Evidence-Based Eating

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The Best Scientific Evidence for Nutritional and Lifestyle Choices

By

W. Kenneth Ward

Cambridge Scholars Publishing

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This book is dedicated to John M. and Jane I. Ward, who promoted a healthy lifestyle and the belief that one should read and examine the evidence before making up one's mind.

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Special thanks to my wife Jeanine for her encouragement and to my personal editors, Jacqueline Kehrwald, James Beard, and Janet Beard.

PREFACE

Both of my parents were librarians. In those pre-internet days, the Ward family turned to books to settle disputes. I remember one dispute in particular. My high school football coach told us that to be healthy and strong, we should consume large amounts of red meat. My parents weren't convinced, and so they did some research and brought home pertinent books.

Mom, a medical librarian, found a book, *Eat Right to Stay Healthy and Enjoy Life More* written by Dr. Denis Burkitt, a pioneering Irish physician and scientist. The book was based on his comparisons of healthy villagers in Africa with the not-so-healthy inhabitants of England and Scotland. Dad, a public librarian, brought home a bestseller, *The Save Your Life Diet*, by David Reuben, who, like Burkitt, based his recommendations on extensive research data. Looking back, I can see that both Burkitt and Reuben were influential early proponents of a high fiber, low saturated fat diet – a diet that was new and unusual to those who lived in the 1960s.

In the Ward family, what followed was a rapid transition away from white bread, desserts, bacon, and heavily-marbled steaks, to a high fiber, mostly-plant-based diet. The Ward family went all in. I am pretty sure that visitors to the Ward house thought we were a little strange, especially after being treated to Mom's oatmeal cookies. They were high in fiber, low in sugar, bulky, and took a while to get down. My parents' dedication to the way of Burkitt and Reuben way was so complete that when we ate out, Dad brought with him a vial of pure bran powder which he sprinkled liberally over the served food. Yes, he may have been a little over the top.

All this goes to say that young Ken was introduced to the concept that when it came to healthy eating, opinions and testimonies accounted for much less than a careful search of the literature. Growing up in this milieu kindled in me a lifelong interest in nutrition and lifestyle research. After medical school and a three-year internal medicine residency, I spent three additional years in a research fellowship learning the field of Endocrinology, Diabetes and Nutrition at the University of Washington. Most of my career has been spent in research, patient care, and in perusal of the scientific literature.

Over the decades, I've been shocked at the amount of misinformation I've heard and read. It can be overwhelming to sift through piles of

research articles in order to make the best lifestyle decisions. I hope this book makes this process easier since most people do not have the time or inclination to read and assess the quality of these articles. Critical analysis of research is necessary to distinguish high quality evidence from advertisement, propaganda, anecdotes, personal opinions, and over-simplification.

How am I qualified to help you evaluate the research? In my career in academic medicine, I wrote and published 80 original peer-reviewed journal articles as well as a number of book chapters and review articles. In preparing for this book, I read over 800 articles from the nutritional literature and I cite about 400 of those in this book. My goal is to provide you, the reader, evidence that assists you in living not only a long life, but a *healthy* life. *Healthspan* is more important than lifespan.

I am very interested in your thoughts and can be reached at: ken@evidencebasedeating.org.

Ken

CHAPTER 1

NUTRITIONAL RESEARCH AND MISCONCEPTIONS

In fall of 2019, the following headline appeared in Global News:

> "Research finds cutting back on red and processed meat won't improve your health"
> (Yourex-West 2019).

Since the article went against expert consensus, it was an attention grabber. Being familiar with the research articles that it summarized, I found it frustrating (Valli, Rabassa *et al.* 2019, Vernooij, Zeraatkar *et al.* 2019, Zeraatkar, Han *et al.* 2019, Zeraatkar, Johnston *et al.* 2019). The news story only partially reflected the substance of these articles. This example illustrates two problems in the dissemination of research results. The first is the unrelenting drive to condense an article into a headline or brief report. This can be dangerous. This issue was discussed by Einstein, who said that things should be made as simple as possible, but no simpler. Sometimes, the results of a study cannot be distilled into a few sentences.

