

Rethinking the Science of Nutrition

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INTRODUCTION

In 1965, my academic career looked promising. After four years as a research associate at MIT, I was settling into my new office at Virginia Tech's Department of Biochemistry and Nutrition. Finally, I was a real professor! My research agenda couldn't have been more noble: end childhood malnutrition in poor countries by figuring out how to get more high-quality protein into their diets. My arena was the Philippines, thanks to a generous grant from the US State Department's Agency for International Development (USAID).

The first challenge was to find a locally produced, inexpensive protein source. (Even though malnutrition is largely an issue of not getting enough calories overall, in the mid-1960s we thought that calories from protein were somehow special.) The second challenge was to develop a series of self-help centers around the country where we could show mothers how to raise their children out of malnutrition by using that protein source. My team and I chose peanuts, which are rich in protein and can grow under lots of different conditions.

At the same time, I was working on another project at the request of my department chair, Charlie Engel. Charlie had secured USDA funding to study a cancer—causing chemical produced by a fungus, *Aspergillus flavus*, and my job was to learn all I could how the fungus grew so we could prevent it from growing on various food sources. This was clearly an important project, as there was quite a bit of evidence that *Aspergillus flavus* caused liver cancer in lab rats (the mainstream assumption was, and still is to this day, that anything that causes cancer in rats or mice probably also causes cancer in humans).

I soon discovered that one of the main foods *Aspergillus flavus* contaminates is . . . peanuts. In one of those cosmic coincidences that appear amazing only years later, I found myself studying peanuts in two completely different contexts simultaneously. And what I found when I looked deeply into these two seemingly unrelated issues (protein deficiency among the poor children of the Philippines and the conditions of *Aspergillus flavus* growth) started to shake my world and caused me to question many of the bedrock assumptions on which I and most other nutritional scientists had built our careers.

Here's the main finding that turned my worldview—and ultimately, my world—upside down:

The children in the Philippines who ate the highest protein diets were the ones most likely to get liver cancer—even though the children with high-protein diets were significantly wealthier, and had better access to all the things we typically associate with childhood health, like medical care and clean water.

I chose to follow this discovery everywhere it led me. As a result, the trajectory of my career veered in unexpected and unsettling directions, many of which are detailed in my first book, *The China Study*. Ultimately, I became aware of two things: First, that nutrition is the master key to human health. Second, that what most of us think of as proper nutrition—isn't.

If you want to live free of cancer and heart disease and diabetes for your entire life, that power is in your hands (and your knife and fork). But sadly, medical schools, hospitals, and government health agencies continue to treat nutrition as if it plays only a minor role in health. And no wonder: the standard Western diet, along with its trendy "low-fat" and "low-carb" cousins, is actually the cause, not the cure, of most of what ails us. In a nutshell: The "miracle cure" science has been chasing for the past half century turns out not to be a new wonder drug painstakingly formulated based on decades of brilliant and relentless lab work, not a cutting edge surgical tool or technique using lasers and nanotechnology or some transformation of our DNA that will turn us all into immortal Apollos and Venuses. Instead, the secret of health has been in front of us all along, in the guise of a simple and perhaps boring word: nutrition. When it comes to our health, it turns out the trump card is the food we put in our mouths each day. In the process of learning all this, I also learned something else very important: why most people didn't know this already.

The medical and scientific research establishments, far from embracing these findings, have systematically dismissed and even suppressed them.

Few medical professionals are aware that our food choices can be far more effective shields against disease than the pills they prescribe.

Few health journalists report the unambiguous good news about radiant health and disease prevention through diet.

Few scientists are trained to look at the "big picture," and specialize in scrutinizing single drops of data instead of comprehending meaningful rivers of wisdom.

And paying the piper and calling the tune for all of them are the pharmaceutical companies and food industry, trying to convince us that salvation can be found in a pill or an enriched snack food made from plant fragments and artificial ingredients.

The truth. How it's been kept from you. And why. That's what this book is all about.

Why This Book

If you've read *The China Study*, you've heard some of this before. You know the truth about nutrition, and you've heard a little bit about the resistance I and other scientists have faced in trying to bring this truth to light.

