TOURO COLLEGE & UNIVERSITY SYSTEM

The Science Journal of the Lander College of Arts and Sciences

Volume 9
Number 2 *Spring 2016*

1-1-2016

A Dietary Approach to Cardiovascular Disease and Cancer: Does a Plant Based Diet Help Prevent and Reverse Cardiovascular Disease and Cancer?

Chana Wircberg
Touro College

A Dietary Approach to Cardiovascular Disease and Cancer: Does a Plant Based Diet Help Prevent and Reverse Cardiovascular Disease and Cancer?

Chana Wircberg

Chana Wircberg graduated in June 2016 with a BS in Biology.

Abstract

Modern Western societies seem to suffer from a veritable epidemic of serious diseases, two of the most serious of which are cardiovascular disease and cancer. In contrast, hunter and gatherer groups have a very low incidence of such diseases. Despite the diversity of hunter and gather diets, they all share the same characteristic: the absence of a Western diet. This suggests that there is something uniquely inflammatory about a Western diet, which is high in both fats and carbohydrates. Departures from a Western diet appear to result in better health. Experimental studies have shown that heart disease can be reversed by adopting a very low-fat, high-carbohydrate, plant-based diet. The results for cancer are less clear. A low-fat, plant-based diet seems to offer promising results, but so does a low-carb, high-fat ketogenic diet. Perhaps forcing the metabolism into burning either fatty acids alone or glucose alone is beneficial, so long as one does not mix fat and carbohydrates.

Introduction

In Western societies, heart disease is the leading cause of death followed by cancer. In 2010, cardiovascular disease (CVD) caused a total of 788,000 deaths, which makes up nearly 32 percent of all deaths. Heart disease is the leading cause of death in blacks, but second to cancer in Hispanics, Asians, and American Indians. In the United States alone, a national survey from 2007 to 2010 showed that an estimated 83.6 million people either suffered from cardiovascular disease or were at risk for it. Of this number, 77.9 million people had hypertension and 15.4 million people had coronary heart disease (NHLBI, 2012). As for cancer, more than thirteen million people in the US had cancer in a survey taken in 2012 (Seer, 2012).

Although important advances have been made in the treatment and control of cardiovascular, lung, and blood diseases, these diseases continue to be a major burden on the nation. It has been estimated that in 2009, for example, we spent $313 billion on treating CVD--$192 billion of which took the form of direct health expenditures and the other $121 billion was in the form of the indirect costs of mortality (NHLBI, 2012).

Might there be a way to allay these financial and human costs? By way of an affirmative, this paper will explore the hypothesis that dietary measures can prevent and/or ameliorate cardiovascular disease and cancer.

Methods

Articles were located on the Touro library, University of Austin webpage, google scholar, and some journals found in the Touro library. The articles were critically read, reviewed, compared, and contrasted.

Discussion: Genes or Diet?

Genes, surely, have role to play in explaining susceptibility to various diseases. For example, one of the risk factors for heart disease, elevated cholesterol, sometimes has a genetic cause. And with the rise of medical inventions, such as penicillin, people who might once have died young from infectious diseases now live long enough to develop other diseases, such as cardiovascular ones and cancers. So it is possible that we are now seeing genetic dispositions come into play.

However, it is unlikely that genes are the whole story. When people of the same genetic stock change their diet, their risk of getting serious diseases changes. For example, when Asian men move to the United States, they develop prostate cancer at a higher rate than their peers at home. (Cook, et. al. 1999). Since the men who moved to the United States did not alter their genes, the increased incidence of prostate cancer is likely a product of a change of lifestyle, of diet, or of both. Further, in the United States the annual number of deaths from cardiovascular disease increased substantially from 1900 to 1970 and remains high(NHLBI, 2012) (Figure 2). While during this period, antibiotic use was on the rise, other changes were afoot. In particular, the way food was produced and consumed underwent enormous transformations. At the turn of the twentieth century, refrigerators designed for home use had not been invented and meals had to be made from scratch. By 1970, housewives were able to buy packaged foods and fast-food restaurants were becoming more and more popular.