The second problem is more insidious and can be attributed to the research investigators themselves rather than the reporter. In my opinion, the authors overstated and overgeneralized their conclusions. This problem is difficult to detect by simply reading lay news stories – it requires going back to the original publication(s) and determining whether the scientists' conclusions are truly justified by their results. In this case, the authors overstated their conclusions, probably for the sake of scientific impact and prestige. This misinformation was exacerbated by the fact that the reporter *further* oversimplified the authors' (already imperfect) conclusions possibly without fully reviewing the original papers.[1] Reading four detailed research articles takes a great deal of time and effort! At any rate, what the news consumer read was not entirely consistent with the actual

[1] More details on these red meat studies in Chapter 7.

research results. This news story is a good example of how conscientious people can acquire erroneous health information.

There are thousands of articles on diet and nutrition published each year; keeping up is a difficult task even for specialists in the field. Another problem is distinguishing marketing statements from objective research. How many of us fall prey to misinformation promulgated by merchants who are selling something? The answer is *all of us.* Why do companies advertise? Because it works. The problem is that too many people make nutritional decisions based on someone's opinion or marketing hype.

What is the source of our nutritional beliefs? We should include advertisements, news articles, government educational materials, school courses, and—a big one—opinions of friends. Ideally, more people would go to the original research articles, but this can be tricky. In some cases, health information consumers may not have access to scientific journals, Furthermore, the liberal and often unnecessary use of jargon by research scientists can make the original articles hard to decipher, even for those with a science background.

The purpose of this book is to clearly explain nutritional research obtained from well-designed scientific studies. I hope to clarify some common misconceptions and give more nuance beyond what can be found in condensed lay summaries. I want to empower readers from all backgrounds to understand the basis of nutritional and lifestyle guidelines and how they are created. I will include key takeaways for each chapter but will also pull the curtain back and explain how the scientific community came to those conclusions.

How research is performed and disseminated

The goal of the scientific method is to discover associations (including cause and effect relationships) between factors. The first step is to ask a question. The next step is to carefully gather the evidence (gathering many observations is better than gathering just a few). The evidence is then examined and interpreted. The analysis usually involves the investigative team gathering to interpret the results. I have found this community process very helpful, since it is not unusual for one investigator to interpret results differently from his or her collaborators. These discussions generally lead to a consensus regarding the nature of the conclusions that can be derived from the results. In some cases, perfectly good research is carried out by a single investigator, though in today's world this is unusual. The vast majority of the references cited in this book are multi-authored.

After the manuscript is written, it is submitted to a scientific journal. At this point, the editor then asks two to four reviewers known as referees to review the manuscript. These peer reviewers are scientists with expertise in the field. The reviewers and editor then determine if the manuscript is acceptable for publication, in need of revision, or unacceptable. When the decision is sent to the authors, the comments of the reviewers and editor are included. In most cases, the identities of the reviewers are kept anonymous in order to avoid compromising their ability to freely offer their opinions.

Peer review is an immensely important system of checks and balances. Not surprisingly, authors sometimes overstate the importance of their work and occasionally write dramatic far-reaching conclusions that are not properly supported by their results. One job of the referees is to disallow such interpretations. Peer reviewers do this job without being paid. I have reviewed hundreds of manuscripts submitted by my peers and can say that the request to review a paper never comes at a perfect time. Nonetheless, most of us in academia do it anyway because we realize that trust in the scientific literature would erode without a solid peer review system.

Sometimes an article appears on its surface to be peer-reviewed research but turns out instead to have been written by a businessperson whose goal is a commercial one. This type of publication falls more into the domain of advertising, and it is important to be able to distinguish such a publication from *bona fide* peer-reviewed work. If in doubt, I recommend investigating the journal and publisher. In a scientific journal, there is always a policy statement summarizing its peer review process.