Since its publication in 2005, millions of people have read or read about *The China Study* and shared its insights with friends, neighbors, colleagues, and loved ones. Not a day goes by



that I don't hear grateful testimonials to the healing power of whole, plant based foods. Anecdotal as each of these stories may be, the overall weight of their combined evidence is substantial. And each of them is more than ample compensation for the troubles and obstacles placed in front of me by powerful interests who make money from our collective ignorance.

Also since 2005, many of my colleagues have conducted varied studies that show even more powerfully the effects of good eating on the various systems of the human body. At this point, any scientist, doctor, journalist, or policy maker who denies or minimizes the importance of a whole food plant-based diet for individual and societal well being is following another agenda coming from a different worldview. There's just too much good evidence to ignore anymore.

And yet, in some ways, very little has changed. Most people still don't know that the key to health and longevity is in their hands. Whether maliciously or, as is more often the case, due to ignorance, the mainstream of Western culture is hell-bent on ignoring, disbelieving, and, in some cases, actively twisting the truth about what we should be eating—so much so that it can be hard for us to believe that we've been lied to all these years. It's often easier to simply accept what we've been told, rather than consider the possibility of a conspiracy of control, silence, and misinformation. And the only way to combat this perception is to show you how and why it happened.

That's why this new book felt necessary. *The China Study* focused on the evidence that tells us the whole foods, plant-based diet is the healthiest human diet. *Whole* focuses on why it's been so hard to bring that evidence to light—and on what still needs to happen in order for real change to take place.

Whole: The Sum of its Parts

This book is split into four sections.

The first, Part I, provides a little more information about my and others' research on the whole foods, plant-based diet, my reflections on some of the most prominent criticisms that research has received since the publication of *The China Study*, and more of my own background and journey, as a context for understanding where the philosophies in this book have come from.

The second section of this book, Part II, looks at the reason it's so hard for so many to not just accept, but even *see*, the health implications of this research: the mental prison, or paradigm, in which Western science and medicine operate, that makes it impossible to see the obvious facts that lie outside it. For many reasons, we now operate under a paradigm that looks for truth only in the smallest details, while ignoring entirely the big picture. The popular expression "can't see the forest for the trees" makes the point well, except that there's much more at stake here than just trees and forests. Modern science is so detail-obsessed that we can't see the forest for the vascular cambium and secondary phloem and so on. There's nothing wrong with looking at details (I spent most of my research career doing just that); the trouble occurs when we start denying that there *is* a big picture, and stubbornly insist that the narrow reality we see, heavily laden with our own biases and experiences, is all there is.

The fancy word for this obsession with minutiae is "reductionism." And reductionism comes with its own seductive logic, so that people laboring under its spell can't even see that there's another way to look at the world. To reductionists, all other worldviews are unscientific, superstitious, sloppy, and not worthy of attention. All evidence gathered by non-reductionist means—presuming that research can get funding in the first place—is ignored or suppressed.

Part III looks at another big factor in this equation—the economic forces that reinforce and exploit this paradigm for their own self-interest as they chase after financial success. These forces completely manipulate the public conversation about health and nutrition to suit their bottom line. We'll look at the many ways money affects thousands of small decisions that add up to a big impact on what, you, the public, hears (and doesn't hear) and thus believes about health and nutrition.

Finally, in Part IV, we look at the totality of what's at stake here, the ways things are changing, and stories about others that have started to make a difference.

The Truth Belongs to All of Us

I wanted to tell this story because I owe it to you, the public. If you are a U.S. taxpayer, you paid for my career in research, teaching, and policy making. I have known too many people, including friends and family, who suffered ill health unnecessarily, just because they did not know what I have come to know—and they also were taxpayers. You have a right to know what your money bought and a right to benefit from its findings.

My own disclaimer: I have no financial interest in your believing me. I don't sell health products, health seminars, or health coaching. I'm seventy-nine years old, I've had a long and rewarding career, and I'm not writing this book to make a buck. When you start talking about what you've learned from this book with your friends and you encounter passionate disdain for me and my motives (and you will!), just consider the original source of the claims they're citing. Ask yourself: What's their financial interest? What do they have to gain from suppressing the information I share here? Telling this story has been a challenge. I know well that a diet only of plants sounds like a wacky idea to many folks. But that's starting to change. This idea becomes bigger and bigger with the passing of time. The current system is unsustainable. The only question is, will we free ourselves before it takes us down with it? Or will we continue to pollute our bodies, our minds, and our planet with the slag of that system until it collapses under its own economic weight and biological logic?

