Der Kardiologenskandal - Urteilen Sie selbst

Seit 1848 gibt es in Deutschland innerhalb der Medizin die „Antisemmelweissfraktion“

Einen Ableger davon gibt es innerhalb der Kardiologenzunft, die die nachfolgende Forschungslage innerhalb der Herz-Kreislauf Kontexte nicht kennt, nicht kennen will, vorsätzlich verleugnet oder innerhalb der Schopenhauer – Triade lächerlich macht…..

Hintergrund:

https://www.herzschule.org/dean-ornish.html

Dean Ornishs Revolution in der Herztherapie

Der amerikanische Arzt Dean Ornish legte 1990 eine aufsehenerregende Studie* vor, in der er letztlich mittels Herzkatheteraufnahmen nachwies, dass durch eine intensive Lebensstiländerung der Verlauf der Koronaren Herzkrankheit gestoppt, ja rückgängig gemacht werden kann. Lebensstiländerung beinhaltet für Ornish neben Nikotinverzicht nachhaltige Änderungen in folgenden Bereichen:

- Kostumstellung hin zu einer ausgeprägt fettarmen und vegetarischen Diät
- Regelmäßiger Gesundheitssport
- Verbesserter Umgang mit Stress, u.a. mittels täglicher meditativer Praxis.
- Betonung der Bedeutung liebevoller menschlicher Beziehungen und sozialer Unterstützung, u.a. in Gruppen von Mitbetroffenen („love and support“)

Ornish erarbeitete für diese Bereiche differenzierte Programme, die sowohl präventiv wie rehabilitativ eingesetzt werden können. Dabei betont er immer wieder, dass es nicht der einzelne Baustein ist, etwa die Diät, dem die Hauptwirkung zuzuschreiben ist, sondern dass erst das Zusammenwirken aller Komponenten den Erfolg bringt. Anwendungsbereiche waren zunächst neben der Koronaren Herzkrankheit Übergewicht, erhöhte Blutfette, Bluthochdruck sowie Diabetes mellitus Typ 2 ("Altersdiabetes"). In Nachfolgestudien zeigte er, dass die von ihm propagierte Lebensstiländerung ebenfalls günstige Einflüsse auf das genetische Substrat von Alterungsprozessen sowie auf bestimmte Tumorkrankheiten wie z. B. den beginnenden Prostatakrebs hat.

Für Ornish ist der Patient in keiner Weise Befehlsempfänger oder Mündel des Arztes in Sachen Krankheit und Gesundheit, sondern eine eigenverantwortliche, mündige Persönlichkeit, die mit dem Arzt auf Augenhöhe kommuniziert. Eigenverantwortung bedeutet aber auch Eigenaktivität. Erfolg wird sich nur einstellen, wenn der Patient selbst an seiner Gesundung und Gesunderhaltung aktiv mitwirkt.

Damit entspricht Ornishs Konzept wesentlichen Grundzügen, die auch die Anthroposophische Medizin auszeichnen. Sie baut ebenfalls auf die Eigenaktivität des Patienten, setzt den Willen, wieder gesund werden zu wollen, voraus und ermuntert jeden einzelnen, selbst an der Therapie mitzuwirken. Denn Gesundheit muss immer wieder aufs Neue erworben werden. Sie ist ein dynamischer Prozess.

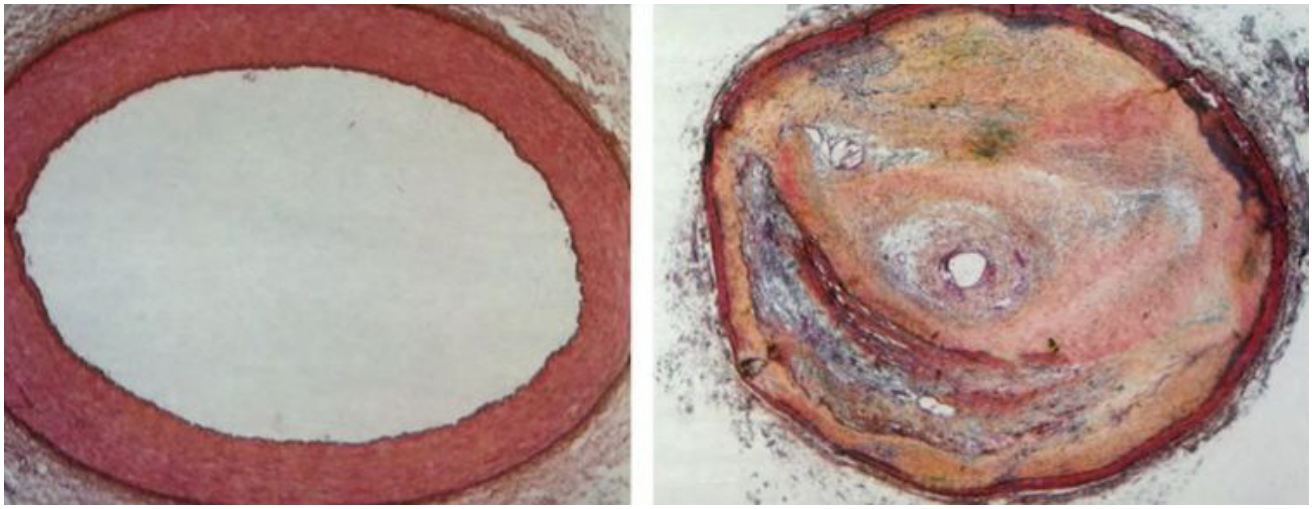
* "Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial." - Lancet 1990; 336: 129-133

Eine eingehende, auch für medizinische Laien gut lesbare Darstellung des Konzeptes ist das Buch:
Dean Ornish: "Revolution in der Herztherapie"
überarb. Neuauflage 2010, Lüchow Verlag

http://www.homeopathy.at/herzerkrankungen-aufloesen-das-esselstyn-wunder

Herzerkrankungen auflösen – das Esselstyn Wunder

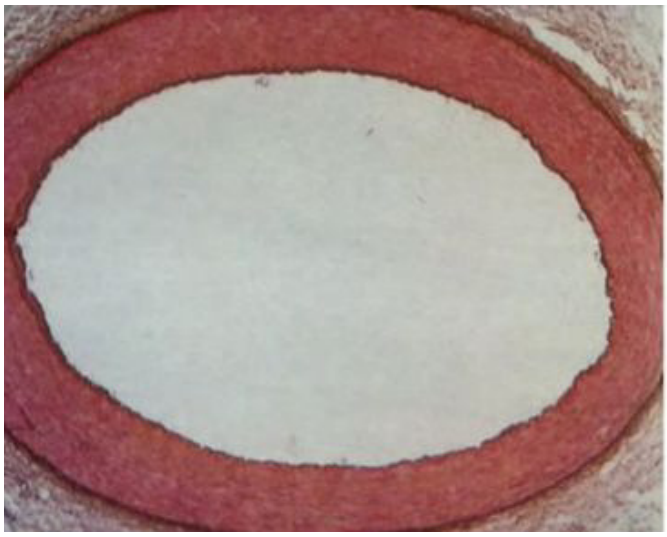
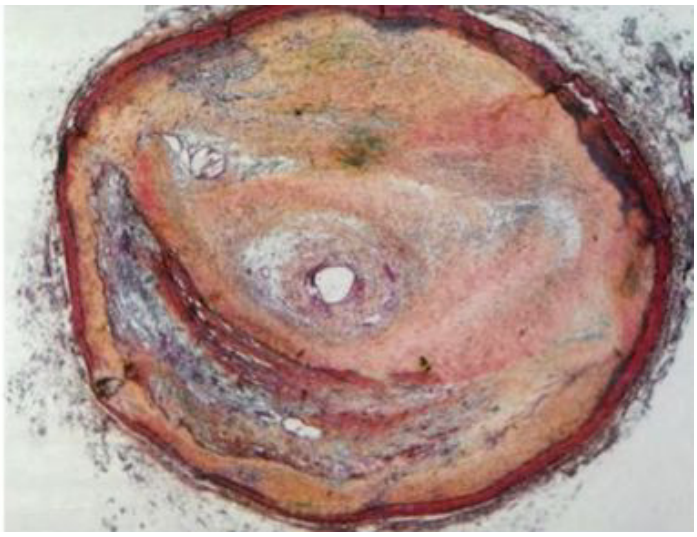
Schlagwort



Dr. Esselstyn hat nicht nur Bill Clinton nach 3 x Bypass-OP geheilt, sondern mittlerweile TAUSENDE Herzkranke.

Dr. Esselstyn war Chirurg und hat nach eigener Aussage (siehe unten das Video) tausende Patienten mit Herzkrankgefäss-Erkrankung kennengelernt, die an seinem Krankenhaus Bypass-OP und implantierte STENTS bekamen.

Ursache von Herzinfarkt und Schlaganfall sind PLAQUES, Cholesterin-Ablagerungen in den Artherien, „Verkalkungen“, Artherio-SKLEROSE.

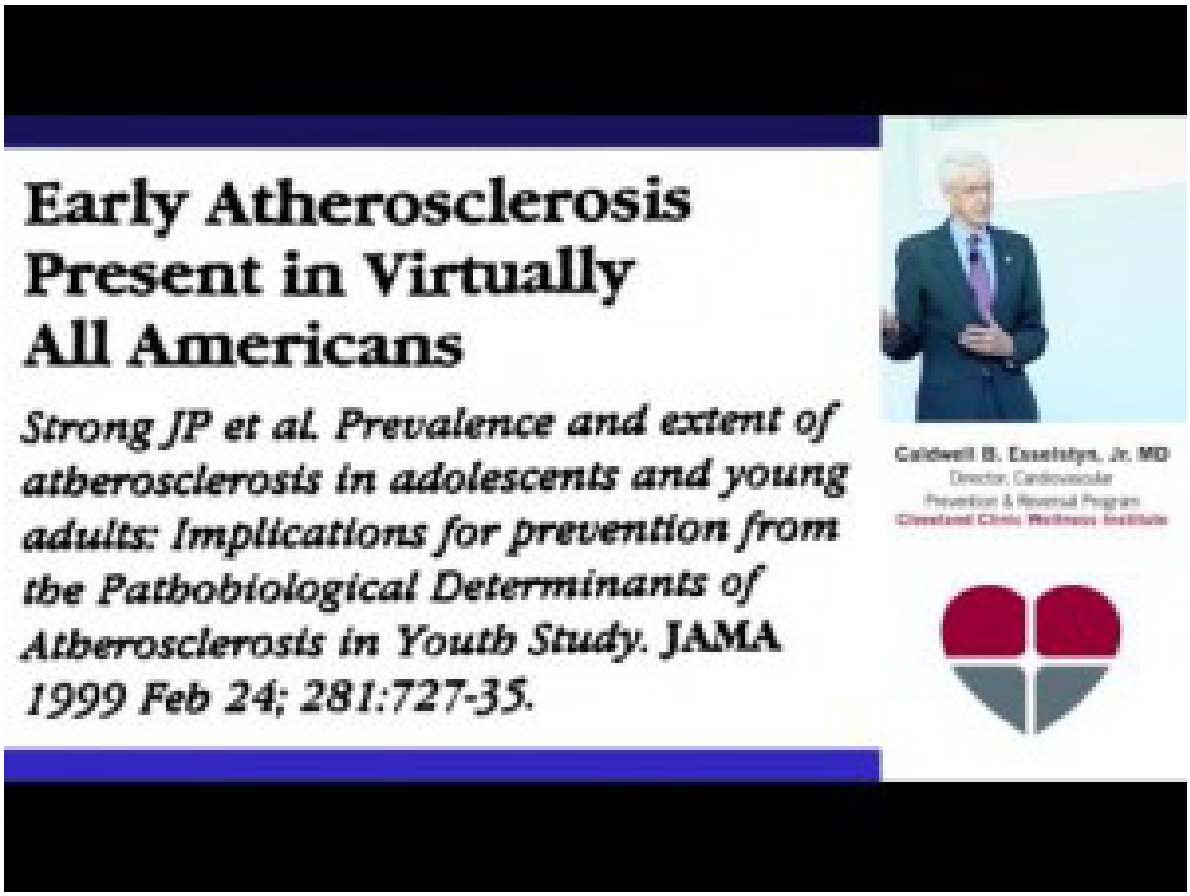



Diese Verkalkungen (Plaques) sind die Folgezustände von Entzündungs-Prozessen, die sich an den Herzkranzgefässen abspielen.

Junge Männer voller Plaques

Bereits seit den Zeiten des VIETNAM Krieges wusste man, dass die jungen Soldaten (gefallen und obduziert) sichtbare Verkalkungen der Herzkranzgefässe hatten.