A few additional comments about peer reviews are in order. In some cases, the peer-review is simply a case of nit-picking. The authors remove the nits and resubmit the manuscript. In other cases, something more profound happens— the peer reviewer comes up with a completely different interpretation of the data, one that is better than that of the investigators. In other words, the right interpretation sometimes requires an outsider coming in from the outside who examines the results from a different vantage point.

Level of evidence

In addition to looking at the design of the study, one must also take into account the *level of evidence* of the findings. A study might suggest a beneficial result, but only with a low level of supporting evidence. To qualify for a high level of evidence, it must show results that are *caused* by a clearly-identified factor rather than merely being associated or correlated

with such a factor. The highest level of evidence exists when the study uses a randomized and controlled design, especially when many participants are studied over a long duration. Studies that accomplish all of those things, especially when it is confirmed by at least one other group, are convincing. On the other hand, a small, short duration study that only shows an association or correlation should be noted with interest but considered inconclusive, at least until more focused studies are reported. The accompanying table helps to decipher some of the jargon used in describing different types of research studies.

TABLE 1-1

Study Type	Description	Strengths	Weaknesses
Observational	Subjects are simply observed; there is no intervention such as a drug or specific diet. The subjects themselves decide what drug to take or which diet to follow (self-selection).	-This design is appropriate for a relatively low-cost initial method for studying large numbers of subjects. -This type of study is appropriate to find associations or correlations between factors.	-Very susceptible to confounding factors. Researchers may be unaware of the factors that contribute to self-selection of a particular drug, habit, or diet. -Not suitable for determining the *cause* of a condition.
Prospective	These studies are designed first, then carried out over a period of time.	-can be used with large numbers of subjects	To acquire the data, these studies take longer (sometimes many years) than retrospective studies.
Retrospective	These studies look backward; they examine data that already exist. The purpose is usually to identify risk factors for particular conditions.	-can be used for very large numbers of subjects -can rapidly collect large amounts of data	Researchers cannot go back and gather missing data.

Randomized	Interventions are determined randomly (think coin toss). Subjects cannot choose their own treatments and must agree to be assigned to an intervention.	This process minimizes confounding factors that often occur when a subject is allowed to select his or her treatment. Studies that are randomized and controlled are the best for determining cause and effect.	The inclusion of a randomized process adds elements of complexity and expense to a study. It also requires that the study be prospective, so it can be time-consuming.
Controlled	In a controlled study, some subjects are given an intervention such as a drug or diet (experimental group) and some are not given the intervention (control group). The control group is a comparison group. Often, the decision to as to who will receive an experimental treatment vs who will be a control subject is randomized.	*Example:* In a long term study for a new drug, both the control group (placebo) and the experimental group (drug) develop skin cancers at the same frequency. These results clearly show that the cancers were not due to the drug. Without a control group, investigators might have concluded that skin cancer was a side effect of the drug.	The inclusion of a control group adds elements of complexity and expense to a study. Furthermore, some subjects may refuse to take part in a study in which they might be assigned to a placebo.
Cross-sectional	Examines (a cross-section of) subjects at one point in time	can study large numbers of subjects quickly and relatively inexpensively	Researchers might fail to detect conditions that take some time to develop.

Longitudinal	Examines subjects over a period of time	Researchers are able to detect the appearance of conditions that take time to develop.	Much more expensive and cumbersome to carry out than a cross-sectional study

As research is translated into decision-making guidelines, one can see the profound importance of study design and level of evidence. As an example, in the 1980s and 1990s, there was evidence from observational studies that women who took estrogens suffered fewer heart attacks than women who did not. This level of evidence merely showed an *association*, rather than a cause and effect relationship, between estrogens and heart attacks. Nonetheless, the studies were large, the associations strong, and randomized, controlled studies on the topic had not yet been carried out. Based on these results, hundreds of thousands of women were prescribed estrogens during and after menopause.