In previous generations, how we ate appeared to be a personal and private matter. Our food choices didn't seem to contribute much, one way or the other, to the well-being or suffering of other people, let alone animals, plant life, and the carrying capacity of the entire planet. But even if that were ever true, it no longer is. What we eat, individually and collectively, has repercussions far beyond our waistlines and blood pressure readings. No less than our future as a species hangs in the balance.

The choice is ours. My hope is that this book will encourage you to choose wisely—for your health, for the next generations, and for the entire planet.

T. Colin Campbell Lansing, New York



Chapter 1

The Modern Health Care Myth

What a great time to be alive! Modern medicine promises salvation from scourges that have plagued humanity since time began. Disease, infirmity, aging—all soon eradicated thanks to advances in technology, genetics, pharmacology, and food science. The cure for cancer is just around the corner. DNA splicing will replace our self-sabotaging or damaged genes with perfectly healthy ones. New wonder drugs are discovered practically every week. And genetic modification of food, combined with advanced processing techniques, will soon be able to turn a simple tomato, carrot, or cookie into a complete meal. Heck, maybe someday soon we won't have to eat at all—we can just swallow a pill that contains every nutrient we need.

There's only one problem with that rosy picture—it's totally false. None of those lofty promises are anywhere close to being realized. We "race for the cure" by pouring billions of dollars into dangerous and ineffective treatments. We seek new genes, as if the ones we've evolved over millions of years are insufficient for our needs. We medicate ourselves with toxic concoctions, a small number of which treat the disease, while the larger number treat the harmful side effects of the primary drugs.

We talk about the health care system in America, but that's a misnomer; what we really have is a disease care system.

Fortunately, we have a far better, safer, and cheaper way of achieving good health—one with only positive side effects. Furthermore, this approach prevents most of the diseases and conditions that afflict us before they show up, so we don't need to avail ourselves of the disease care system in the first place.

The Disease Care System

The US spends more money, per capita, on "health" care than any nation on earth, yet in quality of health care we rank near the bottom when compared with other industrialized nations.

As a country, we're quite sick. Despite our high rate of health expenditures, we're not any healthier. In fact, our rates of many chronic diseases have only increased over time, and based on health biomarkers like obesity, diabetes, and hypertension, it may be headed for further increases. Obesity increased from 13% of the US population in 1962 to a staggering 34% in 2008. (http://www.usatoday.com/news/health/weightloss/2010-01-13-obesity-rates_N.htm) The US Centers for Disease Control and Prevention report that the age-adjusted Type II diabetes rate in the US has more than doubled from 1980 to 2010, from 2.5% to 6.9% of the population. (http://www.cdc.gov/diabetes/statistics/prev/national/figage.htm) Hypertension (high blood pressure) among American adults increased 30% between 1997 and 2009.

Drugs and surgical advances are keeping the death rates more or less constant despite the increased risk factors (except for diabetes, whose mortality rate has increased an astounding 29% in North America from 2007 to 2010). (http://www.worlddiabetesfoundation.org/composite-35.htm) But the data make it clear that none of the advances in medicine deals with primary prevention, and none is making us fundamentally healthier. Those advances aren't *improving* the death rate. And the price we're paying for them is steep.

For many years, costs of medically prescribed drugs have been increasing at a rate faster than inflation. Think we're getting our money's worth? Think again.

Side effects of those very same prescription drugs are the third leading cause of death, behind heart disease and cancer. That's right! Prescription drugs kill more people than traffic accidents. According to Dr. Barbara Starfield, writing in the *Journal of the American Medical Association* in 2000, "adverse effects of medications" (from drugs that were correctly prescribed and correctly taken) kill 106,000 people per year. And that doesn't include accidental overdoses.

Add to that the 7000 annual deaths from medication errors in hospitals, 20,000 deaths from non-prescription-related errors in hospitals (like botched surgeries and incorrectly programmed and monitored machines), 80,000 deaths from hospital-caused infections, and 2000 deaths per year from unnecessary surgery. The tire-screeching ambulance ride starts to look like the safest part of the whole hospital experience.

Yet when you ask the US government about this, you're met with deafening denial. Check out this Centers for Disease Control (CDC) web page on the leading causes of death:

Notice anything strange? Not a peep about the medical system being the third leading cause of death in the US. Admitting that would be bad for business, and if the US government cares about one thing here, it's the economic interests of the medical establishment.