It is plausible, then, that dietary and lifestyle factors might have greatly contributed to the development of serious diseases. Not only that, diet and lifestyle may also contribute to the disease's amelioration. If so, it is only logical that cardiovascular (and cancer) therapy should involve changes in diet and lifestyle.

The question then becomes: what type of diet and lifestyle is most protective against, and most able to ameliorate, cardiovascular disease and cancer?

Non-Western Groups, Western Diseases

One place to look for answers is among groups of people who have low rates of serious disease. One such place is among hunters and gatherers, who have astonishingly low incidences

of both cardiovascular disease and cancer. Weston A. Price's Nutrition and Physical Degeneration documents how agricultural and hunter-gather groups eating their traditional diets tend to have very low rates of degenerative diseases. This hypothesis has been supported by studies of particular groups. Only a few of them are listed here to give an idea of their lowered risk of disease. One study that surveyed blood pressure among Tsimani forager-farmers found that they had low blood pressure, and it remained low even as they aged—a finding that opposes the "normal" trend whereby blood pressure tends to increase with age.(Gurven, et al., 2012) Similarly, a study of traditional hunter-gatherer Cameroon Pygmies found that they had less aortic stiffness, lower LDL, and higher HDL than did semi-urbanized Pygmies and African Bantous.(Lemogoum, et al., 2012). The South Pacific commission of 1985 reported that the rate of cancer incidence among Fijiian Melanesians is quite low (Robertson, 1991). This finding is particularly striking since even the rates of lung cancer is one-fourth less than that of Polynesians and Micronesians, even though all groups smoke regularly. It is possible that the Melanesians' consumption of leafy green vegetables, such as bele and taro leaves, is protective (Robertson, 1991). And in the first half of the twentieth century, Canadian and Alaskan Inuits eating their traditional diet had very low cancer rates compared to Westerners or to Inuits eating a non-traditional diet (Steffanson, 1960). However, in the second half of the twentieth century, "Inuit have undergone noticeable dietary changes from a diet mainly based on fish and sea mammals towards a diet more dependent on imported food" and adapted, as well, to a Western way of life, at the same time, the incidence of cancer of the lung, breast, and colon, has increased (Friborg; Melbye, 2008).

What characteristics do groups such as these share that might be protective against heart disease and cancer? The answer is not a particular diet per se since diets among different non-Western groups tend to vary quite radically. A traditional Melanesian diet, for example, was mostly plant-based, which included both leafy greens and starchy foods such as taro, but also included some seafood and coconut. At the other end of the spectrum, the Inuits traditionally subsisted on a high fat, high-meat diet that included very little plants and other carbohydrates. Nevertheless, what they have in common is avoidance of a Western diet and lifestyle. According to this view, a Western diet and/or lifestyle is uniquely inflammatory and likely to increase risk factors for heart disease and cancer.

Untangling the Lifestyle and Diet Hypotheses

What might account for the tendency of Western diets and lifestyle to increase the incidence of cancer? There are many hypotheses ranging from an intake of excess calories to micronutrient deficiencies produced by processed foods One hypothesis, even, is that it is not a Western diet per se that increases cancer rates, but a Western lifestyle. In contrast to the high-stress Western lifestyle, non-Western groups tended to provide people with a cohesive community, a clear sense of purpose and/or identity, trust in a spiritual power, a more laid back life that is closer to the rhythm of the changing seasons and days. In support of this hypothesis, is the following evidence: Amish adults in Holmes County, Ohio had a cancer rate that was only 60 percent of the rate of cancer among non-Amish white adults in Ohio. (Westman, et al., 2010). However, since the Amish tend to prepare their own food, it is hard to know whether their lowered cancer rate was due to their lifestyle or to the benefits of a particular type of diet. Further complicating this scenario is a study of the Old Order Amish in Pennsylvania, whose mean total serum cholesterol was 212 (and a standard deviation of 45.2), a little above the recommended cholesterol number (200). (Pollin, et al. 1991, Table 1). However, the Old Order Amish are known for being exceptionally long-lived. (Sorkin, et al., 2005). This may be due to genetic mutation that protects them from the negative effects of high cholesterol. (Pollin, et al., 1991).