In 2002, the results of a large double-blinded[2] randomized, controlled trial of estrogens came to a conclusion that was diametrically opposed to the earlier finding. It turned out that women who took estrogens suffered *more* heart attacks. This study, because of its design, provided a very strong and convincing level of evidence. Prescribing habits changed virtually overnight. A more detailed discussion of the estrogen story, the problem of confounding factors, and a hypothesis as to why the earlier conclusions were incorrect are presented in Appendix 2.

Understanding level of evidence is important and can help us understand why the scientific community seem to "change its mind" so often. In many cases, the change in recommendations is made because the newer studies yield a higher level of evidence. As a better and more nuanced understanding of a health topic becomes available, guidelines and recommendations naturally change. For those who get irritated by flip-flops in science, consider this: By its nature, science *must* flip-flop. The whole purpose of research is to obtain new knowledge. In many cases, conclusions from the new knowledge are different from earlier conclusions. It should be this way!

[2] In other words, neither the subjects nor the research personnel were aware of the individual treatment assignments. Another name for a double-blinded study is 'double-masked'.

Another key factor in study design is study duration. Studies of short duration are appealing to scientists because data can be obtained, analyzed, and published in short order. Resumes can be expanded quickly and promotions achieved. Finishing a study quickly can provide rapid benefits to the population as a whole. But, in some cases, short-term studies are misleading. If the main outcome is development of atherosclerosis (and accompanying heart attacks or strokes), a short-term study of less than two years[3] is generally considered to be too short to detect a meaningful difference.

The level of evidence also helps us to judge the certainty of a recommendation. A good example is the health effects of consuming eggs. A very large study from 2019 concluded that those whose egg consumption is high are at increased risk for heart attacks (Zhong, Van Horn *et al,* 2019). However, the study was observational, not randomized. Furthermore, since it contradicts the findings of earlier observational studies, its apparent flip-flop was frustrating to many. One year, eggs are okay; the next year, they are not. The most reasonable interpretation, as discussed later, is that egg consumption probably *does* raise one's cardiovascular risk somewhat, but in the absence of randomized controlled trials, it is impossible to make such a recommendation with certainty. A recommendation on this topic, such as "go easy on egg yolks" must be made with some reservation.

In contrast to the situation with eggs, a large, high quality trial that was randomized and controlled found that diets rich in extra-virgin olive oil and nuts led to marked reductions in the chances of having an adverse cardiovascular event or a stroke (Estruch, Ros *et al,* 2018) (discussed in Chapter 14). This is a good example of a high level of evidence. The conclusions of this study are reinforced by the fact that in the literature there was also *another* randomized, controlled trial that had found a marked benefit of olive oil (de Lorgeril, Salen *et al,* 1999; Estruch, Ros *et al,* 2018). A solid conclusion that withstands the test of time should be reproducible. The scientific community wants to see study results verified by investigators who were not part of earlier research groups.

In summary, throughout this book, I will not only state the conclusions reached by the authors but will also comment on the methodology and the level of evidence.

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[3] One of the most convincing studies in which atherosclerotic cardiovascular disease was an end point was the PREDIMED Study, a randomized and controlled study, discussed in Chapter 14, whose duration was almost 5 years.

Common nutritional beliefs

The following table lists just a few examples of the many common nutritional beliefs (many of which are misconceptions) that will be discussed further in this book.

