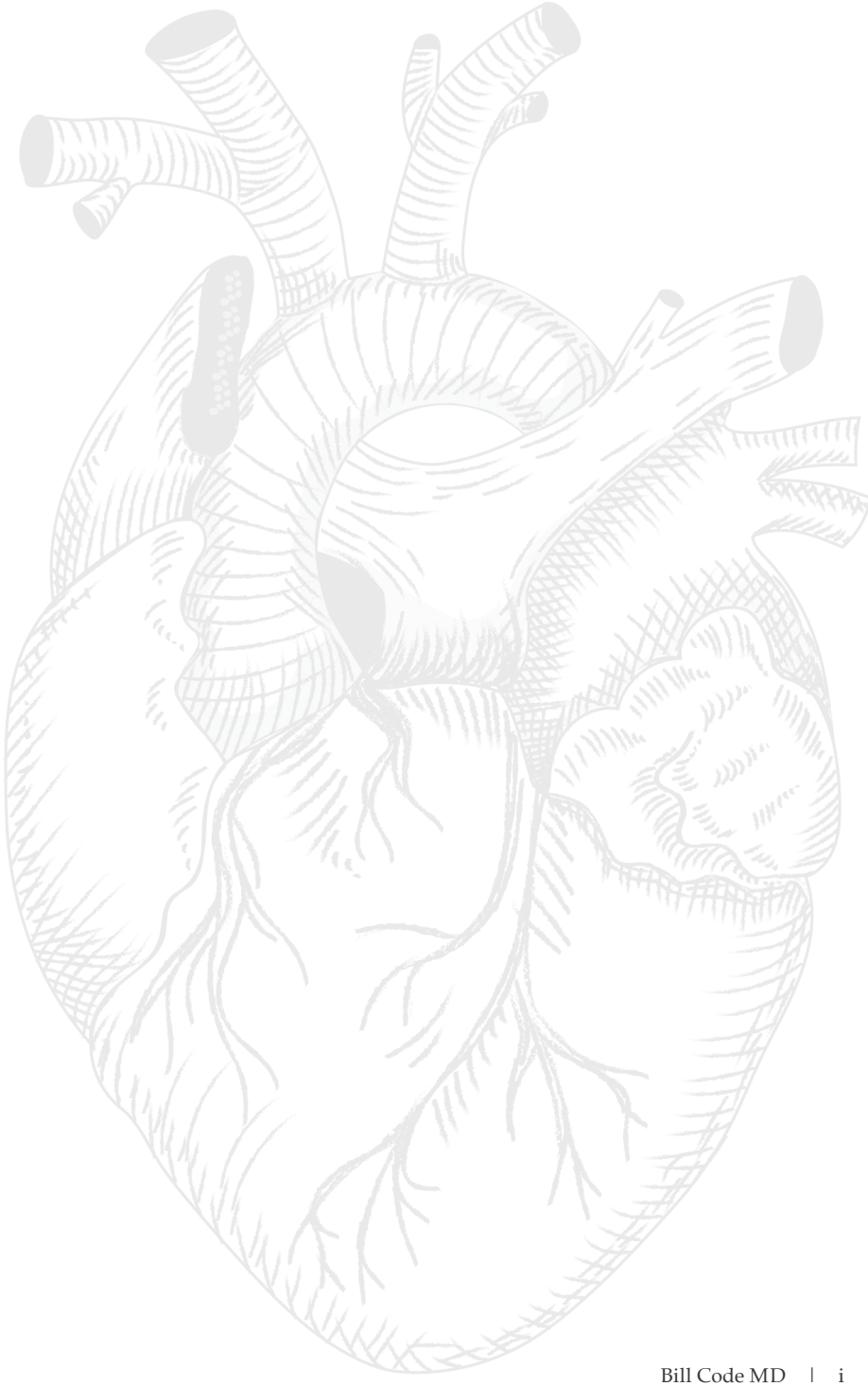

Solving the Heart Puzzle

An MD's Journey Through Oxygen, Omega-3s, and the Science of Healing

— Bill Code MD —

This book contains advice and information relating to healthcare. It is not intended to replace medical advice and should be used to supplement rather than replace regular care by your doctor. It is recommended that you seek your physician's advice before embarking on any medical program for treatment. All efforts have been made to assure the accuracy of the information contained in this book as of the date of publication. The publisher and the author disclaim liability for any medical outcomes that may occur as a result of applying the methods suggested in this book.