Given these complicating factors, one way to test the hypothesis that lifestyle alone and not diet is what determines cancer risk would be to study groups of people that have a cohesive community, sense of purpose, and belief in God but eat a typical Western diet. If we were to find out that people on such a diet experienced rates of cancer similar to the general population, then this would contradict the lifestyle hypothesis. But such communities are very difficult to find, especially since people who adopt a Western lifestyle—even religious groups of people—adopts, as well, the non-dietary accouterments of such a lifestyle, such as 9 to 5 jobs, smoking, and sedentary habits. For example, Seventh Day Adventists—who tend to be vegetarians—tend to have lower mortality rates from serious diseases compared to the rest of the population. (Heuch, et al., 2005). But it is hard to untangle the factors that might explain this, since in the Seventh Day Adventist, this may be due to non-dietary factors, e.g. they are discouraged from smoking.

In the absence of such a stringent test, the next-best test would be to compare differing religious groups that each have a strong sense of community, purpose, and belief in God but that have different diets. Such a study has, in fact, been attempted in Denmark. A study of 11,580 Baptists, who have no dietary restrictions, and Danish Adventists, who are lacto-ovo vegetarians, found, first, that both groups, especially, the Seventh Day Adventists had cancer rates that were lower compared to the general Danish population (66.95 percent for men and 85 percent for women), and that, second, overall "Adventists had lower hazard rates than Baptists" (Thygesen, et al., 2012). These

results suggest that both lifestyle and diet are protective or carcinogenic, since it turns out, first, that being part of a religious group might, in fact, be somewhat preventive against cancer and that, second, nonetheless certain kinds of diets may be more protective than other kinds of diet (and perhaps even more protective than the type of lifestyle one adopts).

Seventh Day Adventists generally tend to consume a mostly vegetarian diet, suggesting that it might be a beneficial diet even among people who follow a Western lifestyle.

Heart Disease: Causes and Characteristics

While some heart attacks are due to arrhythmias or faulty valves, endothelial injury, inflammatory oxidative stress, foam cell formation, and development of plaque can all be an introduction for cardiovascular disease. In obstructive heart disease, high cholesterol sometimes oxidizes, attaches to fatty acids, and begins to clog the arteries (atherosclerosis). These plaques sometimes calcify in the body's attempt to stabilize them, but this has the effect of further occluding the arteries. Occluded arteries make it harder to pump blood through them, and so blood pressure increases, in an attempt to ensure that adequate blood reaches vital organs. When the arteries are obstructed, or when the plaque is too unstable such that a clot forms and breaks off, then that blocks the flow of blood. This prevents enough oxygen from reaching the heart (as in ischemic heart disease), the brain (as in strokes), the lungs (pulmonary heart disease), or other vital organs.

In this scenario, high cholesterol starts an inflammatory cascade. Dietary cholesterol is often the source of high blood cholesterol, as well as of the fatty acids that the cholesterol transports, but the liver, too, can produce cholesterol and fatty acids. Further, when we take in too much sugar and starch than we need or than can be delivered to our cells, the liver converts them to fat. And insulin resistance, which prevents adequate disposal of glucose, is a predictor of heart disease (Yip, et al., 1998). Insulin resistance shifts our metabolism from burning glucose to burning fat, which means that the blood will have elevated levels of circulating free fatty acids, which have also been implicated in heart disease.

This picture is perhaps an overly simplified one. While it begins with the premise that the problem is elevated cholesterol, in a healthy body, ingested cholesterol generally should be converted to pregnenolone, estrogen, testosterone, progesterone, and cortisol. This raises the question: what is stopping or slowing down such a conversion? We may not be able to fully understand the genesis of heart disease without answering this question, but perhaps the answer is simply that we were not designed to ingest as much fat, sugar, and cholesterol that we currently do. So our bodies cannot convert all of it to various hormones.