TABLE 1-2	
Statement	**Comment**
Although 20th century studies suggested that diets high in saturated fat predispose to heart disease, new studies have disproven this.	There is some controversy around this topic, which is discussed in depth in Chapter 4.
The best method for keeping our arteries in good condition is to avoid foods that are rich in cholesterol.	Not as straightforward as it may seem. See Chapter 4.
Vegetarian and vegan diets are risky because they lack the high levels of protein found in meat.	Chapters 7 and 8 address this issue.
We should avoid eating nuts because they are high in fat and can cause weight gain.	This topic and other effects of consuming nuts are discussed in Chapter 8.
Taking fish oil capsules is just as good as eating fish.	It might seem that way. See Chapter 11.
Because the Mediterranean diet is so good, we should avoid foods that originate from other parts of the world.	Does this mean that we should avoid items such as salmon and quinoa that are not native to the Mediterranean region? See Chapter 14.
"I know olive oil is good, but I heard that cooking olive oil breaks down the good compounds and creates bad compounds."	May not be as problematic as you have heard. See Chapter 15.
Antioxidant supplements such as beta-carotene, vitamin C, and vitamin E provide the same benefits as eating vegetables and fruits that contain antioxidants.	Can I skip the broccoli and cauliflower and take a vitamin pill instead? See Chapters 9 and 17.
People with diabetes must choose food items that are different from those of people without diabetes.	How is a "diabetic diet" different from a standard healthy diet? See Chapter 16.
If one wants to lose large amounts of fat, should one's diet be low in fat or low in carbohydrate?	Very common question – discussed in Chapter 21.
Intermittent fasting diets offer greater benefits than diets that don't require periods of fasting.	We now have studies of intermittent fasting. This body of evidence will be discussed in Chapter 22.
Fruit and fruit juice are essentially the same	A common belief, but be careful

thing, right? Isn't fruit juice just fruit that has been squeezed?	here. See Chapter 9.
Since vitamins are so important, one should take more than the recommended daily allowance to get maximal benefit.	Is it possible to take too many vitamins? See Chapter 17.
Drinking alcohol reduces one's risk for having heart problems.	Difficult to summarize in one sentence--the answer is nuanced. See Chapter 18.
Drinking red wine or taking supplements such as resveratrol are great for your blood vessels. Therefore, they serve as substitutes for regular exercise.	Could it really be that easy? See Chapters 17 and 18.
"There is no way that I can start an exercise program. I am simply not going to run marathons, start jogging or working out at a gym."	Examples of healthy activities, based on the body of research, will be discussed in Chapter 26.

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CHAPTER 2

THE TYPICAL AMERICAN DIET

I remember the day I met Andrei and Hideki.[4] On the very same day, they showed up in my clinic as new patients. Their stories revealed a surprising number of parallels. Both were 63-year-old men; both were recent immigrants (Andrei, Russia, and Hideki, Japan), and both required the presence of an interpreter for my interview. Both were on medications for blood pressure.

But here the similarities ended. Hideki's medical history was remarkably unremarkable. No operations, no procedures, no major health problems. Andrei, on the other hand, suffered from what you might call galloping coronary artery disease. He had two heart attacks and two cardiac procedures designed to open up occluded coronary arteries. He had also undergone a coronary artery bypass graft in which two blocked coronary arteries had been bypassed using vessels taken from other parts of his body.

I remember wondering why their histories were so different. Could it have something to do with their countries of origin? Their histories motivated me to search for more information on heart disease in men from Russia and Japan.

Sure enough, the patients I met that day were quite typical of their countrymen. Coronary artery disease in Russian men is much more common than in Japanese men. I learned that in Russia, Ukraine, and nearby countries, there is a very high prevalence of coronary artery disease, especially rampant in men (Weidner and Cain 2003). The story is quite different for inhabitants of Japan, in whom the prevalence of coronary artery disease, and the mortality rate in general, are relatively low (Iso 2011).

It's interesting to know that one's country of origin can influence one's personal health. Although there is room for debate, the reasons underlying these large differences are probably related to lifestyle habits that differ

[4] Names have been changed.

according to region of inhabitance (Weidner and Cain 2003, Finegold, Asaria *et al*. 2013).

How do the USA and UK compare in terms of cardiovascular disease and mortality? Among countries of the world, both are somewhere in the middle, not nearly as low as Japan but not nearly as high as many Eastern European and the former Soviet countries (Finegold, Asaria *et al,* 2013). With regard to our personal habits, each of us must take a stand. Our eating and lifestyle choices are exclusively our own. Just because "X" is the way most inhabitants of our region live their lives doesn't mean that we must follow the X plan.