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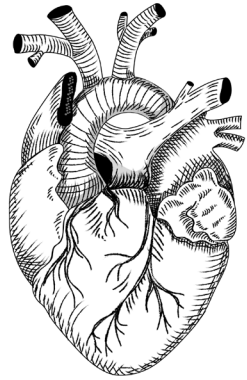
Table of Contents



CHAPTER 3

Shedding Light on Omega-3s

Omega-3 fatty acids are far more profound for optimal health than I once appreciated. In the last few years, out of Norway, a stream of research has emerged that has changed the playing field. This work has helped me connect cardiovascular disease, blood pressure, the microbiome, brain function, and oxygenation in a way that is clinically coherent and actionable.

In this chapter we will look at:

- The origins of Omega-6 and Omega-3 in human health.
- Where these fats occur in nature.
- How we now measure essential fatty acids, including at-home Dried Blood Spot tests.
- The cardiovascular and blood pressure implications of Omega-3s.
- The influence of Omega-3s on the microbiome and short-chain fatty acids.
- Brain function and membrane fluidity.
- Practical sources: diet and supplementation, including the crucial role of olive-oil polyphenols.
- My own test results as an illustration of the issues and the possibilities.

Essential Fatty Acids in Humans

Most of you are familiar with essential amino acids-those the body cannot synthesize and must obtain from food. Essential fatty acids were discovered more recently, in 1929, at the University of Minnesota by Dr. George Burr and his wife, Mildred.

They identified two essential fatty acids:

- An Omega-6 fatty acid, linoleic acid.
- An Omega-3 fatty acid, alpha-linolenic acid.

Their names are similar enough to cause confusion, but their biological roles diverge.

Both linoleic acid (Omega-6) and alpha-linolenic acid (Omega-3) are precursors that the body is unable to make. Linoleic acid is metabolized through a series of steps to arachidonic acid, which is one of the key triggers for body inflammatory processes. Alpha-linolenic acid (Omega-3) is metabolized to EPA (eicosapentaenoic) and then DHA (docosahexaenoic), but this conversion is inefficient in humans. In men, and in some women, the conversion from alpha-linolenic acid to EPA can be as low as 0% and rarely exceeds 12%. You may be at 0%; I may be at 0%. We cannot assume efficient conversion. Hence we must take in pre-formed EPA and DHA from fish oils, krill or algae.

The ratio of Omega-6 to Omega-3 in the human diet has shifted dramatically over the last century. Around 1910, the ratio in North America is estimated to have been roughly 1:1 or 2:1. By 1930 it had drifted to about 9:1, by the 1980s and 1990s to around 12:1, and by 2014 one study put the United States at 21:1. Today it is closer to 25:1. If you wonder why we are not doing well health-wise, this is a major part of the answer.

Where Omega-3s Come From

Alpha-linolenic acid, the precursor Omega-3, is found in almost all green plants and grasses. If we ate large quantities of green plants, our Omega-3 intake would improve somewhat. However, because conversion from alpha-linolenic acid to EPA and DHA is limited in humans we cannot rely on this pathway alone. Women, especially in their child-bearing years, convert more efficiently (20–30%), perhaps as an evolutionary protection for mother and baby, who both require substantial DHA for brain development. This is why DHA is added to infant formula.

Other sources of Omega-3 include:

- Meat and butter from grass-fed animals such as bison, beef, and lamb, which have higher Omega-3 content than grain-fed equivalents.
- Marine algae and plankton, which are the original producers of long-chain Omega-3s in the ocean.
- Fish and other sea creatures, which accumulate Omega-3,especially EPA and DHA, by eating algae, plankton, and each other.

A crucial and often overlooked detail is that when marine organisms synthesize or store Omega-3s, they protect them with polyphenols. Algae surround their Omega-3s with polyphenolic compounds that act as powerful antioxidants. This point will become important when I discuss supplementation and olive oil.

In human practice today, supplementation is often necessary to raise EPA and DHA to healthy levels. Those of us who have lived by the ocean, as Denise and I have for the last thirty-five years, may consume more fish, but even here, things have changed. Our oceans are now contaminated with heavy metals, PCBs, dioxins, and microplastics. That complicates using fish alone as a safe, high-volume source of EPA and DHA.