Given these dynamics, we would expect that diets that have an abundance—not only of fat and cholesterol—but of sugar, fat, and cholesterol, to be ones that are effective at increasing the incidence of heart disease—which is the case in Western countries. Conversely, we would expect that diets that reduce our intake of fat and sugar would be beneficial at preventing and reversing heart disease.

Heart Disease and a Mediterranean Diet

There have been many attempts to find therapeutic diets that might prevent and reverse heart disease. One commonly studied diet is the Mediterranean diet, which comprises of mostly grains, fruits, vegetables, olive oil, nuts, some fish, dairy, and some occasional red meat. Fat makes up roughly 30 to 40 percent of the caloric intake and the fat itself was mostly monounsaturated (McKeown, et al., 2010). The Lyon Diet Heart Study was the first attempt to use this diet on 275 patients who had survived a first myocardial infarction. A test group was to follow the Mediterranean diet, while a control group was to follow the diet prescribed by their doctor. In patients who followed the test diet, the rate of cardiac death was 1.32/100 patients after 27 months and 1.24 after 46 months. This was an impressive reduction in mortality compared to the control group, which had a mortality rate of 5.55 and 4.07 after 27 and 46 months, respectively (de Lorgeril, et al., 1999). Many further studies have attempted to replicate the success of the Lyon Diet Heart Study, with varying success. One review of observational studies estimated that a Mediterranean diet reduced the risk of heart disease by 8 to 45 percent (Panagiotakos, et al., 2004).

It might seem that favoring the intake of monounsaturated to saturated fats might account for these somewhat favorable results, but regardless of whether patients ate either type of fat, the disease spread just at the same rate (Castelli, 1996). Further, while compared to a control group, the results of adhering to a Mediterranean diet seem impressive, we must keep in mind that while it reduced the rate at which people died from coronary heart disease, it did not actually stop or reverse the progression of the disease. The disease continued to progress, albeit at a slower rate compared to the control group (de Lorgeril, et al, 1999).

Heart Disease and a Plant-Based Diet

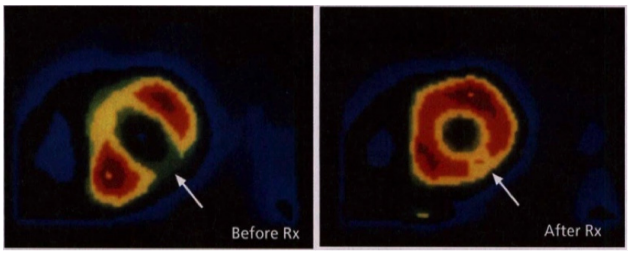
It is possible that the Mediterranean diet is not restrictive enough or permits too much animal-based foods. In support of this hypothesis, we can point to how during World War II, when the Germans confiscated Norwegians' livestock, the Norwegian diet was effectively limited to plants. During this time, the death

rates from strokes and heart attacks dropped considerably and then returned to pre-war levels when livestock was abundant again. This is an epidemiological study, but there is other evidence that supports the use of a plant-based diet to control heart disease. First, on a jocular note, African green monkeys apparently find a plant-based diet to be heart protective, especially when used in conjunction with cholesterol-reducing medication. Over a five-year period, these monkeys saw a halt to the progression of coronary artery disease (Rudel LL et al. 1995).

But clinical studies have yielded positive results for human beings, too, who adopt a plant-based diet. In one study, patients put on a plant-based diet that had less than 10 percent fat saw a drop in their cholesterol: an average of fifty points, from 227 mg/dL to 172 mg/dL. And there was a regression of heart disease in 82 percent of the 28 patients (Ornish et al., 1990). In this study, in addition to making dietary changes, the test patients had to exercise for three hours each week, as well as spend an hour a day on some type of stress-reducing exercise, such as meditation.