Aber 1999 erschien eine Studie, in der bei verunfallten Kindern und Jugendlichen gezeigt werden konnte, dass bereits im **Kindes/Jugend-Alter Verkalkungen der Herzkranzgefässe** vorlagen.



Regional hohe Unterschiedlichkeit der Atherosklerose

Gleichzeitig war bekannt, dass **in gewissen Gegenden oder bei bestimmten Kulturen** wie zB

- rurales China,
- Papua Eingeborene,
- Zentral-Afrika,
- Tarahumara Indianer

selbst in hohem Alter keine Verkalkung der Herzkranzgefässe auftritt.

Auch sah man, dass die langlebigen Japaner, sobald sie in die USA kamen und deren Ernährungsweisen übernommen hatten, genau dieselben Erkrankungen im frühen Alter bekamen.

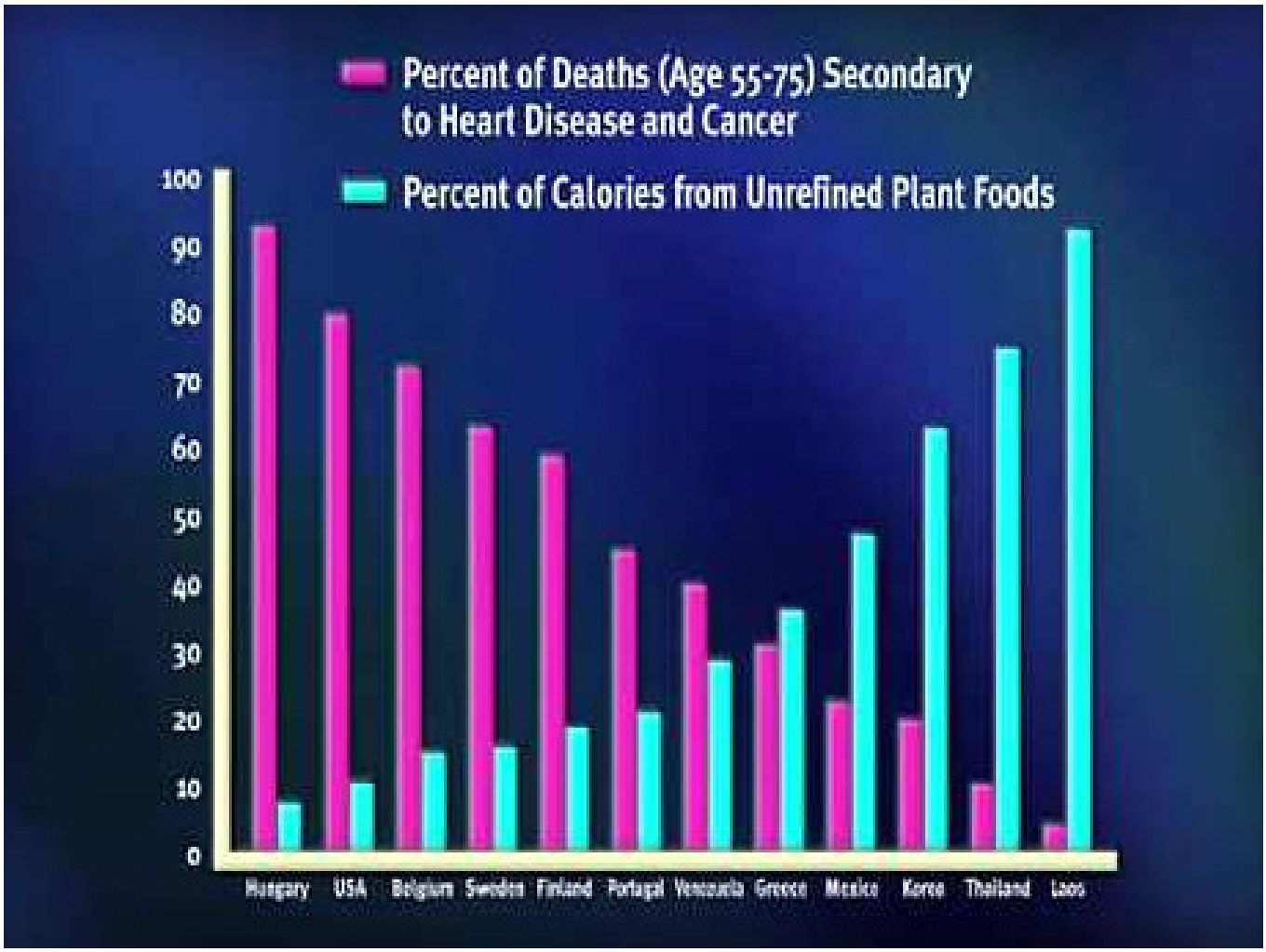
Genetik? Ein Irrweg!!

Es musste also an der US-Ernährung liegen, welche JEDEN erkranken und verkalken lässt, bereits im Kindesalter.

Pflanzenanteil in Ernährung bestimmt Gesundheitsgrad

All diesen Kulturen war gemeinsam, dass sie einen ganz hohen Pflanzlichen Anteil in der Ernährung hatten.

Dies ist ähnlich wie die Untersuchungen welche Dr. Joel Fuhrman als Basis seiner „**EAT 2 LIVE**“ Strategie gemacht hat:



je „WESTLICHER“ Kulturen essen, desto mehr KREBS und HERZ-Krankheiten, je „PFLANZLICHER“ Kulturen essen, desto gesunder!

Dr. Cadwell Esselstyn, Dr. Fuhrman, Dr. Thomas Campbell, Dr. Jamie Plant, Joe Cross, Breuss, Gerson und viele mehr sind tw. extreme Vertreter einer Ernährungs-Variante, die vermutlich tatsächlich den höchsten „Langlebigkeits-Wert“ hat.

Der Hintergrund liegt in der Steuerung der Regeneration und der Entzündung über MIKRO-RNS, ein ganz neues para-genetisches Konzept, welches unsere Wahrnehmung von Vererbung und Anpassung genauso revolutioniert, wie das Konzept der EPIGENETIK.

Weiters ist das Konzept des „intermittierenden Fastens“ genetisch fantastisch gesund und kann mithelfen, die gesunde Lebensspanne ganz deutlich zu verlängern genauso wie bei Erkrankung (Chemo zB) erhebliche Verbesserungen bewirken.

Schliesslich erleben wir in der Praxis die nahezu wundersame Wirksamkeit hoher **Mengen von Magnesium**, einem Mangel-Mineralstoff, welcher durch hohe Mengen von Grün-Pflanzen ebenfalls im Körper erhöht werden kann

Die erstaunliche Wirkung von Magnesium: Über die Bedeutung von Magnesium und Probleme bei Magnesiummangel

by Ana Maria Lajusticia Bergasa [Ennsthaler]
Leser-Reviews
Price: EUR 12,90

Schulmedizin behandelt Symptome, nicht Ursachen

Esselstyn war unzufrieden mit seiner Ärztlichen Leistung: er half mit die Beschwerden zu vermindern, aber hatte nichts in der Hand um den Grundprozess – der schon KINDER befiel – zu beeinflussen!

(Dr.Retzek: stimmt nicht, die Statine vermindern Cholesterin und damit den Verkalkungs-Druck, aber auch dies ist „unnatürliches Doping“ und Aufrechterhaltung eines gefährlichen Lebensstils)

Ernährung als Schlüssel zur Herzgesundheit

Gemäss der epidemiologischen Untersuchungen, der fantastischen China-Studie von Thomas Campbell und vieler vieler weiterer publizierter Daten, welche Substanzen Entzündungen am Blutgefäss (Endothel) auslösen,

nimmt Esselstyn alle Nahrungsmittel weg, die nachgewiesenermassen Entzündungen der Blutgefässe provozierten, dies führte zu einer veganen, stark Rohkost-lastigen Ernährung, bei der er sogar alle ÖLE / FETTE reduziert.

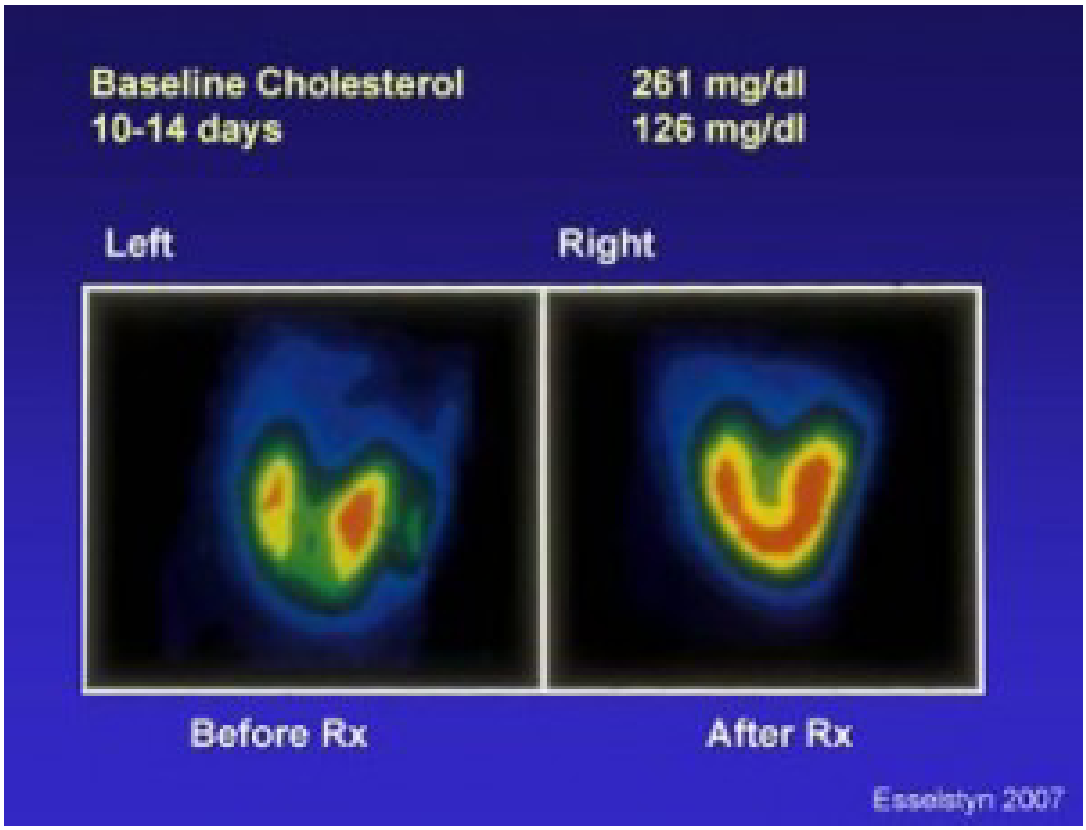
Damit unterscheidet sich Esselstyn von vielen anderen Ernährungs-Spezialisten, seine Argumentation ist jedoch schlüssig: Studien zeigen, dass die meisten Öle mehr Entzündung als Schutz bewirken, dass die Haupt-Schutz-Wirkung in den „Beistoffen“, dem Dreck zu finden ist.

Statt Olivenöl eben Oliven, statt Sonnenblumenöl eben Sonnenblumenkerne usw usf.