The Mediterranean Diet and Olive Oil

Most readers will have heard of the Mediterranean diet. The classic Mediterranean studies were centered in Lyon, in southern France—often described as the gastronomic capital of Europe. The study involved many thousands of people who had already had a first heart attack, which means that they were at high cardiovascular risk from the outset.

The core features of the traditional Mediterranean diet included:

- Frequent consumption of fish, including fatty fish.
- Generous use of olive oil as the primary fat.
- Moderate amounts of meat.
- Abundant fruits and vegetables.

A particularly interesting finding was that people on the island of Crete did even better than the broader Mediterranean cohort. In contrast, people in parts of southern Italy who have adopted more of a “standard American diet” pattern are no longer faring as well as they once did.

One of the “secrets” of the Mediterranean diet appears to be the quality of olive oil and its polyphenol content. Phenolic compounds such as tyrosol and hydroxytyrosol in high-quality extra-virgin olive oil are exceptionally potent

antioxidants. They are especially effective at protecting omega-3 fatty acids from oxidation—whether in fish before it is eaten or in purified fish oil after contaminants have been removed.

If you combine cleaned-up fish oil with olive-oil-derived polyphenols, you dramatically improve the protection and stability of the omega-3s. This is essentially recreating the natural design we see in the ocean: algae and plankton produce omega-3s, then surround them with polyphenols to keep them functional in harsh environments. These harsh environments include our gut and even bloodstream as blood has about 1-2% oxygen circulating, some free iron and both of these are powerful oxidizing agents.

A New Global Lipid Study

In October 2025, two days after I had spoken at the International Society for Orthomolecular Medicine meeting on reducing medications in complex neurological problems with increased oxygenation, I learned of a new study over breakfast in Burlington, Ontario. The lead author was M. Tørrisen, and the paper appeared in 'Lipids" in August 2025.

This study analyzed Dried Blood Spot samples from more than 590,000 individuals worldwide. Any country that had at least thirty-five submitted samples was included. All the analyses were carried out by Vitas, an independent laboratory in Oslo, Norway, It is affiliated with the University of Oslo's large nutrition division. The Dried Blood Spot methodology allows at-home collection. You simply prick your finger (ideally the middle or ring finger, on the side where there are fewer pain fibers), fill two small circles on a card with blood, let it dry, and mail it in.

The lab measures eleven fatty acids from each sample:

- Two saturated fatty acids.
- One monounsaturated fatty acid (oleic acid).
- Eight polyunsaturated fatty acids in the Omega-6 and Omega-3 families.

The identification is fully anonymous, allowing the data to be used in research without being controlled by any single commercial interest. Red blood cells have neither nucleus (DNA) or mitochondria (other source of DNA) so you are NOT giving out your personal info.

The key findings:

- The best Omega-6 to Omega-3 ratios (typically 5:1 to 10:1) were found in northern Europe, Southeast Asia, and Oceania (Australia, New Zealand, and Pacific island nations), regions where fish consumption remains relatively high.
- The worst ratios were in North and South America and in Africa.
- Women, and especially elderly women, had higher omega-3 levels than men, likely reflecting better dietary patterns.
- Obese and overweight people had lower Omega-3 levels, highlighting another leverage point for intervention.
- People taking Omega-3 supplements (usually fish oil, sometimes krill) had higher Omega-3 levels, but many still did not reach what I call the "golden zone."

The "golden zone" is an Omega-6 to Omega-3 ratio of 3:1 or better. Most of the world is nowhere near this.

Genes, Geography, and the FADS Pathway

The Tørrisen study also acknowledged genetic variation. Some individuals carry variants in the FADS gene cluster (fatty acid desaturases) that slow the enzymatic conversion of linoleic acid and alpha-linolenic acid down their respective pathways. Those people have impaired ability to convert to arachidonic acid on the Omega-6 side, and to EPA and DHA on the Omega-3 side. They are over-represented in certain populations, including parts of Africa.