Industrialization of food production

Generally speaking, the eating habits of North Americans and Europeans no longer serve the best interests of our industrial-age lifestyle. Most of us enjoy salty crackers and refined sugars, foods that immediately satisfy but do not contribute to long term health. Indeed, in a society where advertising and marketing are constant and unavoidable, many of us have fallen prey to someone else's financial advancement. Even dining out can feel like we have lost control over what we eat, since we rarely know how the food is prepared.

Poor dietary habits are a tremendous threat to our health. About 65 million Americans have some type of cardiovascular disease, which represents the leading cause of mortality in the US (Woolf and Schoomaker 2019). About 75 million Americans have hypertension (high blood pressure) and over 17 million American have type 2 diabetes[5] (Xu, Liu *et al,* 2018). Sixty-five percent of adults in the US are either overweight or obese; the estimated number of deaths attributable to obesity is massive, about 300,000 per year. In many cases, these disorders can be avoided or minimized by proper nutrition.[6]

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[5] The type of diabetes that usually afflicts people who are overweight and have a family history of diabetes.

[6] Some people with Type 2 diabetes (T2D) cannot resolve their diabetes with weight loss. There is a large genetic component to T2D; for this reason, it is not fair to say that the only cause of T2D is overeating. Not surprisingly, people with T2D resent the implication that they brought it all on themselves due to poor self-control at the dinner table. Fortunately, many people with T2D *are* able to bring their glucose values into the normal range with a good diet and weight loss (Wing, Egan *et al,* 2010).

The US Centers for Disease Control and Prevention conduct dietary surveys on a regular basis. One key publication reported state-by-state data regarding vegetable and fruit intake; the results weren't good. Believe it or not, only 9% of Americans eat the recommended amount of vegetables and only 12% eat the recommended amount of fruit (Lee-Kwan, Moore *et al,* 2017)! What should our fruit and vegetable intake be? The general guideline is fruits and vegetables should constitute about half of our meal plate (roughly ¼ of the plate should be fruits and ¼ vegetables) (USDA 2020).

The US National Center for Health Statistics (NCHS) also acquires nutritional data from Americans. A recent NCHS survey found that 71% of Americans have too much saturated fat and 70% have too much added sugar in their diets. Furthermore, in 89% of Americans, the intake of sodium exceeds the recommended limit (US Centers for Disease Control and Prevention Website 2020).

How did America get to this point? Loren Cordain and Jennie Brand-Miller, both experts on the history of the human diet, have some theories. They believe that to understand the problem, we must go far back in history. They point out that with the advent of farming and modern agricultural practices, the human diet became enriched with refined foods. Over time, our food has become more and more highly processed. Such items include cookies, cakes, bakery foods, breakfast cereals, bagels, rolls, muffins, crackers, chips, snack foods, pizza, soft drinks, candy, ice cream, condiments, and salad dressings. Eons ago, it wasn't that way (Cordain, Eaton *et al,* 2005).

As an example of "progress" in food production, consider the example of cereal.[7] Before the industrial revolution, cereals were ground using stone milling tools and contained all the grain elements, that is, the germ, the bran, and the endosperm. With the invention of mechanized roller mills and automated sifters in the late 1800s, however, grain took on a different characteristic. The germ and bran elements were removed, leaving only the endosperm, the part that gives us refined starch. With this mechanization, the particles of grain flour became very small and uniform (Storck J. 1952). These tiny particles give starchy foods made from refined flour a nice, smooth mouth feel. Furthermore, automated food production is efficient and cost effective. It wasn't until much later, in the second half of the twentieth century, that scientists learned of the health perils of

[7] A cereal is a grass that yields a starchy grain suitable for eating. Wheat is a cereal; quinoa is not (it is technically a pseudocereal).

refined grains and the benefits of whole grains. These discoveries led to the realization that the health effects of the pre-industrial method, in which grains were stone-milled, were vastly superior to the modern methods of rolling and sifting (Burkitt 1973).