But what about when medical care doesn't kill? Surely the benefits to millions outweigh a few hundred thousand deaths each year?

Visit a nursing home or geriatric center to see for yourself how well the system serves those who need it most. You'll feel the physical and emotional pain of once-vibrant people suffering needlessly with ailments and illnesses caused in large part by the pharmaceutical cocktails they take. Who can blame them? Doctors know best, right? And how many daytime TV commercials have they watched, promoting drugs to decrease their blood cholesterol, drive down their blood sugar, and increase their sex drive?

I could go on and on. But I think you get the picture: the more we spend on disease care, the sicker and more miserable we seem to become.

The Good News

All our trillions of dollars are not improving our health outcomes. The promised breakthroughs are always a decade away, and receding just as fast as we chase them. Genetic research has led to nightmarish anti-privacy scenarios, as well as tragic misunderstandings in which mothers are having their young daughters' breasts chopped off just because some geneticist pricked their daughters' fingers, tested their DNA, and scared them half to death with predictions of possible future breast cancer.

That's all pretty depressing, I admit.

The good news is that we don't need medical breakthroughs or genetic manipulation to achieve, maintain, and restore vibrant health. A half-century of research—both mine and that of many others—has convinced me of the following:

- What you eat every day is a far more powerful determinant of your health than your DNA or most of the nasty chemicals lurking in your environment.
- The foods you consume can heal you faster and more profoundly than the most expensive prescription drugs, and more profoundly than the most extreme surgical interventions, with only positive side effects.
- Those food choices can prevent cancer, heart disease, Type II diabetes, stroke, macular degeneration, migraines, erectile dysfunction, and arthritis and that's only the short list.
- It's never too late to start eating well. A good diet can *reverse* many of those conditions as well.

In short: change the way you eat, and you can transform your health for the better.

The Ideal Human Diet

For some reason, "health food" has a reputation for being tasteless and joyless. You might be thinking at this point that the "miracle diet" for human health must be the most grim fare imaginable. Fortunately, that's not the case. Thankfully, evolution has programmed us to seek out and enjoy foods that promote our health. All we have to do is get back to our "dietary roots"—nothing radical or miserable required.

The ideal human diet looks like this: Consume plant-based foods in forms as close to their natural state as possible ("whole" foods). Eat a variety of vegetables, fruits, raw nuts and seeds, beans and legumes, and whole grains. Avoid heavily processed foods and animal products. Stay away from added salt, oil, and sugar. Aim to get 80 percent of your calories from carbohydrates, 10 percent from fat, and 10 percent from protein.

That's it, in 73 words. In this book I call it the whole foods plant-based (WFPB) diet—and sometimes, the WFPB lifestyle (I'm not crazy about the word "diet," which implies a heroic and temporary effort rather than a sustainable and joyful way of eating).

If the WFPB Were a Pill

Just how healthy is the WFPB diet? Let's pretend that all its effects could be achieved through a drug. Imagine a big pharmaceutical company holding a press conference to unveil a new pill called Eunutria. They unveil a list of scientifically proven effects of Eunutria that includes the following:

- Prevents 95% of all cancers, including those "caused" by environmental toxins
- Prevents nearly all heart attacks and strokes
- Reverses even severe heart disease

• Prevents and reverses Type II diabetes so quickly and profoundly that, after three days on this drug, it's dangerous for users to stick to previous insulin levels

What about side effects, you ask? Of course there are side effects. They include:

- Gets you to your ideal weight in a healthy and sustainable fashion
- Eliminates most migraines, acne, colds and flus, chronic pain, and intestinal distress
- Improves vision and hearing
- Cures erectile dysfunction (that makes the pill a blockbuster success all by itself!)

Those are just the side effects for individuals taking the pill. The pharmaceutical company also touts an entirely different class of side effects, environmental ones:

- Slows and possibly reverses global warming
- Reduces ground water contamination
- Ends the need for deforestation
- Shuts down factory farms
- · Reduces malnutrition and dislocation among the world's poorest citizens

How healthy is the WFPB diet? It's hard to imagine anything healthier—or anything more effective at addressing our biggest health issues. Not only is WFPB the healthiest way of eating that has ever been studied, but it's far more effective in promoting health and preventing disease than prescription drugs, surgery, vitamin and herbal supplementation, and genetic manipulation.