However, in my view, genetics are not the main story. For most of us in North and South America, our extreme Omega-6 dominance is driven by diet—processed and ultra-processed foods, seed oils in everything, and the standard American (and Canadian) diet. India, with heavy use of seed oils in cooking, and southern European countries that have adopted more American eating patterns (Croatia, Serbia, Greece, southern Italy) show similar issues.

The Tørrisen paper referenced the Lyon Heart Study, which found that when the Omega-6 to Omega-3 ratio is brought below 4:1, mortality from cardiovascular disease falls by about 70%. That statistic caught my attention, because I have my own cardiovascular risk factors–a microvascular disease burden from multiple sclerosis and a history of very high cholesterol—highest in my medical school class in 1973. Cholesterol is only the tip of the iceberg and often overemphasized still today. More on this later.

My Own Lipid Profile

To illustrate the practical meaning of these numbers, I will share my own results openly.

At the time of my test, at age seventy-two, I was not taking any significant Omega-3 supplement. For the previous two years, I had taken two capsules of fish oil daily. Each time I tried a different fish oil, I used my standard three-month test: take it faithfully for three months, stop, and ask, "Do I feel any different?" I never noticed a benefit. Worse, some of the oils tasted horrific, and I now know why: they were rancid. We now have good evidence that taking a poor-quality Omega-3 oil may be worse than taking none at all, because oxidized oils add to the oxidative stress burden.

My key results were:

- Omega-6 to Omega-3 ratio: 7.9:1, which put me in a "semi-balanced" yellow zone, just barely in the middle category.
- Omega-3 index (EPA + DHA as a percentage of total fatty acids in red blood cells): 3.9%, in the red zone of the test report. Cardiovascular risk drops meaningfully above 4.5%, and optimally when the index is above 8%.
- DHA-related "mental strength" measure: moderate, in the yellow zone, likely reflecting somewhat better DHA than EPA.
- Cell membrane fluidity index: 10:1, in the red zone, indicating stiff cell membranes that impede optimal cellular function.
- Arachidonic acid index (Omega-6 end product): 7.3, nicely in the green zone, suggesting I do not have excessive arachidonic acid. I eat almost no processed foods.
- I like these reports as they show red, yellow and green colours for easy interpretation. Red is not good!

The detailed breakdown showed my saturated fats in the normal range. I had a healthy amount of stearic acid, consistent with my fondness for butter, which reassured me. My oleic acid (Omega-9 from olive oil) was slightly above the suggested amount, which is not a problem. All my measured Omega-6s were within the reference range; the main problem was deficiency of EPA and DHA.

On the Omega-3 side:

- Alpha-linolenic acid was at 0% deviation from the reference range; I was getting enough from leafy greens and other foods, even though I had not used flax supplements for 15–20 years.

- EPA was 72% below where it should have been—a substantial deficiency.
- DHA was 30% below optimal, better than EPA, but still deficient.

This pattern—adequate alpha-linolenic acid, low EPA, moderately low DHA—is common. The practical upshot is that I, like many people, need a lot more EPA (and a decent amount more DHA), and I need it in a form that is stable, unoxidized, and well-protected from breakdown by oxidation. That is why I decided to try a fish oil/olive oil blend. What I was doing was not working!

Cardiovascular Disease and Omega-3: The Big Picture

Cardiovascular research is abundant because the heart has long been the prima donna organ in our healthcare system. Omega-3s have been studied extensively in this context since initial work on the Greenland Inuit in the 1970s.

Broadly, higher intakes of EPA and DHA are associated with:

- Reduced fatal coronary deaths (around 19% in some large studies).
- Fewer coronary events (heart attacks and arrhythmias), by roughly 23%.
- A striking 47% reduction in sudden coronary deaths.

Sudden coronary death is typically due to ventricular fibrillation, a chaotic rhythm that almost always kills unless defibrillation is applied rapidly. Even if you collapse on the hospital doorstep, your odds are not good. Anything that can reduce the risk of these arrhythmias has immense value.

The Inuit Story Revisited

Many of you will remember that the modern interest in Omega-3 started with the Inuit. It is worth revisiting that story with more nuance.

In the 1970s, Bang and Dyerberg studied Inuit populations in Greenland and found that they had markedly lower rates of cardiovascular disease than Danes. This was despite a diet very high in fat and almost devoid of fruits and vegetables. Their traditional diet was primarily meat and blubber from seals and whales, with relatively small amounts of oily fish. The key Omega-3s were coming from the marine mammals, not from fish fillets.