Sugar is another good example of how food technology affects us all. J.N. BeMiller is the author of a fascinating article that reviews the history of sugar production methods. He points out that in ancient times, honey was the primary source of sugar, but it was consumed in small amounts because it was available only during certain seasons. Later, about two thousand years ago, manufacturers in India learned how to make granular sugar from sugar cane. But even then, in most parts of the world, sugar was expensive. In many epochs, due to its cost, sugar was considered to be more of a spice than a commodity. Like the situation for grain refinement, growing and processing sugar has become quite efficient over the past few hundred years, thus reducing the price of cane and beet sugar production and markedly increasing consumption.

In the 1940s, ‘50s, and ‘60s, advances were made in manufacturing sugar syrups that could be added to food and drink products. In the beginning, these syrups were made with glucose. But there were problems that prevented its wide sales and distribution. First, glucose is not as sweet as table sugar (sucrose). Second, if glucose is stored at low temperatures, it crystallizes (comes out of solution).

To overcome these shortcomings, a huge leap forward in sugar technology occurred in the 1970s: fructose enrichment technology. This technology allowed for large scale manufacture of inexpensive high-fructose corn syrup. Fructose is about twice as sweet as glucose and even sweeter than table sugar. It stays in solution nicely without the risk of crystallization. The advances necessary to manufacture high-fructose corn syrup were hugely successful. Currently, Americans consume massive quantities of high fructose corn syrup (HFCS) in soft drinks, pancake syrup, cereals, and other processed foods (BeMiller 2009). As discussed more in Chapter 12, there is nothing inherently bad with any sugar, including HFCS. The problem is an imbalance between need and level of consumption.

Sugar is not the only culprit in Western nutrition. How about salt? Most Americans consume more salt than they need, and an amount that is hazardous to many of us. Though some people are probably resistant to its effects, many of us develop high blood pressure if our salt intake is too

great (Titze and Ritz 2009).[8] High blood pressure is a major risk for heart disease, stroke, and kidney failure. It is best for all of us to minimize salt, i.e., to not exceed 2300 mg of sodium per day (USDA 2020.). Most experts believe that the ideal intake amount is even lower, especially if one has high blood pressure or cardiovascular disease. We should go easy on adding salt to food and read labels to determine how much the manufacturer has already added.

The vast majority of daily salt intake in Western populations comes from salt that manufacturers add to processed foods. Only about 10% of our salt intake comes from naturally occurring salt in food. The rest is added either by the food processing company or by us (James, Ralph *et al,* 1987).

Many studies are also finding that many Americans eat more meat than is healthy. To understand this, one has to wonder how meat production and consumption have changed over time. The answer can be summarized in a single sentence: Cows have become fatter. This is good for beef sales because fat cows produce very tasty meat with lots of marbling. In the mid-1800s, cattle were free-ranging and were slaughtered at 4 to 5 years of age. Currently, with better grain availability and modern farming practices, cattle are fattened rapidly in fenced feedlots and are ready for slaughter much earlier. Now, steers are often slaughtered at an age of only 14 months, at which time they are already obese (Cordain, Eaton *et al,* 2005). Meat from these animals contains a large amount of saturated fat and a small amount of omega-3 fatty oils (Cordain, Watkins *et al,* 2002).[9] This is the reverse of what is good for us (lower amounts of saturated fat and higher amounts of omega-3 fats).

How much benefit can be achieved by a good diet?

No one argues about the quality of the typical diet in industrialized nations. The real unknown is the degree of benefit one can expect from a healthy, balanced diet – one that is low in saturated fat, processed food, and rich in whole grains and a variety of fruits and vegetables. This is a very hard question to answer. An investigator could take 10,000 teenagers

[8] Being overweight is also a major risk factor for high blood pressure.

[9] You may be wondering how an animal that consumes a plant-based diet such as a cow has muscle (meat) that is high in saturated fat. The answer is this: A process is carried out in their rumens whereby saturated fat is created from unsaturated fat. This process is known as biohydrogenation (Enjalbert, Combes *et al,* 2017)

and randomize half to a good diet, half to a bad diet and follow them for fifty years. The problem is obvious; such a study is not going to happen. It is far too impractical, expensive and unethical. How many human research review boards would approve an obviously detrimental diet for an extended period of time? None! And, if one accounts for the inevitable dropouts in a clinical study, there may not be anyone left after fifty years!