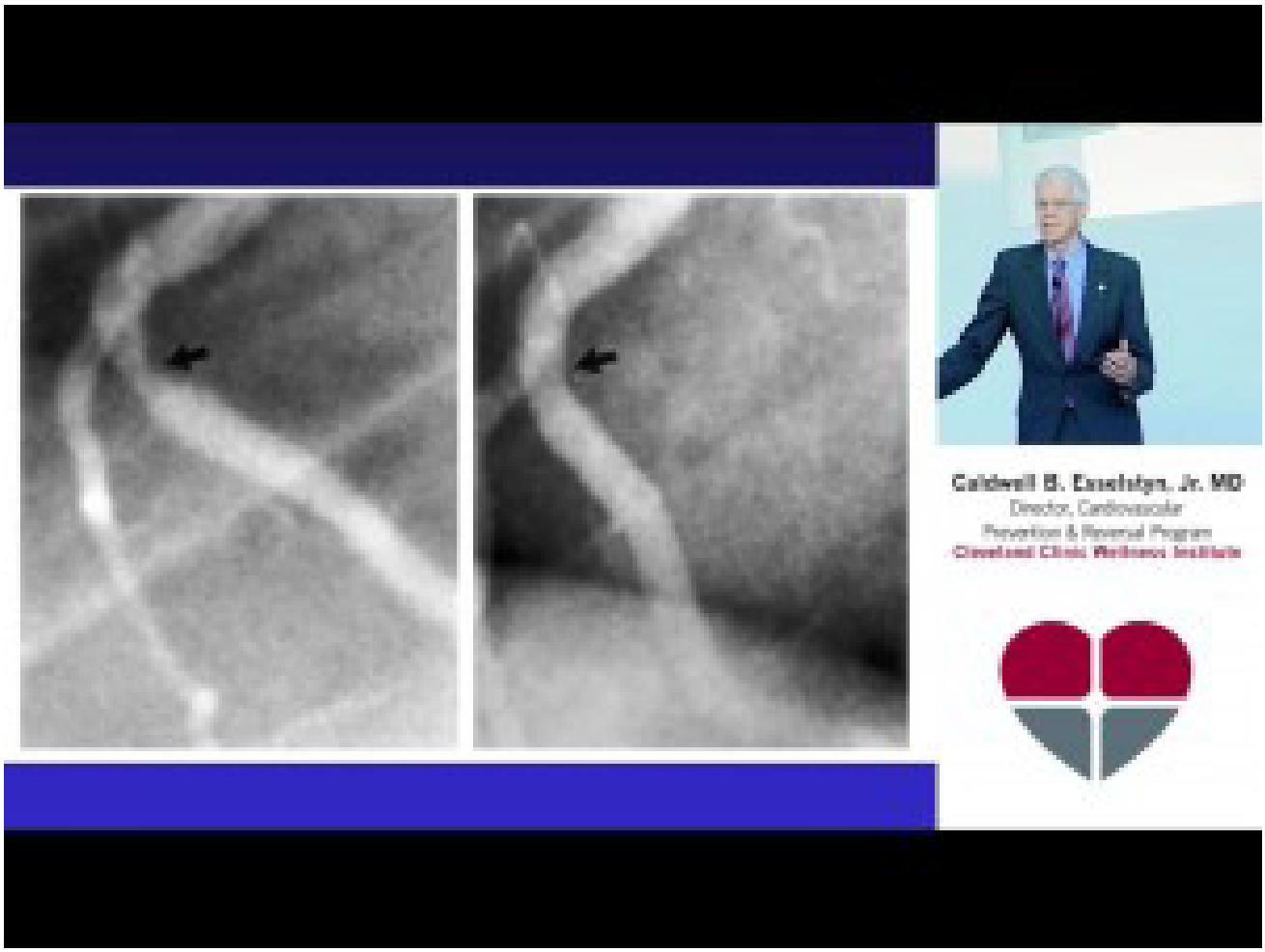
Ergebnisse sind schlichtweg spektakulär

Das was Nesselstyn daraufhin erlebte war für ihn, den erfahrenen Arzt und Chirurgen schlichtweg ein Wunder!

- innerhalb von 2-3 Wochen verschwanden die Herzbedingten Schmerzen (Angina Pectoris)
- innerhalb von 2-3 Wochen reduzierte sich der Cholesterin-Spiegel um > 50%



- **Energie kam hoch**, **Depressionen** verschwanden, **Lebensfreude und Vitalität** kam ins Leben der Menschen, Übergewicht schmolz weg wie Schnee in der Sonne
- und – oh wunder – bei einer **Re-Coronar-Angiographie** zeigte sich dass nach einigen Monaten die **Herzkranzgefässe tatsächlich völlig restauriert waren**



dieses Foto oben ist das Coronar-Angiogramm eines Herzchirurgischen Kollegen von Esselstyn in der Klinik, welcher mit 44j an einer langstreckigen LAD-Stenose litt, zu lange um mit 2-3 Stents überwunden zu werden und der mit ärgsten Beschwerden berufsunfähig war.

Das genaue Angio-Video und mehr Fotos davon sind im Vortrag von Dr. Esselstyn.

Spannend auch, dass dieser Herzchirurg zu Esselstyn sagte „Statine nehme ich sicher keine, ich habe genug Nebenwirkungen davon gesehen!“ (aus dem unten verlinkten Vortrag)

Ordentliches Coaching ist der Schlüssel zum Erfolg

Esselstyn betreute seine Patienten – gemeinsam mit seiner Frau – sehr intensiv. Es war schwer für diese Patienten durch die initial-phase der Ernährungs-Umstellung durchzugehen, ist doch für einen US-Amerikaner das Süssgetränk und der Burger universelle Alltags-Nahrung!

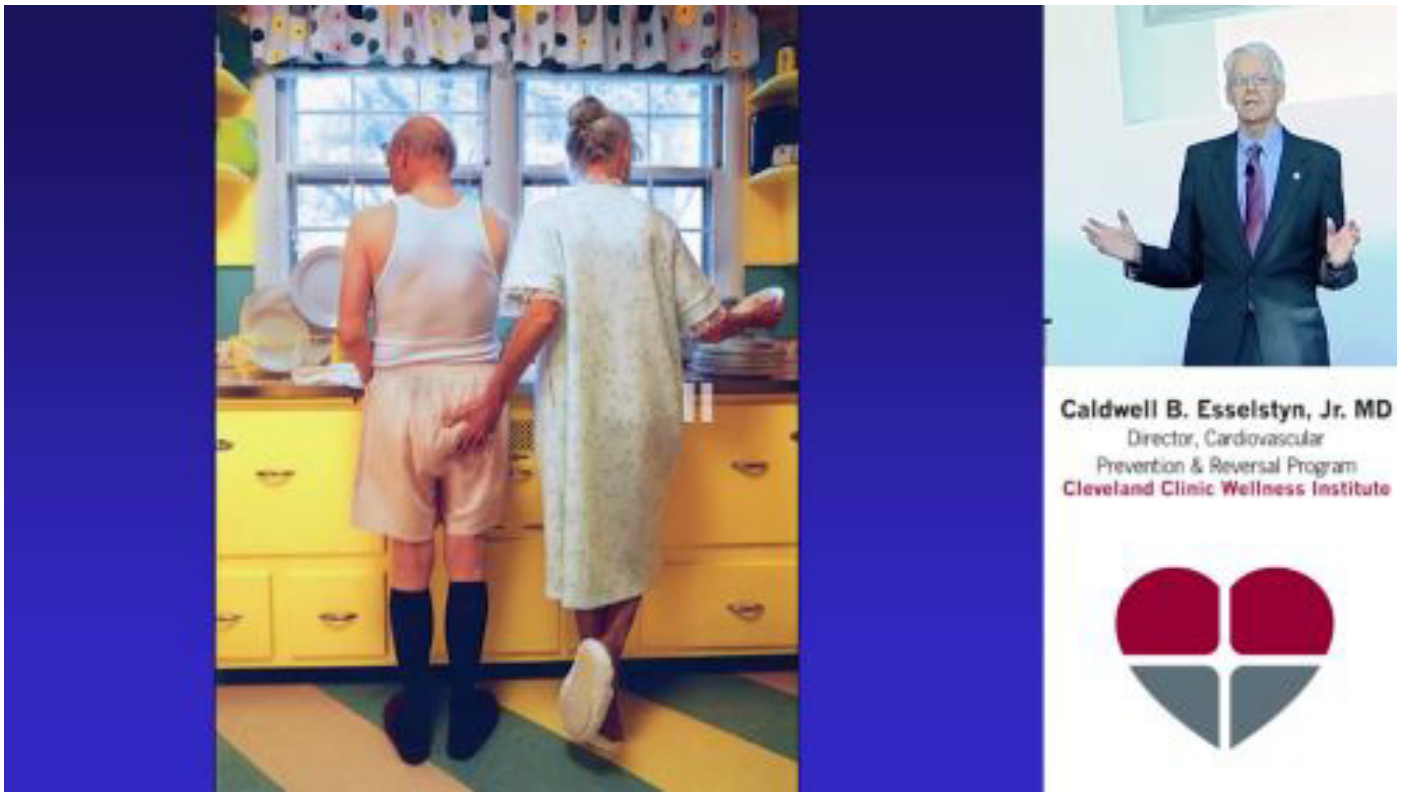
Publizierte Studien

Bereits 1995 publizierte Dr. Esselstyn die ersten Daten in einer Fachzeitschrift, damals mit nur 11 patienten (Studie 1995)

Dr. Esselstyn hatte aber durch sein Coaching eine sehr hohe – über 90% Programm-Adheränz, sodass er tatsächlich 2014 eine Nachstudie mit fast 200 Patienten publizieren konnte mit unglaublichen, fantastischen Ergebnissen: während in der Kontrollgruppe viele Patienten verstorben, jedenfalls immer wieder Herzinfarkte und Schlaganfälle erlitten haben, waren alle seine „Esselstyn-Patienten“ gesund und munter. (Studie / FulltextPDF)

Für Männer interessant – Impotenz als Vorbote des Herzinfarktes

schon früher hab ich bei anderen Herz-Artikeln von mir beschrieben, dass häufig einige Jahre vor dem drohenden Infarkt die Potenz deutlich nachlässt, weil auch hier das zuführende Blutgefäss verkalkt. Dr. Esselstyn konnte von fast allen Patienten berichten, dass sie sehr rasch eine deutliche Verbesserung ihrer Potenz erfuhren.



Zahlreiche weitere Studien bestätigen die Ergebnisse von Dr. Esselstyn

In der Pubmed finden sich mittlerweile von zahlreichen Arbeitsgruppen entsprechende Untersuchungen zur Anti-Plaque-Diät und der tw. vollständigen Wiederherstellung einer herzgesundheit durch Ernährung und Mikronährstoffe (Suchterm für Pubmed)

Bill Clinton wieder hergestellt durch Ernährungsumstellung nach Esselstyn

Literatur:

Revolution in der Herztherapie: Der Weg zur vollkommenen Gesundheit

https://www.amazon.de/Revolution-Herztherapie-Weg-vollkommenen-Gesundheit/dp/389901328X/ref=sr_1_1?ie=UTF8&qid=1528786442&sr=8-1&keywords=ornish

Essen gegen Herzinfarkt: Das revolutionäre Ernährungskonzept

https://www.amazon.de/Essen-gegen-Herzinfarkt-revolution%C3%A4re-Ern%C3%A4hrungskonzept/dp/3432108435/ref=sr_1_1?s=books&ie=UTF8&qid=1528786492&sr=1-1&keywords=esselstyn


Caldwell B. Esselstyn
ESSEN GEGEN
HERZINFARKT
Das revolutionäre
Ernährungskonzept
TRIAS

http://www.homeopathy.at/ernaehrung-um-gesund-zu-altern

Dr. Joel Fuhrman ist mein „derzeitiger“ (2015) Hero hinsichtlich Ernährung. Er hat mich in wenigen Minuten überzeugt mit folgenden paar Aussagen:

Dr. Fuhrman präsentiert folgende Erklärung:

„die meisten Konzepte basieren auf einer Story, einer Geschichte, einer Idee. Es werden dann sowohl Erklärungen als auch Studien passend zu dieser Idee gesucht und natürlich auch gefunden aber gleichzeitig alle widersprüchlichen Daten ausgeblendet“.

„für mich zählen vor allem Langzeit-Untersuchungen die aufzeigen, wie kann ich möglichst gesund hundert Jahre alt werden“.

„zB die Weizen-Wampe: ein schlampig recherchiertes Buch mit wirklich schlechtem wissenschaftlichem Hintergrund. Es werden ständig negativen Effekte der Intoleranz gegen Weizen-Glutens mit dem schlechten metabolischem Wert des hohen glykämischen Index zusammengemischt. Es wird ignoriert bzw. kein einziges mal drauf hingewiesen, dass es v.a. der Feinheits-Grad des Getreide-Mehls ist, was dessen Glykämischen Index bestimmt. Vollkornmehl muss feiner gemahlen werden als weisses Mehl, desswegen hat es einen höheren Glykämischen Index während ganzer Weizenkorn- gekocht wie Reis – einen ziemlich niederen glykämischen Index mitbringt.“

„eine Ernährung wie Paleo ist ein klassisches Beispiel für ‚Erfinden einer Geschichte‘ und Zusammensuchen von Beispielen, welche diese stützt. Die Urmenschen haben nicht PALEO gegessen, deren Essverhalten wurde sicher bestimmt vom Angebot, denn es galt nur zu überleben. Dies ist eine völlig andere Situation wie heute, wo wir im Überfluss leben und auswählen können bzw. müssen, was wir zu uns nehmen um möglichst gesund 100 Jahre alt zu werden.“

Natürlich auch mit seinen Antworten und den klar studien-abgesicherten Hinweisen über die Notwendigkeit der Pflanzeninhaltstoffe.

Dr. Kim A. Williams, American College of Cardiology, often sees patients who are overweight and struggling with hypertension, Type 2 diabetes and high cholesterol. One of the things he advises them to do is to change their diets.

Specifically, he tells them to go vegan.