If the WFPB diet were a pill, its inventor would be wealthiest person on earth. Since it isn't a pill, no market forces conspire to advocate for it. No mass media campaign to promote it. No insurance coverage pays for it. Since it isn't a pill, and nobody has figured out how to get

hugely wealthy by showing people how to eat it, the truth has been buried by half-truths, unverified claims, and downright lies. The concerted effort by many powerful interests to ignore, discredit, and hide the truth has worked, so far.

Why WFPB Makes Sense

I have spent the last few decades studying the effects of WFPB; at this point, for me, those results are convincing, based solely on the data. But it's still helpful to explore the question of why: Why is WFPB the healthiest way for humans to eat? Based on my training as a biochemist, I have a few conjectures to share that boil down to one concept: oxidation gone awry.

Oxidation is the process by which molecules lose electrons as they come into contact with other molecules; it's one of the most basic chemical reactions in the universe. When you cut an apple and it turns brown in contact with air, or when your car fender rusts, you're witnessing oxidation at work. Oxidation happens within our bodies as well. Some of it is natural and good; oxidation facilitates the transfer of energy within the body. Oxidation also gets rid of potentially harmful foreign substances in the body by making them water soluble (and therefore able to be excreted in urine). Excessive uncontrolled oxidation, however, is the enemy of health and longevity in humans, just as excessive oxidation turns your new car into a junker and your apple slice into compost. Oxidation produces something called free radicals, which we know are responsible for incurring aging, initiating cancer by damaging our DNA, and rupturing plaques, leading to strokes and heart attacks.

Excessive oxidation happens the most during robust transfers of energy. So how might a plant-based diet protect us from the disease-causing effects of free radicals? For one thing, there is some evidence that high protein diets enhance free radical production, thus encouraging

unwanted tissue damage. But it's virtually impossible to eat a high-protein diet if you're consuming mostly whole plant-based foods. Even if you munched on legumes, beans and nuts all day, you'd be hard pressed to get more than 12% or so of your calories from protein.

But there's much more to WFPB than the high protein animal foods it replaces. It turns out that plants also produce harmful free radicals, in their case during photosynthesis. To counteract that free radical production, plants have evolved a defense mechanism: a whole battery of compounds that prevent damage by binding and neutralizing the free radicals. These compounds are known, not particularly poetically, as antioxidants.

When mammals consume plants, we're also consuming the antioxidants in those plants. And they serve us just as faithfully and effectively as they serve the plants, protecting us from free radicals and slowing down the aging process in our cells. Remarkably, they have no effect on the useful oxidative processes I talked about earlier. They only neutralize the harmful products of excessive oxidation.

It seems reasonable to assume that we animals never went to the trouble of making our own antioxidants because they were so readily available in what, for most of our history, was our primary food source: plants. It's only when we shifted to a diet rich in animal-based food and processed food fragments that we tilted the game in favor of oxidation. The excessive protein promotes excessive oxidation, and we no longer consume enough plant-produced antioxidants to contain and neutralize the damage.

It's important to remember, however, that this is just a theory. The most important thing is not *why* the WFPB diet works so much as the fact that it *does* work. The evidence is clear about the WFPB diet's effectiveness—whatever the reason may be.



Frequently Asked Questions

When I lecture publicly, I'm often asked about the numbers. Many people want precise formulas and rules. How many ounces of leafy greens should I eat daily? What proportion of my diet should be fat, protein, or carbohydrate? How much vitamin C and magnesium do I need? Should certain foods be matched with other foods and, if so, in what proportion? And the number one question I'm asked is, "Do I need to eat 100% plant-based to obtain the health benefits you talk about?"

If you're asking those questions right now, here's my answer: Relax. When it comes to numbers, I am reluctant to be too precise, mostly (1) because we don't yet have scientific evidence that fully answers these questions, (2) because virtually nothing in biology is as precise as we try to make it seem, and (3) because, as far as the evidence suggests at this point, eating the WFPB way eliminates the need to worry about the details. Just eat lots of different plant foods; your body will do all the math for you!