Two additional details are often overlooked:

- Much of the fat consumed was raw or dried, not heavily cooked.
- The blubber was often “brown fat,” rich in polyphenols originating from algae and plankton lower in the food chain.

Those polyphenols protected the Omega-3s from oxidation, preserving their function in open air environments—and, when consumed, in human tissues. The result was at least a 15–18% lower cardiovascular mortality rate among men and women compared with reference populations, with women doing even better than men.

When Inuit in Canada and Alaska shifted from traditional diets to Canadian or American "SAD" diets, they lost this protection and developed the same cardiovascular problems as everyone else. The lesson is clear: it is not just the quantity of fat; it is the type, the ratio, and the protective compounds that accompany it, namely polyphenols.

Mechanisms: Blood Pressure, Microbiome, and Membranes

Cardiovascular risk is not just about coronary arteries. Blood pressure, blood vessel function, and the microbiome all contribute, and Omega-3s act at each of these levels.

Arterial hypertension (high blood pressure) remains the number one modifiable cardiovascular risk factor, and roughly one-half of adults (47%) will develop high blood pressure in their lifetimes. When I left the University of Saskatchewan in 1992, I was right on the cusp of needing blood pressure medication, largely from stress and overwork. Simply moving to the coast and reducing stress dropped my pressure significantly, which underscores how important stress management is.

Omega-3s influence blood pressure and vascular function through several mechanisms:

- Direct antioxidant effects, mopping up free radicals that damage endothelium (the cells lining blood vessels).
- Reduction in thrombosis (clot formation) by modulating platelet function and coagulation (blood clotting).
- Improvement in endothelial (the cells lining the blood vessels) function, including better dilation and constriction responses.
- Anti-inflammatory effects through shifting inflammatory molecules balance away from pro-inflammatory arachidonic-acid-derived mediators toward anti-inflammatory mediators.

The gut microbiome adds another layer. The gut houses 70–80% of the immune system, and the "gut–brain" and "gut–kidney" axes are now recognized as key regulatory pathways. Bacteria in the colon ferment indigestible fibers (cellulose, inulin, and others) into short-chain fatty acids (SCFAs),

notably acetate, propionate, and butyrate. Since about 2021, it has become clear that SCFAs are major mediators of blood pressure control, influencing vascular tone, inflammation, and sympathetic nervous system activity (the adrenalin pathway).

Omega-3s: EPA and DHA

- Support beneficial SCFA-producing bacteria and so assist the above.
- Improve the integrity of the intestinal barrier by enhancing mucus production and tight junction function, thereby reducing "leaky gut."
- Indirectly reduce systemic inflammation, which helps normalize blood pressure.

In my own case, after six weeks on a high-quality Fish oil/Olive oil blend with EPA and DHA, my forty-year history of irritable bowel symptoms largely resolved—more effectively than after my fecal microbiota transplants in the UK in 2017!

At the cellular level, EPA and DHA are incorporated into membrane phospholipids, the bilayer structures that make up cell membranes. Membranes rich in saturated or trans fats become stiff and rigid. Membranes enriched with Omega-3s are flexible and fluid, allowing:

- New nutrients to enter cells more easily
- Waste products to exit the cells more easily
- Better deformability of red blood cells as they navigate tiny capillaries (microcirculation).

EPA is especially important in mitigating atherosclerosis (plaque formation), while DHA is particularly critical in mitochondrial membranes, where it supports ATP production and thus energy. I suspect that my increased energy over the previous three months is linked to improved mitochondrial function as my Omega-3 status has begun to normalize. This amazes me after taking "quality" fish oils for more than 25 years.

Anti-Arrhythmic Effects and Sudden Cardiac Death

Omega-3s EPA and DHA also appear to have specific anti-arrhythmic effects. They:

- Improve membrane fluidity in cardiac cells.
- Inhibit L-type calcium channels, which can reduce susceptibility to dangerous arrhythmias during ischemia (lack of oxygen) and during reperfusion (return of blood flow) after stent placement or bypass surgery.

