hemoglobin is an iron-rich protein in your red blood cells. It carries oxygen from your lungs to the rest of your body. Your cells need oxygen to grow, reproduce, and make energy for you to function. Your hemoglobin levels provide information about the health of your red blood cells. If

your hemoglobin levels are abnormal, it may be a sign that you have a blood disorder, often referred to as anemia.

IGF-1 (insulin-like growth factor 1) is a hormone, a chemical messenger in your bloodstream controlling the actions of certain cells or organs. IGF-1 manages the effects of growth hormone (GH) in your body. Together, IGF-1 and GH promote normal growth of bones and tissues. GH levels in the blood change throughout the day, depending on your diet and activity levels, while IGF-1 levels are more stable. A reliable way to track GH in your body is by measuring the level of IGF-1 in the blood. Levels of IGF-1 and GH change throughout your life. Besides growth, GH also helps control your metabolism, which is the process your body uses to make energy from the food you eat. Some conditions, such as pituitary tumors, can cause your body to produce too much or too little GH.

LDL Cholesterol (low-density lipoprotein), LDL Cholesterol (low-density lipoprotein) carries cholesterol made by the liver through the bloodstream to other parts of the body where it is needed for healthy cell function and hormone production.

LDL-ApoB Ratio (LAR) compares levels of low-density lipoprotein cholesterol (LDL) with Apolipoprotein B (ApoB), the main protein in LDL particles. This ratio provides additional information on cardiovascular risk by assessing both the cholesterol content and the number of LDL particles, as each ApoB represents an LDL particle. A lower LAR may indicate smaller, denser LDL particles, which are associated with a higher risk of cardiovascular disease.

Lipoprotein (a) is a type of LDL (low-density lipoprotein). Lipoproteins are particles made of protein and fats (lipids). They carry cholesterol through your bloodstream to your cells. These lipoproteins carry cholesterol to the cells in your arteries.

Mean Corpuscular Volume (MCV) is part of a complete blood count (CBC). A CBC is a common blood test measuring many parts of your blood, including red blood cells. An MCV blood test measures the average size of your red blood cells. Red blood cells carry oxygen from your lungs to every cell in your body. Your cells need oxygen to grow, reproduce, and stay healthy. If your red blood cells are too small or too large, it could be a sign of a blood disorder such as anemia, a lack of certain vitamins, or other medical conditions.

Pulse Rate (or resting heart rate) measures the number of times your heart beats per minute at rest. It provides information on heart health and can vary with activity, stress, and health conditions. Resting heart rate gives insights into cardiovascular fitness and overall health, with lower rates often indicating better fitness and higher rates suggesting potential stress, dehydration, or heart conditions. Sudden changes also may signal early health issues like infection or thyroid changes.

Red Blood Cell Count (RBC) measures the number of red blood cells, also known as erythrocytes, in your blood. Red blood cells are made in your bone marrow, the spongy tissue inside your large bones. They contain hemoglobin, an iron-rich protein that carries oxygen from your lungs to every cell in your body. Your cells need oxygen to grow, reproduce, and make energy for you to function. An RBC count higher or lower than normal is often the first sign of an illness.

Red Blood Cell Distribution Width (RDW) is a measurement of the variation in the volume and size of your red blood cells (erythrocytes). Red blood cells are made in your bone marrow (the spongy tissue inside your large bones). They contain hemoglobin, an iron-rich protein that carries oxygen from your lungs to every cell in your body. Your cells need oxygen to grow, reproduce, and make energy for you to function. Normally, your red blood cells are about the same size. Differences in the size of your red blood cells may affect how well they can deliver oxygen through your body. An RDW test uses a special graph called a histogram. If your red blood cells are about the same size, they will be close together on the histogram, and the RDW will be low. A high RDW means the size of your red blood cells varies more than it should. The sizes will be more spread out on the histogram. This may be a sign of a medical condition.

SHBG (sex hormone binding globulin) is a protein made mostly in your liver. It binds (attaches) to sex hormones in your blood. SHBG helps control the amount of sex hormones actively working in your body. When the SHBG protein binds to sex hormones, your tissues can't use those hormones. Your tissues can only use sex hormones that are "free," which means they aren't attached to proteins, such as SHBG. An SHBG test is usually done if you have signs and/or symptoms of having too much or too little of the sex hormone testosterone.

Smoke Pack Years is a measure of smoking exposure calculated by multiplying the number of cigarette packs smoked per day by the number of years the person has smoked. It's a common way to assess the long-term impact of smoking on health, particularly in studies related to lung disease.

Systolic Blood Pressure is the top number in a blood pressure reading. It indicates the pressure in the arteries when the heart beats. Each time your heart beats, it pumps blood into your arteries (the blood vessels that carry blood from your heart to the tissues and organs in your body). A blood pressure measurement is a test measuring the force (pressure) in your arteries as your heart pumps. Blood pressure is measured as two numbers: systolic and diastolic blood pressure.

Testosterone is known as a "male" sex hormone, but females have testosterone in smaller amounts. Testosterone is made by the testicles (or testes), the part of the male reproductive system that makes sperm; the ovaries, the part of the female reproductive system that makes eggs; the adrenal glands, organs on top of each kidney that make several hormones.

Triglycerides is the amount of a fat in your blood called triglycerides. High triglycerides may increase your risk for a heart attack or stroke. Your body uses triglycerides for energy. If you eat more calories than you need, your body turns the extra calories into triglycerides and stores them in your fat cells to use later. When your body needs energy, your cells release triglycerides into your bloodstream to provide fuel for your muscles to work.

Urate (also known as Uric Acid) is a normal waste product your body makes when it breaks down chemicals called purines. Purines come from your cells when they die. Purines also are found in many foods and beverages. Most uric acid dissolves in your blood. Your kidneys filter the uric acid out of your blood, and it leaves your body in your urine. If uric acid builds up in your blood, it can form needle-shaped crystals in and around your joints. This condition is called gout. Gout is

a type of arthritis causing painful swelling in your joints. High uric acid levels also can cause kidney stones, or kidney failure. However, not everyone with high levels of uric acid will have these problems.

Urea is a waste product created when the liver breaks down proteins, and it is filtered by the kidneys and excreted in urine. Urea levels help indicate kidney and liver function, and abnormal results may signal health concerns in these areas.

Vitamin D is essential for healthy bones and teeth, and for your body to work well. It also helps keep your muscles, nerves, and immune system working normally. Having low levels of vitamin D is a common problem that can lead to bone disorders and other medical problems. Vitamin D testing can let you know if you need to increase your vitamin D levels. You get vitamin D in three ways. Your body makes vitamin D when your bare skin is exposed to sunlight. Only a few foods, such as egg yolks and fatty fish, naturally contain vitamin D. You can take vitamin D supplements.

White Blood Cell (WBC) Count (also called leukocytes) is a measurement of your white blood cells, which are part of your immune system. They are a type of blood cell made in your bone marrow and found in your blood and lymph tissue (part of your immune system). WBCs help your body fight off infections and other diseases.

Appendix C. About the Organizations

About Voloridge Health, LLC

Voloridge Health, LLC develops advanced tools to provide predictive and personalized insights that empower individuals and organizations with data-driven clarity, enabling longer, healthier lives. To learn more visit www.voloridgehealth.com.

About VoLo Foundation

VoLo Foundation is a private family organization that exists to accelerate change and global impact by supporting science-based climate solutions, enhancing education, and improving health. Find out more at www.VoLoFoundation.org.

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