Dr. Williams became a vegan in 2003 because he was concerned that his LDL cholesterol — the kind associated with an increased risk of heart disease — was too high. Dr. Williams wrote about his reasons for going vegan and his belief in the cardiovascular benefits of a plant-based diet.

Veganism has grown in popularity in recent years, reflected by the explosion of meat-free cookbooks and restaurants, and vegan-friendly products in grocery stores. But the endorsement by the man who is set to become the president of one of the country's leading cardiology associations, which helps formulate health policies and guidelines, did not strike a totally positive chord.

"I didn't know it would create such a firestorm of everything from accolades to protests," said Dr. Williams, who is also the chairman of cardiology at Rush University Medical Center in Chicago. "The response was really loud, and much of it diametrically opposed."

One person suggested he was promoting a radical diet to his patients based on the experience of a single person: himself. Others accused him of trying to get the college of cardiology to encourage everyone to go vegan, which he dismissed. And some critics suggested that Dr. Williams and the college were "unduly influenced by industry," which baffled him.

"Who is the industry that promotes vegan dieting?" he asked. "Maybe the people who publish books on it. But that wouldn't be considered industry, I don't think."

Dr. Williams said that his switch to veganism was prompted by a routine blood test about 10 years ago.

The test showed that his LDL cholesterol, which had been 110 a couple years earlier, had climbed to 170. Dr. Williams, who was about 49 at the time, said he assumed that age and physical activity had played a role; his once frequent levels of exercise had fallen, and cholesterol tends to rise as people get older. But he also suspected that his diet was not as healthy as he had thought.

"I was basically eating chicken and fish, no skin, no fried food and no red meat," he said. "I thought it was healthy. But it was low fat instead of low cholesterol, which is what I needed."

Researchers have long known that the relationship between the dietary cholesterol found in food and the cholesterol that circulates in the blood is complicated, varying greatly from one person to the next. In many people, the cholesterol in food has only a minor or negligible effect on blood cholesterol levels. But in some people, the effect can be more pronounced, which Dr. Williams said was probably the case with him.

He eliminated cholesterol from his diet by avoiding dairy and animal protein to see if there would be any effect. Instead of eating chicken and fish, he started eating vegetable-based meat substitutes like veggie burgers and sausages made from soy and other plant proteins and nuts. He also switched to almond milk from cow's milk.

Six weeks later, his LDL had fallen to 90.

“It seems that the response to dietary cholesterol and other changes in diet are all genetically determined and quite variable,” he said. “One person might go from 170 to 150 by going to a plant-based diet. Another person might go from 170 to 90.”

Although LDL plays a role in heart disease, it is not the only factor. The plaque that accumulates in arteries consists not only of cholesterol, but immune cells that invade the artery walls as a result of chronic inflammation. Some researchers argue that this inflammation is the underlying problem in coronary artery disease. But Dr. Williams says he believes that being vegan can lower inflammation, too.

He said his enthusiasm for plant-based diets was based on his interpretation of medical literature. He cited observational studies of tens of thousands of members of the Seventh-day Adventist Church that found that people following vegetarian diets lived longer than meat eaters and had lower rates of death from heart disease, diabetes and kidney problems. And he pointed to research carried out by Dr. Dean Ornish, who found that patients who were put on a program that included a vegetarian diet had less coronary plaque and fewer cardiac events.

But Dr. Williams said he readily acknowledged that such studies were not conclusive.

Observational studies like those carried out on the Seventh-day Adventists show correlations, but they cannot establish cause and effect. And the study by Dr. Ornish was a small, randomized trial that, in addition to diet, included a number of interventions. Besides becoming vegetarians, the patients also gave up smoking, started exercising and had stress-management training. The extent to which diet played a role in the outcome is difficult to know.

Critics also point out that the Ornish diet restricts not only meat, but refined carbohydrates like added sugars and white flour, which have been implicated in cardiovascular disease in many studies.

Dr. Williams said he thought the research on the benefits of substituting nuts, beans and plant protein for meat was strong, but largely observational. But he was not arguing that the college of cardiology should promote veganism in its dietary guidelines. He said he would like to see large, extensive clinical trials of such diets “that pass muster” first.

Plenty of things that looked promising based on correlations that were identified in observational studies were later found to be problematic, he said, like vitamin E, hormone-replacement therapy, folic acid and, most recently, the HDL-raising drug niacin.

“There is a long list of things that, based on observational trials, we thought were beneficial, and then a randomized trial done for a long period of time showed that it wasn’t,” he said. “So I approach all of this with a sense of humility and an open mind.”

In the meantime, he said, he has made a habit of telling patients who are obese and plagued by metabolic problems like Type 2 diabetes to try exercising and eating less meat. And he discusses some of his favorite vegan foods with them.

“I recommend a plant-based diet because I know it’s going to lower their blood pressure, improve their insulin sensitivity and decrease their cholesterol,” he said. “And so I recommend it in all those conditions. Some patients are able to do it, and some are not.”

In this guest blog, Kim A. Williams, MD, a cardiologist at Rush University in Chicago and the next president of the American College of Cardiology, explains why he went vegan and now recommends it to patients.

Physicians want to influence their patients to make lifestyle changes that will improve their health, but sometimes the roles are reversed and we are inspired by patients. It was a patient's success reversing an alarming condition that motivated me to investigate a vegan diet.

Just before the American College of Cardiology's (ACC) annual meeting in 2003 I learned that my LDL cholesterol level was 170. It was clear that I needed to change something. Six months earlier, I had read a nuclear scan on a patient with very-high-risk findings -- a severe three-vessel disease pattern of reversible ischemia.

The patient came back to the nuclear lab just before that 2003 ACC meeting. She had been following Dean Ornish, MD's program for "Reversing Heart Disease," which includes a plant-based diet, exercise, and meditation. She said that her chest pain had resolved in about 6 weeks, and her scan had become essentially normalized on this program.

When I got that LDL result, I looked up the details of the plant-based diet in Ornish's publications -- 1- and 5-year angiographic outcomes and marked improvement on PET perfusion scanning -- small numbers of patients, but outcomes that reached statistical significance.

I thought I had a healthy diet -- no red meat, no fried foods, little dairy, just chicken breast and fish. But a simple Web search informed me that my chicken-breast meals had more cholesterol content (84 mg/100 g) than pork (62 mg/100 g). So I changed that day to a cholesterol-free diet, using "meat substitutes" commonly available in stores and restaurants for protein. Within 6 weeks my LDL cholesterol level was down to 90.

I often discuss the benefits of adopting a plant-based diet with patients who have high cholesterol, diabetes, hypertension, or coronary artery disease. I encourage these patients to go to the grocery store and sample different plant-based versions of many of the basic foods they eat. For me, some of the items, such as chicken and egg substitutes, were actually better-tasting.

There are dozens of products to sample and there will obviously be some that you like and some that you don't. One of my favorite sampling venues was the new Tiger Stadium (Comerica Park) in Detroit, where there are five vegan items, including an Italian sausage that is hard to distinguish from real meat until you check your blood pressure -- vegan protein makes blood pressures fall.

In some parts of country and some parts of world, finding vegan restaurants can be a challenge. But in most places, it is pretty easy to find vegan-friendly options with a little local Web searching. Web searching can also help with the patients who are concerned about taste or missing their favorite foods. I typically search with the patient and quickly email suggestions.

Interestingly, our ACC/American Heart Association (AHA) prevention guidelines do not specifically recommend a vegan diet, as the studies are very large and observational or small and randomized, such as those on Ornish's whole food, plant-based diet intervention reversing coronary artery stenosis. The data are very compelling, but larger randomized trials are needed to pass muster with our rigorous guideline methodology.

Wouldn't it be a laudable goal of the American College of Cardiology to put ourselves out of business within a generation or two? We have come a long way in prevention of cardiovascular disease, but we still have a long way to go. Improving our lifestyles with improved diet and exercise will help us get there.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4991921/

Plant-Based Diets: A Physician's Guide

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Abstract

Because of the ever-increasing body of evidence in support of the health advantages of plant-based nutrition, there is a need for guidance on implementing its practice. This article provides physicians and other health care practitioners an overview of the myriad benefits of a plant-based diet as well as details on how best to achieve a well-balanced, nutrient-dense meal plan. It also defines notable nutrient sources, describes how to get started, and offers suggestions on how health care practitioners can encourage their patients to achieve goals, adhere to the plan, and experience success.

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SUMMARY OF HEALTH BENEFITS

Plant-based nutrition has exploded in popularity, and many advantages have been well documented over the past several decades.1 Not only is there a broad expansion of the research database supporting the myriad benefits of plant-based diets, but also health care practitioners are seeing awe-inspiring results with their patients across multiple unique subspecialties. Plant-based diets have been associated with lowering overall and ischemic heart disease mortality2; supporting sustainable weight management3; reducing medication needs4–6; lowering the risk for most chronic diseases7,8; decreasing the incidence and severity of high-risk conditions, including obesity,9 hypertension,10 hyperlipidemia,11 and hyperglycemia;11 and even possibly reversing advanced coronary artery disease12,13 and type 2 diabetes.6

The reason for these outcomes is two-fold. First, there are inherent benefits to eating a wide variety of health-promoting plants. Second, there is additional benefit from crowding out—and thereby avoiding—the injurious constituents found in animal products, including the following:

- Saturated fats: Saturated fats are a group of fatty acids found primarily in animal products (but also in the plant kingdom—mostly in tropical oils, such as coconut and palm) that are well established in the literature as promoting cardiovascular disease (CVD).14,15 The American Heart Association lowered its recommendations15 for a heart-healthy diet to include no more than 5% to 6% of total calories from saturated fat, which is just the amount found naturally in a vegan diet (one consisting of no animal products).
- Dietary cholesterol: Human bodies produce enough cholesterol for adequate functioning. Although evidence suggests that dietary cholesterol may only be a minor player in elevated serum cholesterol levels, high intakes are linked to increased susceptibility to low-density lipoprotein oxidation, both of which are associated with the promotion of CVD.16–18 Dietary cholesterol is found almost exclusively in animal products.
- Antibiotics: The vast majority (70% to 80%) of antibiotics used19,20 in the US are given to healthy livestock animals to avoid infections inherent in the types of environments in which they are kept. This is, therefore, the number one contributor to the increasingly virulent

antibiotic-resistant infections of the type that sickened 2 million and killed 23,000 Americans in 2013.[20]

- Insulin-like growth factor-1: Insulin-like growth factor-1 is a hormone naturally found in animals, including humans. This hormone promotes growth. When insulin-like growth factor-1 is consumed, not only is the added exogenous dose itself taken in, but because the amino acid profile typical of animal protein stimulates the body's production of insulin-like growth factor-1, more is generated endogenously.[21] Fostering growth as a full-grown adult can promote cancer proliferation.
- Heme iron: Although heme iron, found in animal products, is absorbed at a higher rate than nonheme iron, found in plant-based and fortified foods, absorption of nonheme iron can be increased by pairing plant-based protein sources with foods high in vitamin C.[22] Additionally, research suggests that excess iron is pro-oxidative[23] and may increase colorectal cancer risk[24] and promote atherosclerosis[25] and reduced insulin sensitivity.[26]
- Chemical contaminants formed from high temperature cooking of cooked animal products: When flesh is cooked, compounds called polycyclic aromatic hydrocarbons,[27] heterocyclic amines,[28] and advanced glycation end products[29] are formed. These compounds are carcinogenic, pro-inflammatory, prooxidative, and contributive to chronic disease.
- Carnitine: Carnitine, found primarily in meat, may be converted in the body by the gut bacteria to produce trimethylamine N-oxide (TMAO). High levels of trimethylamine n-oxide are associated with inflammation, atherosclerosis, heart attack, stroke, and death.[30]
- N-Glycolylneuraminic acid (Neu5Gc): This compound is found in meat and promotes chronic inflammation.[31,32]

On the other hand, there are infinite advantages to the vast array of nutrients found in plant foods. Phytochemicals and fibers are the two categories of nutrients that are possibly the most health promoting and disease fighting. Plants are the only source of these nutrients; they are completely absent in animals. Plants contain thousands of phytochemicals, such as carotenoids, glucosinolates, and flavonoids, which perform a multitude of beneficial functions, including:

- Antioxidation, neutralizing free radicals[33]
- Anti-inflammation[34]
- Cancer activity reduction via several mechanisms, including inhibiting tumor growth, detoxifying carcinogens, retarding cell growth, and preventing cancer formation[35]
- Immunity enhancement[36]
- Protection against certain diseases, such as osteoporosis, some cancers, CVD, macular degeneration, and cataracts[37–39]
- Optimization of serum cholesterol.[40,41]

Fibers found in whole plant foods powerfully support the gastrointestinal, cardiovascular, and immune systems through multiple mechanisms. Yet more than 90% of adults and children in the US do not get the minimum recommended dietary fiber.[42]

Thus, it can be advantageous for physicians to recommend and support plant-based eating to achieve optimal health outcomes and possibly minimize the need for procedures, medications, and other treatments. Aiming for lifestyle changes as primary prevention has been estimated to save upwards of 70% to 80% of health care costs because 75% of health care spending in the US goes to treat people with chronic conditions.[43] Offering this option and guiding patients through the logistics and their concerns about plant-based eating is a viable first line of therapy in the clinical setting. This article will delineate how best to achieve a well-balanced, nutrient-dense meal plan, define notable nutrient sources, describe how to get

started, and offer suggestions on how physicians can encourage and work with their patients who are interested to maintain adherence and enjoy success.