Every year, about 300,000 people in North America die from sudden cardiac arrest outside hospital, most due to ventricular fibrillation triggered by an acute clot. Sudden cardiac death rates in Western countries are roughly twenty times higher than in Japan. A major difference is the Omega-3 Index: in Japan it averages around 10%; in North America it averages around 4.5%; mine was 3.9% originally, but 5.4% some months later. I am aiming for greater than 8.3%.

An Omega-3 Index of at least 8% is associated with about a 90% reduction in sudden cardiac death risk. That is a target worth aiming at.

The half-life of Omega-6 fatty acids in human tissues is about two years. If you stopped consuming them entirely, it would take two years for tissue levels to drop by half. The good news is that by adding EPA and DHA, you can markedly shift the functional balance within about four months, and if you continue for a decade (and, ideally, for life), you can fundamentally remodel your cellular membranes.

Polyphenols: Completing the Picture

Polyphenols are, in a sense, the missing half of the modern Omega-3 story. Many fish oils start out as clean, high-quality oils but degrade once in the bottle and then further once in the body. Classic formulations rely on vitamin E, which turns out to be a relatively weak protector of Omega-3s under real-world conditions.

By contrast, olive-oil-derived polyphenols such as tyrosol and hydroxytyrosol are exceptionally potent for protecting EPA and DHA molecules. When you combine:

- 60% purified fish oil (rich in EPA and DHA), and
- 40% extra-virgin olive oil (rich in polyphenols),

you mimic the natural combination seen in marine ecosystems and in traditional diets like the Mediterranean pattern. The polyphenols both:

- Protect the Omega-3s from oxidation so they reach tissues intact.
- Provide their own independent cardiovascular and anti-inflammatory benefits.

Brain Health and Cognitive Function

I cannot leave the topic without touching on the brain. Remember my last book was Solving the Brain Puzzle. DHA is the dominant Omega-3 in brain tissue; about 40% of the brain's fatty acids are DHA. Being called a "fathead" is, in that sense, a compliment.

EPA and DHA across the lifespan:

- Improve learning, memory, cognition, and cerebral blood flow.
- Protect against neurodegeneration.
- Increase membrane fluidity in neurons.
- Enhance neurotransmitter release, reducing anxiety and depression.
- Decrease neuronal apoptosis (programmed cell death).

There is also an oxygen story here. Omega-3s increase hemoglobin oxygen saturation and total hemoglobin in brain-adjacent regions (e.g., measured at the ear), suggesting improved blood circulation and oxygenation in the brain. That link between Omega-3, blood flow and oxygenation is in chapter 18, "Synergy".

Practical Supplementation: Products and Dosing

Given contamination in fish and the practical difficulty of radically lowering Omega-6 in the modern food environment, most people will need supplementation to get into the golden zone.

For dosing, the fish oil/olive oil blend it is recommended 0.15 ml per kilogram of body weight per day. This equates to .07 mls per pound of weight.

- At 100 kg: about 15 ml (one tablespoon, or three teaspoons) daily.
- At 80 kg (my weight): about 12 ml. I usually take just under a full tablespoon. Make sure this is accurate.
- At 50 kg: about 7–8 ml, or 1.5 teaspoons.

This weight-based approach is especially important for very overweight individuals. They may benefit from higher doses, perhaps up to two tablespoons daily, especially while they are actively mobilizing fat stores, changing diet, and losing weight.I have a friend who has lost 4 inches waist!

For children, dosing can start as early as one year of age, with small amounts (e.g., 1–2 ml), and by around five years old, many can handle a teaspoon daily. The oil I use tastes surprisingly pleasant to most people. In the United States, capsules are available. I expect they will eventually become available in Canada as well.

Timing is flexible. Ideally, take oils before mid-afternoon, with or around meals, but if you forget, taking them later is better than skipping them.