One method of addressing the degree of lifelong benefit of a good diet is the use of mathematical modeling. This method starts with skilled mathematicians reviewing the nutrition literature. They then reduce the knowledge to a series of equations that allow them to build a model of the effects of nutrition on long term health. They plug in variables for a healthy diet and poor diet, start the ignition, and let the model crank out its results. Such a study was published in February of 2022. Suffice it to say that the results were surprising. Most of us in the field knew that a good diet would be quite beneficial in the long run, but most of us likely underestimated the degree of benefit.

The methods used by Fadnes and colleagues were superb. They started by examining a massive amount of data from a giant worldwide study known as the Global Burden of Disease study, published in 2019 (Collaborators 2019). They then created the model and had it crank out predictions for different age groups. The model predicted that, starting at age 20, eating an optimal diet rather than a typical Western diet over one's lifespan would increase longevity by 11-13 years! For sixty-year olds, it would increase longevity by 8-9 years, and for eighty-year olds, 2.5-4 years. They found that the greatest gains would be realized by increasing whole grains, legumes, fish, fruits, vegetables, and nuts, while reducing red and processed meats, sugar-sweetened beverages, and refined grains (Fadnes, Okland *et al,* 2022).

The implications are huge. If one factors in freedom from *disability* (from heart attacks, stroke, diabetes, etc.), the actual benefit from an optimal diet would probably be even greater than these longevity results reported by Fadnes. Living longer is nice, but living longer without a long period of disability is even better.

Mathematical modeling was also used by Franco and colleagues in an effort to understand the importance of dietary choices to overall health and risk for cardiovascular disease. What if people ate only the very best foods, those foods that have known cardiovascular benefits? After crunching the numbers, these investigators concluded that a diet rich in almonds, garlic, dark chocolate, fish, fruits and vegetables would lower the risk of cardiovascular events such as heart attacks by about 75% (Franco, Bonneux *et al,* 2004). Very tantalizing! However, please note that, like the

Fadnes study, this was a mathematical modeling study carried out with the investigators sitting in front of a computer without any actual human or animal subjects.

Whether data are collected directly from humans or generated from computer modeling, it is clear that our dietary choices are important to our health. Over the short term, one may not appreciate an effect, but over the long term, the benefits are indisputable.

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CHAPTER 3

A CONUNDRUM—
WHAT CAUSES CORONARY HEART DISEASE?

I remember the day that the emergency room called me to let me know that a patient of mine had been admitted with chest pain. That morning, Hal, a 60-year old healthy sales manager, had eaten breakfast then started out on his usual three-mile walk around a golf course. While walking uphill, he developed an aching pain in the center part of his chest. He sat down and called his wife who then called 911. Later, in the hospital, the cardiac dye study revealed a high grade occlusion (blockage) in a single coronary artery. His other arteries showed only a few low-grade atherosclerotic abnormalities. Hal underwent a successful procedure during which the blockage was opened without a need for major surgery. The blood work and imaging studies showed that the damage of heart muscle was very small and the pumping function of his heart was preserved.

In a way, Hal's coronary artery blockage was mysterious. He walked and swam on a regular basis, didn't smoke, and didn't have diabetes. He and his wife were committed to eating a healthy diet. He had mild high blood pressure, well-controlled with medication. What causes arterial blockages and why did this particular man develop the problem?

How do arteries become blocked?

For most of recorded history, the root cause of arterial blockages has been unclear. One of the best early descriptions of coronary artery occlusion comes from the records of an eighteenth-century Scottish surgeon, John Hunter. Dr. Hunter carefully documented his personal experience. He suffered from angina pectoris, a condition typified by chest pain that sometimes travels to the left arm or the jaw. He wrote that his anginal pains were often precipitated by situations that were psychologically stressful. As it turned out, Hunter's manner of death also provided valuable information to the medical community. He died of a