NOTABLE NUTRIENTS

Although nutrient deficiency is a primary concern for many people when considering plant-based eating, the Academy of Nutrition and Dietetics states[44] that "vegetarian diets, including total vegetarian or vegan diets, are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain diseases." The Academy's position paper goes on to conclude that "well-planned vegetarian diets are appropriate for individuals during all stages of the life cycle, including pregnancy, lactation, infancy, childhood, and adolescence, and for athletes." Because any type of meal plan should be approached with careful thought, it is helpful to note that plant-based diets, including calorie-restricted, weight-loss diets, have been found to be more nutritionally sound than typical dietary patterns.[45]

A well-balanced, plant-based diet is composed of vegetables, fruits, whole grains, legumes, herbs, spices, and a small amount of nuts and seeds. Half of the plate should consist of vegetables and fruits in accordance with the US Department of Agriculture, American Cancer Society, and American Heart Association, because they are filled with fiber, potassium, magnesium, iron, folate, and vitamins C and A—almost all of the nutrients that tend to run low in the American population, according to the Scientific Report of the 2015 Dietary Guidelines Advisory Committee.[46] Legumes are excellent sources of lysine (an amino acid that may fall short in a plant-based diet), fiber, calcium, iron, zinc, and selenium. It is ideal to consume one to one-and-a-half cups of legumes per day. Substantiating meals with whole grains aids with satiety, energy, and versatility in cuisine. Nuts are nutritional nuggets, brimming with essential fats, protein, fiber, vitamin E, and plant sterols, and have been shown to promote cardiovascular health[47] and protect against type 2 diabetes and obesity,[48] macular degeneration,[49] and cholelithiasis.[50] One oz to 2 oz (or 30 g to 60 g) of nuts per day is recommended. Seeds, too, are special in that their essential fat ratios are well-balanced, and they contain multiple trace minerals and phytochemicals. One or 2 tablespoons per day will boost overall nutrition. Opting for whole food sources of fats, as opposed to extracted fats as found in oils, is optimal to decrease caloric density and increase nutrient and fiber consumption. Herbs and spices also contain phytochemicals and help make food delicious, varied, and exciting, and should be used according to preference. Food group recommended servings per day are shown in Table 1.

Table 1.

Food group recommended servings per day

Food group	Recommended servings per day
Vegetables, all types, including starchy	Ad libitum, with a variety of colors represented
Fruits, all types	2–4 servings (1 serving = 1 medium piece or 1/2 cup)
Whole grains (eg, quinoa, brown rice, oats)	6–11 servings (1 serving = 1/2 cup cooked or 1 slice whole grain bread)
Legumes (beans, peas, lentils, soy foods)	2–3 servings (1 serving = 1/2 cup cooked)
Leafy green vegetables (eg, kale, lettuce, broccoli)	At least 2–3 servings (1 serving = 1 cup raw or 1/2 cup cooked)

Food group	Recommended servings per day
Nuts (eg, walnuts, almonds, pistachios)	1–2 ounces
Seeds (eg, chia, hemp, and flax seeds)	1–3 tablespoons
Fortified plant milks (eg, soy, almond, cashew)	Optional, 2–3 cups
Fresh herbs and spices	Optional, ad libitum

Go to:

PLANT-BASED MACRONUTRITION

All calories (kcals) come from some combination of carbohydrates (4 kcals/g), proteins (4 kcals/g), and fats (9 kcals/g). Alcohol also provides calories (7 kcals/g) but is not considered an essential nutrient. The ideal ratio of intake of these 3 macronutrients is highly controversial and debatable. There is plenty of evidence supporting health and weight management benefits of low-fat/high-carbohydrate diets, as seen in the traditional Okinawan diet[51] and in Dean Ornish, MD's[12] and Caldwell Esselstyn, MD's[13] reversal of advanced coronary artery disease and Neal Barnard, MD's[6] reduction of glycemia in type 2 diabetes using a plant-based diet with 10% of calories from fat. Similarly, the Mediterranean[52] and many raw food[53] diets consisting of upwards of 36% or more of calories from fat show consistently positive health advantages. Thus, it appears that it is likely the quality of the diet that is responsible for health outcomes rather than the ratio of macronutrients.

Carbohydrates

The Institute of Medicine's adequate intake of carbohydrates[54] is 130 g/d for everyone (except during pregnancy and lactation) beginning at age 1 year. Optimal sources of carbohydrates, such as wholesome vegetables, fruits, whole grains, and legumes, are high in fiber and nutrients. Refined carbohydrates from sugars, flours, and other processed foods can lead to mal-nourishment and promote illness.

Protein

Adequate intake[54] of protein is based on weight and is estimated at 1.5 g/kg/d for infants, 1.1 g/kg/d for 1 to 3 year olds, 0.95 g/kg/d for 4 to 13 year olds, 0.85 g/kg/d for 14 to 18 year olds, 0.8 g/kg/d for adults, and 1.1 g/kg/d for pregnant (using prepregnancy weight) and lactating women. Protein is readily available throughout the plant kingdom, but those foods that are particularly rich in protein include legumes, nuts and nut butters, seeds and seed butters, soy foods, and intact whole grains.

Fats

Fats—or fatty acids—are more complicated because there are several different chemical varieties based on level and type of saturation. Each category of fatty acid performs different functions and acts uniquely in the body.[14]

The essential fatty acids are polyunsaturated and include both omega-3 and omega-6 fatty acids. Omega-3 fats are found in their shorter chain form as alpha linolenic acid and are used as energy. They are also converted by the body to the longer-chain eicosapentaenoic acid

(EPA) and then docosahexaenoic acid (DHA). Because this conversion process can be inefficient, some people may require a direct source of these longer-chain EPA and DHA in the form of a microalgae supplement. Alpha linolenic acid can be found in flaxseeds, hemp-seeds, chia seeds, leafy green vegetables (both terrestrial and marine), soybeans and soy products, walnuts, and wheat germ, as well as in their respective oils. A direct plant source of EPA and DHA is microalgae, through which fish acquire them. Plant sources may be superior because they do not contain the contaminants that fish contain, including heavy metals, such as mercury, lead, and cadmium, as well as industrial pollutants.[55] Also, plant sources are more sustainable than fish sources.[56]

Monounsaturated fats are not essential but have been found to impart either a neutral or slightly beneficial effect on serum cholesterol levels, depending on which nutrient they are replacing. When swapped for saturated fats, trans fats, or refined carbohydrates, monounsaturated fats may lower low-density lipoprotein and raise high-density lipoprotein cholesterol. These fatty acids are found in olives, avocados, macadamia nuts, hazel-nuts, pecans, peanuts, and their respective oils, as well as in canola, sunflower, and safflower oils.

Saturated fats, as mentioned above, are not essential in the diet and can promote CVD. They are found primarily in animal products but are available in some plant foods, mostly in tropical fats and oils, such as palm and coconut, and also in other high-fat foods, including avocados, olives, nuts, and seeds. If a vegan diet contains an average of 5% to 6% of kcals from saturated fat, which is what the American Heart Organization recommends for a heart-healthy diet, any added serving of animal products will significantly increase the total intake.

Trans fatty acids are laboratory-made via hydrogenation and are found in processed, fried, and fast foods. Although they were originally developed to be a healthy alternative to butter and lard, trans fatty acids were found to significantly increase CVD risk. In November 2013, the US Food and Drug Administration issued a notice that trans fatty acids were no longer considered safe[57] and is now trying to eliminate artificially produced trans fatty acids (there are small amounts found naturally in meat and dairy products) from the food supply. Be aware that a nutritional label can state a food product contains “0 g trans fats” even if it contains up to 0.5 g per serving. Thus, advise your patients to focus on the ingredient list on food products and to avoid anything with the words “partially hydrogenated.”

Dietary cholesterol is a sterol that is found primarily in animal products. Although cholesterol is required for the production of hormones, vitamin D, and bile acids, the liver produces enough cholesterol on its own. Excessive intake of dietary cholesterol is associated with increased risk of CVD.

Phytosterols, which are similar to cholesterol, are plant-based sterols found in all plant foods (especially wheat germ, nuts, seeds, whole grains, legumes, and unrefined plant oils). Phytosterols reduce cholesterol absorption in the gut, thereby optimizing lipid profiles. Together with viscous fibers, soy proteins, and almonds, phytosterols have been found to be as effective as statins in some studies in lowering low-density lipoprotein cholesterol.[5,58]

It is crucial to note that all whole foods contain all three macronutrients. It is a pervasive misunderstanding to identify a food as a “carb,” “protein,” or “fat.” Instead, these are all nutrients within a complex of other myriad constituents that are beyond the oversimplification perpetuated by the media and trendy diet fads.

Ideally, a healthful diet is loaded with wholesome carbohydrates, moderate in fat, and temperate in protein. The emphasis must be on the quality of the totality of foods coming from whole plant sources as opposed to calculations and perfect ratios.

PLANT-BASED MICRONUTRITION

All nutrients, with the exception of vitamin B_{12} and possibly vitamin D, which is ideally sourced from the skin's exposure to the sun's ultraviolet rays, can be found in plants. They are also packaged together with thousands of powerful disease-fighting nutrients that work synergistically to support optimal health.[59]

Vitamin B_{12}

Cobalamin, commonly referred to as vitamin B_{12}, is the only nutrient not directly available from plants. This is because vitamin B_{12} is synthesized by microorganisms, bacteria, fungi, and algae, but not by plants or animals. Animals consume these microorganisms along with their food, which is why this vitamin can be found in their meat, organs, and byproducts (eggs and dairy). Vitamin B_{12} deficiency can lead to irreversible neurologic disorders, gastrointestinal problems, and megaloblastic anemia. Among other populations, vegans who do not supplement with a reliable source of vitamin B_{12} or breastfeeding infants of vegan mothers who are not consuming a regular reliable source of vitamin B_{12} are at risk for deficiency.

The body can store vitamin B_{12} for approximately three to five years, but after that, with no repletion or with inability to absorb, deficiency symptoms may present; deficiency may also be asymptomatic. Because of this lag time and because serum tests for B_{12} levels can be skewed by other variables, irreversible damage may occur before a deficiency is caught.

In a vegan diet, vitamin B_{12} can be found in fortified plant milks, cereals, or nutritional yeast. However, these are not dependable means of achieving B_{12} requirements. Although there are claims that fermented foods, spirulina, chlorella, certain mushrooms, and sea vegetables, among other foods, can provide B_{12}, the vitamin is not usually biologically active. These inactive forms act as B_{12} analogues, attaching to B_{12} receptors, preventing absorption of the functional version, and thereby promoting deficiency. The most reliable method of avoiding deficiency for vegans or anyone else at risk is to take a B_{12} supplement.

Because the body can absorb only approximately 1.5 µg to 2.0 µg at a time, it is ideal to supplement with a dose greater than the Recommended Dietary Allowance (RDA) to ensure adequate intake. Plant-based nutrition experts recommend a total weekly dose of 2000 µg to 2500 µg. This can be split into daily doses or into 2 to 3 doses of 1000 µg each per week to help enhance absorption. Because vitamin B_{12} is water soluble, toxicity is rare.

Vitamin D

Vitamin D, or calciferol, is also known as the "sunshine vitamin" because it is the only nutrient that is acquired from the sun. Although vitamin D is classified as and treated like a fat-soluble vitamin, it is actually a prohormone produced in the skin upon exposure to ultraviolet B sun radiation and then activated by the liver and kidneys.

Although human bodies evolved to produce vitamin D via the sun, there appears to be a worldwide epidemic of deficiency. Vitamin D is not widely available from the food supply. Sources of preformed vitamin D include fish liver oil, oily fish, liver, and in smaller doses, meat and egg yolk—foods that also contain high concentrations of saturated fat, cholesterol, and other less-than-ideal components. Vitamin D from sunshine and animal sources is in the form of cholecalciferol, or vitamin D_3. A second form called ergocalciferol, or vitamin D_2, is found in plant sources, mostly in ultraviolet B-irradiated mushrooms. However, a plant-derived version of D_3 made by lichen was recently discovered.60 Dietary supplements may contain either D_2 or D_3, both of which can be effective at optimizing blood levels.