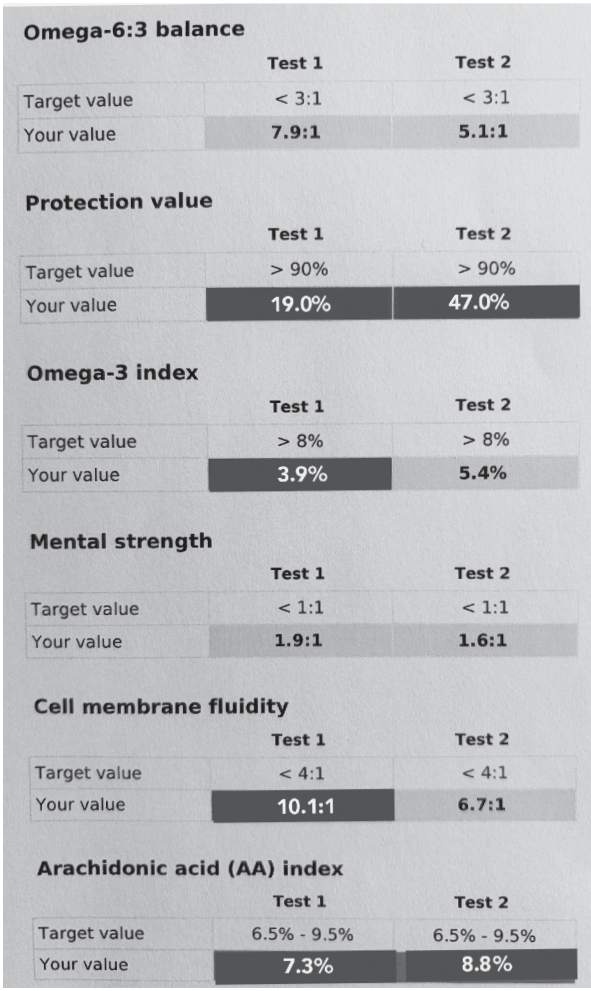
Coconut oil, by contrast, contains virtually no EPA or DHA. It is a saturated fat, and saturated fats have been unfairly demonized. However, coconut oil,

lard, and tallow are now being rehabilitated as acceptable fats in moderation. Coconut oil provides medium-chain triglycerides, which have their own metabolic benefits, but it is not a substitute for Omega-3.

Self-Care as Healthcare

To bring this back to the human level: after nearly five decades in medicine, I am convinced that self-care is healthcare. The Omega-3 story is a prime example of a domain in which:

- The science is deep and rapidly evolving.
- The tools are increasingly accessible (at-home testing, high-quality oils).
- The impact is broad: cardiovascular, neurological, immunological, and microbiome-related.



Omega-6:3 balance

	Test 1	Test 2
Target value	< 3:1	< 3:1
Your value	**7.9:1**	**5.1:1**

Protection value

	Test 1	Test 2
Target value	> 90%	> 90%
Your value	**19.0%**	**47.0%**

Omega-3 index

	Test 1	Test 2
Target value	> 8%	> 8%
Your value	**3.9%**	**5.4%**

Mental strength

	Test 1	Test 2
Target value	< 1:1	< 1:1
Your value	**1.9:1**	**1.6:1**

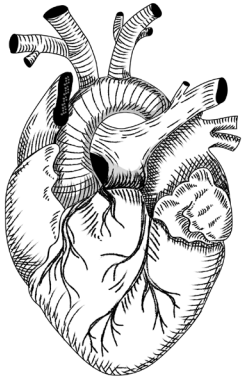
Cell membrane fluidity

	Test 1	Test 2
Target value	< 4:1	< 4:1
Your value	**10.1:1**	**6.7:1**

Arachidonic acid (AA) index

	Test 1	Test 2
Target value	6.5% - 9.5%	6.5% - 9.5%
Your value	**7.3%**	**8.8%**

Figure 2: Bill's Lab Results
This is Bill Code's initial and then 4 months later lab tests. Some progress is being made.



Acknowledgements

Just as it takes a village to raise a child, I have needed a village to write this book. I am grateful to everyone who have contributed to this end result. Inevitably, I will miss someone, and I sincerely apologize for that.

My inhouse editors of my wife Denise, son Brian, Karen Whitehouse, Patrick Hrushowy, Amy Newhook and Andrew Paterson. I also thank my many friends for their assistance: McKenzie Paterson, Elaina Konoby, Peter Burris, Lani Royce, Elaine Merritt, Alan, Diane and Ashlee Brough, Julie Monty, Cynthia Pincombe, and Stuart Tomc. These individuals have all contributed both inspiration and effort. I have been greatly assisted in this book's preparation by Laura Timmermans.

Any errors you note in this book are my responsibility. Please forgive me and let me know for the next printing.