As far as whether one should strive to eat 100 percent plant-based instead of something less—say, 95-98 percent—my answer is that I am not aware of reliable scientific evidence showing that such purity is absolutely necessary—at least in most situations. (Exceptions would include patients with cancer, heart disease, and other potentially fatal ailments, for whom any deviation can lead to worsening or relapse.) I do believe, however, that the closer we get to a whole foods, plant-based diet, the healthier we will be. I say this not because we have foolproof scientific evidence of this, but because of the effect on our taste buds. When we go the whole way, our taste buds change and remain changed, as we begin to acquire new tastes that are much more compatible with our health. You wouldn't advise a heavy smoker who wants to quit to continue smoking one cigarette per day. It's much easier to go 100 percent than 99 percent, and you're much more likely to succeed in the long run.

I'm also often asked whether I consider the WFPB diet to be vegetarian or vegan. When describing the WFPB diet, I prefer not to use the "V" words. Most vegetarians still consume dairy, eggs, too much added oil, refined carbohydrates and processed foods. Vegans, although eliminating all animal-based foods, also often continue to consume added fat (including all cooking oils), refined carbohydrates (sugar, refined flour), salt, and processed foods. The phrase "whole food plant-based" is one I first introduced to my colleagues in 1978-80, when I was a member of a NIH cancer research grants review panel. Like me, they were reluctant to use the words vegetarian and vegan, or assign a particular value to ideology that lies behind much vegetarian and vegan practice. I was interested in describing the remarkable health effects of this diet in reference to the scientific evidence, rather than in reference to personal and philosophical ideologies—however noble they may be.

Why Should You Listen to Me?

Later in this book, I'll share a more personal life and career trajectory in this book, but I do want to briefly recap my research career so you can decide right away whether I have credibility on the subjects I cover here.

For more than fifty years, I have lectured and done experimental research on the complex effects of food and nutrition on health. For approximately forty of those years I did laboratory experiments with my many students and colleagues. For twenty of those same years I was a member of expert committees evaluating and formulating national and international policies on food and health and determining which research ideas should be funded. (Often, my views were in the minority and did not end up having the impact I would have liked on policy—one reason, in fact, that I left academia and starting writing "popular" books.) I have published more than 350 research papers, most of which were peer-reviewed, in the very best scientific journals. I have served on the editorial review boards of several top-flight scientific journals. In short, I have been for the last half a century deeply immersed in the development of scientific evidence all the way from its experimental origin to the presentation of results in the classroom and the public arena.

WFPB: An Idea Whose Time Has (Almost) Come

In *The China Study*, I shared the research, my own and that of others, that led me to champion the WFPB diet as the optimal human diet. I must admit to some naiveté when that book hit the shelves in early 2005. I was hopeful that the (in my view) incontrovertible evidence reported in that volume would shake up the American way of eating. I innocently thought that the truth, by itself, could inform government policy, shape business decisions, and change the public debate on food.

To a limited extent, all those things have happened. Some very powerful ex-government officials (including former president Bill Clinton) have touted *The China Study* and plant-based nutrition in general. Progressive and influential companies like Google and Facebook offer many WFPB dishes in their cafeterias. It's much easier to buy WFPB ingredients, meals, and snacks at grocery stores, restaurants, and online outlets than ever before. And the recent "gluten-free" craze (about which the scientific debate is still raging) has pushed many people away from highly processed breads, cookies, and pastas and toward less refined and more natural alternatives.

But the mainstream culture has not embraced plant-based eating. The government still teaches and subsidizes the wrong things. Businesses still cater to the Standard American Diet (aptly abbreviated the "SAD" diet), comprised largely of white flour, white sugar, hormoneinjected and antibiotic-doused meat and dairy, and artificial colors, flavors, and preservatives. And "low-carb" supporters typically advocate a diet consisting of an unconscionable amount of animal protein and fat. Partly, this book is my attempt to answer a very troubling question: Why? If the evidence for a WFPB diet is so convincing, why has so little been done? Why do so few people know about it?

Before I share what I believe, based on my decades of work in the nutrition field, are the answers—answers that have implications not only for our food choices and health care system, but for the vibrancy of our democracy and our future as a species—I want to make sure you are aware of the evidence for the WFPB lifestyle. In the next chapter I'll share that evidence, explain how I evaluate research, and address the most important criticisms of my research into the relationship between diet and disease.



Thanks for checking out the first chapter of