More and more physicians are testing for serum levels of vitamin D using the 25-hydroxyvitamin D test. The Institute of Medicine concluded that adequate serum 25-hydroxyvitamin D levels are ≥ 50 nmol/L (≥ 20 ng/mL).61

If patients have suboptimal levels, emphasizing food sources (especially fortified plant milks) as well as supplements may be helpful. Dosing may be tricky because of variable responses in individuals and differences in types of vitamin D formulas. Of note, although both of the 2 forms of vitamin D—cholecalciferol (D_3) and ergocalciferol (D_2)—are effective at raising serum D levels in small doses (4000 IU or less), cholecalciferol (D_3) is superior when using large boluses. Because the supplement industry is not regulated by the Food and Drug Administration, it is "buyer beware" in the supplement market. Thus, aim to find well-reputed companies. A few organizations, such as Consumer Lab, NSF International, and US Pharmacopeia, act as independent third parties and offer seals of approval after testing products for potency and contaminants. They do not, however, test for safety or efficacy.

Calcium

Calcium, a macromineral, is the most abundant mineral in the human body. A mere 1% of the body's calcium circulates in the blood and tissues; 99% is stored in the bones and teeth. Calcium is a nutrient of concern for the general population with respect to bone mineral optimization during the lifespan. However, because bone metabolism is multifactorial and complex, it is important to emphasize consumption of ample sources of calcium as well as vitamins K and B_{12}, fluoride, magnesium, phosphorus, and potassium; to maintain serum vitamin D levels; and to ensure consistent exercise. Throughout the lifespan, dietary recommendations for adequate intake of calcium fluctuate.62

Excellent plant sources of calcium include leafy green vegetables—especially bok choy, broccoli, napa cabbage, collard greens, dandelion greens, kale, turnip greens, and watercress—as well as fortified plant milks, calcium-set tofu, dried figs, sesame seeds and tahini, tempeh, almonds and almond butter, oranges, sweet potatoes, and beans.

No matter how much calcium is consumed, the amount that is actually *absorbed* is more significant. Many variables affect calcium levels via absorption or excretion, including:

- Overall consumption determines how much is absorbed. Only about 500 mg can be absorbed at a time, and absorption decreases as calcium intake increases
- Age. Calcium absorption peaks in infants and children, as they are rapidly growing bone, and then progressively decreases with age
- Phytates, compounds found in whole grains, beans, seeds, nuts, and wheat bran, can bind with calcium as well as with other minerals and inhibit absorption. Soaking, sprouting, leavening, and fermenting improve absorption

- Oxalates are constituents found in some leafy green vegetables, such as spinach, Swiss chard, collard greens, parsley, leeks, and beet greens; berries; almonds; cashews; peanuts; soybeans; okra; quinoa; cocoa; tea; and chocolate. They may also somewhat inhibit absorption of calcium and other minerals, but some may still be absorbed. Emphasizing variety in the foods eaten on a regular basis encourages adequate absorption
- Serum vitamin D levels must be within optimum range in order for the body to absorb calcium.
- Excessive intake of sodium, protein, caffeine, and phosphorus (as from dark sodas) may enhance calcium excretion.62

Iron

Ironically, iron is one of the most abundant metals on Earth and yet iron deficiency is one of the most common and widespread nutritional deficiencies. It is the most common deficiency in the world and is a public health problem in both industrialized and nonindustrialized countries.63 It is particularly prevalent in women of childbearing age, pregnant women, infants, children, teenage girls, and anyone experiencing bleeding, such as people with ulcers, inflamed intestines caused by malabsorptive disorders, or heavy menstruation. Iron-deficiency anemia is no more common in vegetarians than in nonvegetarians.

Because plant-sourced iron is nonheme iron, which is susceptible to compounds that inhibit and enhance its absorption, the recommendation for vegans and vegetarians is to aim for slightly more iron than nonvegetarians. Fortunately, this is easy to do with the wide array of iron-rich food choices in the plant kingdom. Leafy greens and legumes are excellent sources of iron and a multitude of other nutrients, so it is advantageous to include these foods often. Other good choices include soy products, dark chocolate, blackstrap molasses, sesame seeds, tahini, pumpkin seeds, sunflower seeds, raisins, prunes, and cashews.

Iron absorption may be diminished in the presence of phytates, tannic acids from tea, calcium in dairy, fiber, polyphenols in coffee and cocoa, and certain spices (eg, turmeric, coriander, chilies, and tamarind). To minimize this, separate iron-rich foods from these nutrients as much as possible. An example is to drink coffee or tea separately from meals or to mix up meal combinations. One of the best tips for optimizing iron absorption is to eat iron-rich foods in combination with foods high in vitamin C and organic acids. This improves solubility, thereby facilitating absorption. Examples of such optimizing food combinations are a green smoothie with leafy greens (iron) and fruit (vitamin C) or salad greens (iron) with tomatoes (vitamin C).

Iodine

Dietary sources of the trace mineral iodine are unreliable and fluctuate geographically because of varying soil qualities. It is crucial for vegans to be mindful of consuming a source of iodine to avoid thyroid issues. Sources of iodine include iodized salt and sea vegetables. However, it is important to note that iodine is not found in sea salts, gourmet salts, or other salty foods. One half-teaspoon of iodized salt provides the daily recommended 150-µg dose. Also, iodine levels in sea vegetables fluctuate dramatically, with some (especially dulse and nori) containing safe amounts and others (such as kelp) harboring toxic doses. Hijiki, also spelled hiziki, should be avoided owing to its excessive arsenic levels. A preexisting iodine deficiency, a selenium deficiency, or high intake of goitrogens (antinutrients found in cruciferous vegetables, soy products, flaxseeds, millet, peanuts, peaches, pears, pine nuts, spinach, sweet potatoes, and strawberries) can interfere with iodine absorption. There is no

need to avoid goitrogenic foods as long as iodine intake is sufficient. If a patient does not enjoy sea vegetables or is minimizing intake of salt, an iodine supplement may be warranted.

Selenium

Selenium is a potent antioxidant that protects against cellular damage and also plays a role in thyroid hormone regulation, reproduction, and dialpha nucleic acid (DNA) synthesis. Brazil nuts are an especially rich source of selenium in the plant kingdom. Although selenium content varies depending on the source, an average ounce (approximately 6 to 8 nuts) can provide 777% of the RDA. When accessible, one Brazil nut a day is an ideal way of meeting selenium recommendations. Other plant sources include whole grains, legumes, vegetables, seeds, and other nuts.

Zinc

Zinc supports immune function and wound healing; synthesis of protein and DNA; and growth and development throughout pregnancy, childhood, and adolescence. Because of the presence of phytates, bioavailability of zinc from plants is lower than from animal products. Zinc deficiency may be difficult to detect in blood tests but can show up clinically as delayed wound healing, growth retardation, hair loss, diminished immunity, suppressed appetite, taste abnormalities, or skin or eye lesions. Consider advising patients to aim for 50% or greater than the RDA of zinc daily by including legumes, cashews and other nuts, seeds, soy products, and whole grains. Preparation methods such as soaking, sprouting, leavening, and fermenting will improve absorption. Table 2 provides a convenient chart highlighting excellent sources of notable nutrients.

Table 2.

Sources of notable nutrients

Nutrient	Food sources
Protein	legumes (beans, lentils, peas, peanuts), nuts, seeds, soy foods (tempeh, tofu)
Omega-3 fats	seeds (chia, hemp, flax), leafy green vegetables, microalgae, soybeans and soy foods, walnuts, wheat germ
Fiber	vegetables, fruits (berries, pears, papaya, dried fruits), avocado, legumes (beans, lentils, peas), nuts, seeds, whole grains
Calcium	low-oxalate leafy greens (broccoli, bok choy, cabbage, collard, dandelion, kale, watercress), calcium-set tofu, almonds, almond butter, fortified plant milks, sesame seeds, tahini, figs, blackstrap molasses
Iodine	sea vegetables (arame, dulse, nori, wakame), iodized salt
Iron	legumes (beans, lentils, peas, peanuts), leafy greens, soybeans and soy foods, quinoa, potatoes, dried fruit, dark chocolate, tahini, seeds (pumpkin, sesame, sunflower), sea vegetables (dulse, nori)
Zinc	legumes (beans, lentils, peas, peanuts), soy foods, nuts, seeds, oats
Choline	legumes (beans, lentils, peas, peanuts), bananas, broccoli, oats, oranges, quinoa, soy foods
Folate	leafy green vegetables, almonds, asparagus, avocado, beets, enriched grains (breads,

Nutrient	Food sources
	pasta, rice), oranges, quinoa, nutritional yeast
Vitamin B_{12}	fortified foods (nutritional yeast, plant milks), supplement (2500 µg per week)
Vitamin C	fruits (especially berries, citrus, cantaloupe, kiwifruit, mango, papaya, pineapple), leafy green vegetables, potatoes, peas, bell peppers, chili peppers, tomatoes
Vitamin D	sun, fortified plant milks, supplement if deficient
Vitamin K	leafy green vegetables, sea vegetables, asparagus, avocado, broccoli, Brussels sprouts, cauliflower, lentils, peas, nattō (a traditional Japanese food made from soybeans fermented with *Bacillus subtilis* var *nattō*)

HELPING PATIENTS GET STARTED

To support patients to delve into this therapeutic nutrition plan to help them prevent or manage chronic disease and improve or maintain their state of health, it is crucial to provide optimistic, simple, and strategic guidance. See Sidebar: Six-Step Guide for Initiating and Maintaining a Nutrition Dialogue with Patients.

Six-Step Guide for Initiating and Maintaining a Nutrition Dialogue with Patients

1. During the first part of an office visit when interviewing patients regarding wellness behaviors (typically covering exercise and smoking), include questions about diet.
2. When discussing a patient's treatment plan, include diet as a viable option with positive effects (eg, improved gastrointestinal function, decreased risk for chronic diseases, and better outcomes for existing conditions).
3. Advocate simple suggestions to start off. Instead of overwhelming a patient with drastic renovations to their current way of eating, begin with a few changes that can be made within reason.
4. Educate patients on both the risks associated with inadequate intake of produce and regular consumption of refined sugars and animal products as well as the advantages of emphasizing whole plant foods. Enlist all health care practitioners on the patient's team to be aware of diet modification goals. One way to simplify this is by charting progress and goals.
5. Offer patients educational support (see Sidebar: Suggested Educational Support). Information in the form of pamphlets, onsite nutrition counseling, in-house cooking classes, and articles on the Internet (see Sidebar: Suggested Internet Nutrition Resources) is ideal because there are multiple points of reference and communication for patients.

Suggested Educational Support

- Informational sheets, such as pamphlets and handouts, of meal options, recipes, nutrient sources (as in Table 2), sample meal plans, benefits of eating healthfully, additional resources, and advice based on the information in this guide will support the patient in pursuing plant-based eating at home.
- Individual nutrition counseling as prescribed by a physician provides encouragement, reinforces positive outcomes, and helps address needs and concerns.
- Cooking classes, available in many communities, led by plant-based chefs or registered dietitians are excellent tools for successful adaptation of healthy cooking patterns in the home. Demonstrations and interactive methods whereby participants

are able to prepare food or at least taste samples and receive recipes to take home will inspire adherence.
- Articles on the Internet (see Sidebar: Internet Nutrition Resources) and other online resources (or even nutrition-specific Web sites) are opportunities to provide patients with ready-to-go information and perhaps a 24-hour interactive resource.

Suggested Internet Nutrition Resources

- www.nlm.nih.gov
- https://ndb.nal.usda.gov
- http://vegetariannutrition.net
- http://nutritionfacts.org
- www.pcrm.org
- www.brendadavisrd.com
- www.veganhealth.org
- http://plantbaseddietitian.com
- www.theveganrd.com
- www.vrg.org/nutrition/
- https://fnic.nal.usda.gov/lifecycle-nutrition/vegetarian-nutrition
- www.vegansociety.com
-

6. Maintain a plan for follow-up and continued encouragement. It is common for people to lose motivation, and to become frustrated over time, particularly if there is not a strong support system in place (see Sidebar: Tips for Patient Motivation). Engage patients by ensuring they are enrolled in classes, have family or friends participating alongside them, are connected to others in similar phases of transition, and have access to continued information, as designated above.55

Tips for Patient Motivation

- Focus on optimism. Encourage every positive choice because food is deeply personal and making significant changes is challenging for most people. Every bite matters.
- Encourage the conversation with patients who are interested. The single person most people trust for advice and recommendations on health, diet, and wellness is their physician. It is an honor and special occasion to be able to open up the dialogue from a place of caring and support and without judgment. Offer advice and an ear to help propel patients onto the path of long-term health.
- Make it fun. Recalculating diet is similar to learning a new language. Initially, a few new ingredients are discovered, which is like learning some new words. Then enjoyable recipes and meals become part of the repertoire, which is similar to learning some phrases in the new language. Finally, the knowledge base expands so greatly that it becomes second nature to choose and prepare plant-based meals, akin to speaking the language fluently. Health care practitioners are ideally situated to easily guide patients toward fluency and success in this new language.

GUIDE FOR INITIATING AND MAINTAINING A NUTRITION DIALOGUE WITH PATIENTS

1. During the first part of an office visit when interviewing patients regarding wellness behaviors (typically covering exercise and smoking), include questions about diet, such as the following:
    - Do you eat at least 7 to 9 servings of vegetables and fruits every day?64
    - How many times per week do you eat fried foods/red meat/processed meat/refined sugars?
    - How often do you choose whole grains over refined grains?
    - Do you eat at least a cup to a cup-and-a-half of legumes (beans, lentils, peas) per day?
    - Do you include leafy green vegetables in your daily diet?
2. When discussing a patient's treatment plan, include diet as a viable option with positive effects (eg, improved gastrointestinal function, decreased risk for chronic diseases, and better outcomes for existing conditions).
3. Advocate simple suggestions to start off. Instead of overwhelming a patient with drastic renovations to their current way of eating, begin with a few changes that can be made within reason. Some examples include the following:
    - Incorporate leafy green vegetables with at least two meals or snacks each day (enjoy a salad, add broccoli to pasta, try a green smoothie for breakfast or a snack).
    - Start reducing intake of red and processed meat to once per week or less.
    - Opt for whole grains over refined (eg, brown rice instead of white rice, whole grain pasta instead of white pasta, 100% whole grain or sprouted bread).
    - Enjoy 2 to 4 servings of fruit per day.
    - Include colorful vegetables with each meal.
    - Try making a plant-based meal and then an entire plant-based day by prioritizing previously loved plant-based dishes (eg, pasta primavera, bean and rice burrito, bean chili).
    - Aim to eat a rainbow every day (foods naturally red, orange, yellow, green, and blue/purple).

    For those patients eager to make more dramatic changes, encourage switching to eating a combination of vegetables, fruits, legumes, and whole grains, according to the recommendations above.

4. Educate patients on both the risks associated with inadequate intake of produce and regular consumption of refined sugars and animal products as well as the advantages of emphasizing whole plant foods. Enlist all health care practitioners on the patient's team to be aware of diet modification goals. One way to simplify this is by charting progress and goals.
5. Offer patients educational support (see Sidebar: Suggested Educational Support). Information in the form of pamphlets, onsite nutrition counseling, in-house cooking classes, and articles on the Internet (see Sidebar: Suggested Internet Nutrition Resources) is ideal because there are multiple points of reference and communication for patients.

    It is also important to educate patients on the importance of reading labels (see Sidebar: Label-Reading Protocol).

Label-Reading Protocol

- Ignore misleading marketing terminology on labels (eg, “excellent source of,” “free of,” “natural”)
- Focus solely on ingredient list and ignore rest of packaging
- Strive to purchase foods with:
    - - Only recognizable ingredients
    - - Few total ingredients listed
    - - Absence of artificial colors/flavorings/sweeteners, refined sugars, preservatives, stabilizers, thickeners, or any unrecognizable names

6. Maintain a plan for follow-up and continued encouragement. It is common for people to lose motivation, and to become frustrated over time, particularly if there is not a strong support system in place (see Sidebar: Tips for Patient Motivation). Engage patients by ensuring they are enrolled in classes, have family or friends participating alongside them, are connected to others in similar phases of transition, and have access to continued information.65

CONCLUSION

Ultimately, it is a win-win situation—for patients, and for health care practitioners—to have plant-based eating as a powerful tool in the toolbox. Pharmaceuticals are an important tool in a physician’s armamentarium, particularly in treating acute illness, but lifestyle changes, eg diet, can be an important and powerful tool in treating chronic illness. To facilitate lower health care costs and likely better health outcomes, let food be medicine and the route of the future.

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Go to:

Footnotes

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

Go to:

Food Rules

Eat food. Not too much. Mostly plants.

— *Food Rules,* Michael Pollan, b 1955, American author, journalist, activist, and professor of journalism

Go to:

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Association Between Protein Intake and Blood PressureThe INTERMAP Study

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Abstract

Background Findings from epidemiological studies suggest an inverse relationship between individuals' protein intake and their blood pressure.

Methods Cross-sectional epidemiological study of 4680 persons, aged 40 to 59 years, from 4 countries. Systolic and diastolic blood pressure was measured 8 times at 4 visits. Dietary intake based on 24-hour dietary recalls was recorded 4 times. Information on dietary supplements was noted. Two 24-hour urine samples were obtained per person.

Results There was a significant inverse relationship between vegetable protein intake and blood pressure. After adjusting for confounders, blood pressure differences associated with higher vegetable protein intake of 2.8% kilocalories were −2.14 mm Hg systolic and −1.35 mm Hg diastolic ($P<.001$ for both); after further adjustment for height and weight, these differences were −1.11 mm Hg systolic ($P<.01$) and −0.71 mm Hg diastolic ($P<.05$). For animal protein intake, significant positive blood pressure differences did not persist after adjusting for height and weight. For total protein intake (which had a significant interaction with sex), there was no significant association with blood pressure in women, nor in men after adjusting for dietary confounders. There were significant differences in the amino acid content of the diets of persons with high vegetable and low animal protein intake vs the diets of persons with low vegetable and high animal protein intake.

Conclusions Vegetable protein intake was inversely related to blood pressure. This finding is consistent with recommendations that a diet high in vegetable products be part of healthy lifestyle for prevention of high blood pressure and related diseases.

Despite progress in the detection, evaluation, and treatment of hypertension, most of the adult population has prehypertensive or high blood pressure levels, with a consequent increase in cardiovascular risk.[1,2] To combat this, populationwide efforts are needed to modify adverse lifestyles leading to high blood pressure levels.[3] Current recommendations emphasize reduced salt intake and increased potassium intake, avoidance or correction of excess alcohol and calorie consumption, and adoption of the Dietary Approaches to Stop Hypertension combination diet, shown to contribute significantly to further blood pressure reduction.[3-5]

Findings of higher blood pressure among meat eaters compared with vegetarians[6] suggest that high dietary protein intake may be detrimental to blood pressure. This view was challenged by epidemiological and experimental evidence indicating that total dietary protein intake is inversely related to blood pressure,[7-13] which has practical and theoretical implications for

medical care and public health. Accordingly, the initial hypothesis of the INTERMAP Study on macronutrients, micronutrients, and blood pressure, involving 17 diverse population samples in 4 countries, was that total protein intake is inversely related to blood pressure.[14] In the present study, we report results on the association of vegetable, animal, and total protein intake with blood pressure.

Methods

The INTERMAP Study methods have been reported in detail.[14,15] They are summarized herein.

Population samples and field surveys

The INTERMAP Study included men and women, aged 40 to 59 years, from 17 randomly selected population samples in Japan (4 samples), the People's Republic of China (3 samples), the United Kingdom (2 samples), and the United States (8 samples). The mean participation rate was 49% (45% in Japan, 83% in the People's Republic of China, 22% in the United Kingdom, and 44% in the United States).

Each participant had 2 study visits on consecutive days, with 2 additional study visits on consecutive days 3 to 6 weeks later. Measurements included systolic and diastolic blood pressure (2 measurements per study visit, for a total of 8 measurements), height and weight (on the first and third study visits), and dietary intake based on multiple-pass 24-hour recalls (at each study visit).[15,16] All foods and beverages consumed in the previous 24 hours, including dietary supplements, were recorded. Because single 24-hour recalls are generally inadequate for assessing diets of individuals,[17] 4 dietary recalls per person were obtained, yielding greater precision on the associations between nutrient intake and blood pressure of 0.06.[18]

Questionnaire data on demographics and other possible confounders were obtained by interview, including 2 histories of 7-day alcohol intake, medical and family histories, medication use, special diets, and physical activity.

Two 24-hour urine samples, started at the research center (on the first and third study visits) and completed the next day, were obtained from each participant. Urine aliquots were stored at −20°C for shipment to the Central Laboratory, Leuven, Belgium. For external estimation of laboratory precision, a random 10% of samples were split locally and sent to the Central Laboratory with different identification numbers. Urinary measurements included sodium, potassium, urea, creatinine, calcium, and magnesium.[14]

Quality control was extensive, with local, national, and international checks on the completeness and integrity of nondietary[14] and dietary[15] information. In the United States, dietary data were entered directly into a computerized database (Nutrition Data System, version 2.91; University of Minnesota, Minneapolis). This system contains information on the nutrient composition of 17 000 foods, beverages, ingredients, and supplements. In the other countries, data were entered onto standard forms, coded, and computerized; a random 10% of dietary recalls were recoded and reentered (with the staff blinded to the original entries). Nutrient intake was calculated using country-specific food tables, which were standardized for consistency across countries by the Nutrition Coordinating Center at the University of Minnesota.[19]

Of 4895 individuals initially surveyed, 215 were excluded as follows: 110 persons who did not attend all 4 study visits, 7 individuals for whom the diet data were considered unreliable, 37 persons for whom the calorie intake from any 24-hour dietary recall was less than 500 kcal/d (2100 kJ/d) or was greater than 5000 kcal/d (21 000 kJ/d) for women or greater than 8000 kcal/d (33 600 kJ/d) for men, 37 individuals for whom 2 complete urine samples were unavailable, and 24 persons with other data that were incomplete, missing, or indicating a protocol violation. Therefore, 4680 participants (2359 men and 2321 women) were included in the analysis.

The study was designed to have sufficient power to test prior hypotheses at the 1% level. With a sample size of 4680, the power is greater than 90% at the 1% level to detect partial correlations between nutrient intake of 0.06 (that is, true correlations of 0.10 or more because, with 4 dietary recalls and 8 blood pressure measurements, correlations could be attenuated by 40% or more due to daily variability in nutrient intake and blood pressure). A true correlation of 0.10 indicates that 1 SD above vs 1 SD below the group mean of daily protein intake is associated with a mean difference of 20% of the standard deviation in blood pressure, corresponding to about 3 mm Hg systolic and 2 mm Hg diastolic.

The study received institutional review board or ethics committee approval at each site. All participants gave written informed consent.

Statistical analysis

The dietary data of individuals were converted to macronutrient and micronutrient intake, including 18 amino acids.[15] Data were based on intake of foods and beverages, including dietary supplements. Dietary protein was divided into animal protein and vegetable protein (including grains, legumes, and other nonanimal sources). Nutrients supplying energy were calculated as the percentage of total energy; other dietary variables were calculated per 1000 kcal (4200 kJ). Measurements for each individual were averaged across study visits. Means, standard deviations, numbers, and percentages were calculated by country.

Associations among nutritional variables were explored by partial correlation analysis and were adjusted for sample, age, and sex by pooling cross-country correlations weighted by sample size. Multiple regression analysis was used to examine associations between individuals' vegetable, animal, and total protein intake (percentage of kilocalories or kilojoules) and their blood pressure. Potential confounders were added sequentially to the regression models, calculated with and without adjustment for height and weight because of known associations among vegetarianism, lighter body weight, and lower blood pressure[6] (the overadjustment problem) and because height and weight affected associations, possibly because of their high precision of measurement compared with dietary variables.[17] Adjustments were made for 5 models, with each successive model repeating the adjustments of the previous model, as follows: *model 1* (adjustment for sample, age, and sex), *model 2* (plus adjustment for special diet, history of cardiovascular disease or diabetes mellitus, family history of hypertension, moderate or heavy physical activity [usual hours per day], and dietary supplement intake), *model 3* (plus adjustment for 24-hour urinary sodium and potassium excretion and 7-day alcohol intake[20]), *model 4* (plus adjustment for calcium, saturated fatty acid, polyunsaturated fatty acid, and dietary cholesterol intake[11,21]), *model 5a* (plus adjustment for dietary magnesium intake), and *model 5b* (plus adjustment for fiber intake).[13,22] Model 5a and model 5b were considered separately because of multicollinearity.[23] Interaction terms were included for age and sex. Because of significant interaction with sex, results for total protein intake are presented separately for men and women. Additional analyses used 24-hour

urinary urea as a marker of total protein intake, adjusted (as in the INTERSALT study[10]) for sample, age, 7-day alcohol intake, body mass index (calculated as weight in kilograms divided by the square of height in meters), and urinary sodium, potassium, calcium, and magnesium excretion[10] separately by sex because of significant interaction with sex.

To check linearity, associations between protein intake and blood pressure were plotted by country (mean systolic and diastolic blood pressure by country-specific quartiles of protein intake), and the significance of adding a quadratic term for protein intake was assessed for each regression model. These analyses did not indicate a need for nonlinear models.

Regression models were fit separately by country, and coefficients were pooled across countries, weighted by the inverse variance of each coefficient, to obtain an overall estimate of association. To assess interactions in the size and direction of country-specific regression estimates, homogeneity was tested. Overall regression coefficients were expressed as millimeters of mercury for a 2-SD difference in protein intake (ie, 1 SD below the mean to 1 SD above the mean) from pooled within-country standard deviations (1-way analysis of variance).

To assess the sensitivity of primary findings, additional analyses were performed. These included calorie intake in all models,[24] nutrient intake from foods and dietary supplements, intake (in grams per day) adjusted for calories (instead of nutrient densities), separate exclusions of participants taking antihypertensive or other cardiovascular disease medications, individuals with history of cardiovascular disease or diabetes mellitus, individuals on special diets, and those with high daily variability of nutrient intake and blood pressure.[14]

To examine possible differences in the amino acid content of diets, participants were assigned to quartiles of vegetable and animal protein intake within each country. The amino acid content of diets among participants in the top quartile of vegetable protein intake and bottom quartile of animal protein intake was compared with those among participants in the bottom quartile of vegetable protein intake and top quartile of animal protein intake (analysis of covariance with adjustment for country, age, and sex). Analyses were conducted using SAS version 8.02 (SAS Institute Inc, Cary, NC).

Results

Descriptive statistics

The mean ± SD systolic blood pressure ranged from 117.2 ± 13.8 mm Hg (in Japan) to 121.3 ± 17.4 mm Hg (in the People's Republic of China) (Table 1). The mean body mass index, caloric intake, and animal protein intake (caloric percentage) were lowest in the People's Republic of China and highest in the United States. The mean vegetable protein intake was lowest in the United States and highest in the People's Republic of China.

Partial correlation analysis

Vegetable protein intake and animal protein intake (adjusted for sample, age, and sex) were inversely correlated (r=−0.36) (Table 2). High correlations were found between vegetable protein intake and total fiber intake (r=0.64), between vegetable protein intake and dietary magnesium intake (r=0.56), between animal protein intake and cholesterol intake (r=0.55), and between dietary magnesium intake and total fiber intake (r=0.71).

Multiple regression analyses

Vegetable Protein Intake and Blood Pressure

With adjustment for sample, age, and sex (model 1), blood pressure differences for higher vegetable protein intake by 2.80% kilocalories (ie, 2 SD of vegetable protein intake) were –2.72 mm Hg systolic and –1.67 mm Hg diastolic; with additional adjustment for height and weight, these values were –1.95 mm Hg systolic and –1.22 mm Hg diastolic ($P<.001$ for all) (Table 3). With further adjustment (model 3), blood pressure differences without adjustment for height and weight were −2.14 mm Hg systolic and −1.35 mm Hg diastolic ($P<.001$ for both); with additional adjustment for height and weight, these values were −1.11 mm Hg systolic ($P<.01$) and −0.71 mm Hg diastolic ($P<.05$). Significant heterogeneity in systolic blood pressure differences was found among countries for models 1, 2, and 3 unadjusted for height and weight, with the largest differences (inverse) in the United States and the smallest differences in the United Kingdom. Adjusted for other dietary variables (models 4 and 5), systolic blood pressure differences remained significant in models unadjusted for height and weight. All models were significant or borderline significant for diastolic blood pressure differences. There were no significant age or sex interactions.

Multiple sensitivity analyses (models 2, 3, and 5a) showed blood pressure differences associated with higher vegetable protein intake that were generally similar to those for the main analyses. An exception was observed for persons on a special diet (Table 4).

Based on computerized data (see the "Methods" section), foods contributing to vegetable protein intake could be assessed for the 2195 participants from the United States, which had the largest inverse relationship between vegetable protein intake and blood pressure. Of 1647 food items consumed by US participants, 978 (59%) contained vegetable protein. The following 4 food groups supplied 75% of the vegetable protein intake: breads, rolls, and biscuits (33%); vegetables (16%); soy and soy products (15%); and rice and pasta (11%). Four other food groups supplied an additional 20% of vegetable protein intake as follows: beans, excluding soy (7%); nuts, nut butters, and seeds (6%); fruit and fruit juices (5%); and cereals (2%).

Animal Protein Intake and Blood Pressure

Unadjusted for height and weight, there was a significant association (direct) in most models between higher animal protein intake (by 2 SDs equal to 5.84% kilocalories) and systolic and diastolic blood pressure. Adjusted for height and weight, the blood pressure differences were smaller and nonsignificant (Table 3).

Total Protein Intake and Blood Pressure

Given the significant ($P<.01$) interactions with sex, the results for the association between total protein intake and blood pressure are given by sex in Table 5. For men, the associations unadjusted for height and weight were nonsignificant; adjusted for height and weight, the blood pressure differences were inverse (significant only in models 1 and 2). For women, no associations were significant.

Based on 24-hour urinary urea nitrogen excretion (in grams per 24 hours) as an index of dietary total protein intake,[10] blood pressure differences for higher urinary urea nitrogen by 5.34 g per 24 hours (ie, 2 SDs) were small and nonsignificant. These blood pressure differences were −0.77 mm Hg systolic and −0.40 mm Hg diastolic for men and −1.11 mm Hg systolic and −0.41 mm Hg diastolic for women.

Amino acid content of diets (high vegetable and low animal protein intake vs low vegetable and high animal protein intake)

Overall, 491 individuals in the country-specific top quartiles of vegetable protein intake and bottom quartiles of animal protein intake consumed 9.1% (95% confidence interval, 9.0%-9.1%) of their total calories from vegetable protein and 4.3% (95% confidence interval, 4.2%-4.4%) from animal protein. For 471 individuals in the country-specific bottom quartiles of vegetable protein intake and top quartiles of animal protein intake, the corresponding percentages were 5.4% (95% confidence interval, 5.3%-5.5%) of their total calories consumed from vegetable protein and 12.0% (95% confidence interval, 11.9%-12.2%) from animal protein. Blood pressure differences between these 2 diet groups (adjusted for sample, age, and sex) were –4.15 mm Hg systolic (P<.001) and –2.15 mm Hg diastolic (P<.01). For 18 amino acids, the percentage of total protein intake was compared between the 2 diet groups (Table 6), ranked by T score (most positive to most negative). There were significant between-group differences for 17 amino acids. Individuals with high vegetable and low animal protein intake consumed greater proportions of glutamic acid, cystine, proline, phenylalanine, and serine, and they consumed smaller proportions of the other 13 amino acids compared with persons with lower vegetable and higher animal protein intake.

Comment

Our main finding was an inverse relationship between individuals' vegetable protein intake and their blood pressure. For animal protein intake, significant direct associations with blood pressure did not persist after adjustment for height and weight. Among women, there was no significant association between total protein intake and blood pressure; among men, the associations were not significant after adjusting for dietary confounders.

Investigators from previous epidemiological cross-sectional and prospective studies[25-27] reported inverse relationships between vegetable protein intake and blood pressure. Regarding possible inverse relationships between total protein intake[9-11,28] or animal protein intake[8,29,30] and blood pressure, the INTERMAP Study found no significant independent relationships, consistent with the results of other cross-sectional[31-33] and prospective[34,35] studies. Specifically, we did not replicate the INTERSALT Study[10] and MRFIT Study[11] findings of an inverse relationship between total protein intake and blood pressure.

The reasons for these differences in results may be differences in study methods or populations. The INTERSALT Study[10] included 52 population samples in 32 countries, with 24-hour urine sample analysis as a marker of dietary intake. The INTERMAP Study, carried out in 4 countries, included 4 direct measures of dietary intake from 24-hour dietary recalls. Although the MRFIT Study[11] results were based on a mean of 4 or 5 measures from 24-hour dietary recalls, these were conducted annually during 5 to 6 years, not 3 to 6 weeks apart as in the INTERMAP Study. In addition, the MRFIT Study included only men at high risk of coronary heart disease.

Given the high correlations among vegetable protein intake, total fiber intake, and dietary magnesium intake, it is difficult to assess whether vegetable protein intake, these other variables, or their combination is responsible for the inverse relationship between vegetable protein intake and blood pressure.[36,37] Vegetarians have lower blood pressure and lighter body weight than nonvegetarians[6]; their lower blood pressure may, in part, reflect their higher vegetable protein intake. If so, the INTERMAP Study inclusion of body weight as a confounder of vegetable protein intake may be an overadjustment. After controlling for body

weight, an association between blood pressure reduction and vegetable protein intake was found in randomized trials of vegetarian diets[37,38] and of soy protein supplement use.[39]

In part, because heavier individuals consume more food on average, body weight correlates more strongly with nutrient intake expressed as amounts per day than as caloric density. Although we expressed dietary variables as percentages of kilocalories, adjustment for height and weight still had a marked effect on the extent of the associations between protein intake and blood pressure, possibly reflecting greater precision of measurement for body mass than for dietary variables.[17]

In the Dietary Approaches to Stop Hypertension trials,[4,5] the recommended combination diet emphasized fruits, vegetables, and low-fat or fat-free dairy products; included whole grains, poultry, fish, and nuts; and reduced the intake of red meats, fats, and sweets. In the first Dietary Approaches to Stop Hypertension trial,[4] total protein intake was moderately increased in the group receiving the combination diet (17.9%) compared with the control group (13.8%), sodium intake across the groups was similar by design, and alcohol intake was low or nil. The isocaloric diet increased the intake of fiber, potassium, phosphorus, calcium, and vitamins; improved the polyunsaturated fat–saturated fat ratio; and decreased the intake of total fat, saturated fat, cholesterol, and all sugars. Compared with the control group fed a usual American diet, mean systolic and diastolic blood pressure among the combination diet group was significantly lowered by 5.5/3.0 mm Hg.[4] Because this combination diet entailed multiple dietary modifications, no conclusion is possible as to contributions of specific nutrients to the blood pressure reduction.

Regarding animal protein intake, a small study[40] reported increased systolic blood pressure with 250 g of beef per day added to the diets of normotensive vegetarians for 4 weeks. However, other similar small studies[41,42] found no effect on blood pressure.

If a causal relationship exists between vegetable protein intake and blood pressure, a potential mechanism is the action of constituent amino acids, several of which have been implicated.[43-46] We found significant differences in the amino acid content of diets predominating in vegetable protein compared with those predominating in animal protein, possibly contributing to the opposing blood pressure effects of vegetable vs animal protein. Other components of diets high in vegetable protein (eg, magnesium) may interact with amino acids to lower blood pressure. Further work is needed to assess such concepts.

The epidemiological approach in the INTERMAP Study has limitations. These include the lack of a gold standard for dietary assessments, which are dependent on reporting by participants (subject to systematic and nonsystematic errors); variation among food tables in different countries; variability in daily dietary intake, with consequent attenuation of associations between nutrient intake and blood pressure[17,18]; use of cross-sectional data to make inferences about long-term dietary effects on blood pressure; and intercorrelations and nonindependence among dietary variables,[23] limiting the ability to clarify causal relationships.

We attempted to minimize dietary reporting errors through extensive quality control procedures.[15] The problem of variability in daily dietary intake was addressed through the use of repeated dietary recalls[11,17] and 24-hour urine samples, rather than statistical corrections, given the complex underlying statistical assumptions.[17] Despite the use of repeated measures, the effects of vegetable protein intake on blood pressure may still be underestimated. Finally, we standardized the food tables[19] and used urinary biomarkers for sodium, potassium, and protein (urinary urea) excretions to verify dietary intake.[15]

Cross-sectional data probably underestimate the true effects if lifelong dietary exposures are important and if people modify their diets because of health concerns. We addressed these problems by controlling for participants on a special diet in regression models. Regarding dietary intercorrelations and potential overfitting of statistical models, we adopted a parsimonious approach and limited inclusion of highly correlated variables in the same model.

Conclusions

We found an inverse relationship between individuals' vegetable protein intake and their blood pressure. We did not confirm previous epidemiological findings of an inverse relationship between total protein intake and blood pressure.[9-11,28] Our results are consistent with current recommendations that a diet high in vegetable products be part of a healthy lifestyle for prevention of high blood pressure and related chronic diseases.[3] Definitive ascertainment of a causal relationship between vegetable protein intake and blood pressure awaits further data from randomized controlled trials, especially regarding the effect of constituent amino acids on blood pressure.

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