It would have been useful to compare the effects of a regimen of stress-reduction alone to a dietary regimen only; this would allow us to better tease out the degree to which diet accounts for the results. But we have a semi-answer in the form of clinical studies undertaken by Caldwell Esselstyn at the Cleveland Clinic. Twenty two patients with cardiovascular disease were put on a plant-based diet consisting of legumes, whole grains, fruits, and vegetables; the total fat intake was around 8 percent of total caloric intake. The 17 patients who adhered to this diet all witnessed a complete halt to the disease, and in 4 of them there were signs that the disease was reversed. One patient, who was limping from obstruction of the arteries in the leg, known as claudication, and who also had a low pulse volume experienced total pain relief after ten months of being on a plant based diet. Figure 3, below, presents the PET results of the myocardium of another patient before the diet and three weeks after: the restricted myocardial blood flow showed signs of restored blood flow (Esselstyn, 2014).

Figure 3



Restoration of blood flow to myocardium after three weeks on plant-based diet

While this study was a small one, a study consisting of a larger sample size, a cohort of 198 patients was performed. The patients had medical issues ranging from hyperlipidemia, hypertension, and diabetes. These patients were then counseled on the guidelines of the core of a plant-based diet. They were instructed to eat only whole grains, legumes, and fruits and vegetables. They were encouraged to take a multivitamin and a B12 supplement and then assured that these food and vitamins would provide all of their amino acid needs. Omega-6 and omega-3 essential fatty acids were provided in the form of flax seeds so were therefore also recommended as part of the diet. Foods that contained oil, fish, meat, fowl, dairy, avocado, nuts, caffeine and sugar were foods that were prohibited. Out of these patients, twenty one patients were not adherent to the diet. Out of these twenty one patients, 13 (62 percent) experienced at least one cardiovascular disease event including sudden cardiac death, heart transplants, and ischemic stroke. This is in glaring contrast to the patients who did follow the diet. Out of the 198 patients, 177 (89 percent) followed these guidelines and ninety-three percent of these adherent patients experienced improvement or even resolution of symptoms. There was only one major cardiovascular event that was related to disease progressions within the patients who adhered to the diet (Esselstyn, 2007). This is a 0.6 percent recurrent event rate. This contrasts sharply to the 62 percent recurrence rate recorded from the nonadherent patients.

Because adherence is generally the hardest factor to maintain in a diet, this study provided the patients with a five hour counseling seminar before the start of the diet to inform the patients of the risks involved when ingesting animal products. The patients were then called and given psychological support during a 3.7 year follow up to ensure they were adhering to the diet. This may have contributed to the success of the study. But there are some limitations to this study. First, it did not include a control group. Second, the patients who made up the cohort were very specific. They fell into a certain age range and all had history of cardiovascular disease. Further study would be needed to determine if complete prevention of cardiovascular disease can be accomplished in patients who do not have a history of cardiovascular disease. Third, the sample size, even though larger than the sample included in the Cleveland Clinic study, is still rather small.

Despite these limitations, in both of Esselstyn's studies, the percentages of patients in which cardiovascular disease did not progress are consistent. The percentage of patients in the study who adhered to the diet and had a recurrence of cardiovascular disease events is less than one percent. This is strong enough data to be used in order to inform people of this cheap and effective option of preventing and reversing cardiovascular

disease. And it supports the hypothesis that a plant-based diet can significantly affect the progression of the cardiovascular epidemic that is rampant in Western countries.

What might explain the impressive results of a plant-based diet? One possibility is that plant polyphenols themselves are heart-protective. Another is that a plant-based diet avoids the negative effects that might result from eating red meat, such as the production trimethylamine-N-oxide, a metabolite of L-carnitine, which has been linked to coronary artery disease (Tuso, et al., 2015). Another possibility is that by restricting a macronutrient (fat), subjects ended up cutting out a huge source of calories, and so perhaps a plant-based diet better cuts calories than does a Mediterranean diet. Another possibility is that fat itself is harmful to the heart and so lowering dietary lipids to under 15 or even 10 percent might be advantageous. Perhaps even a zero-fat diet might not be ill-advised for some. One man cured himself of his migraines, reduced his blood pressure, and reduced his cholesterol from 252 to 206 by switching to a completely fat-free diet. (Brown et al. 1938). This diet, however, was not a plant-based one, but used sugar and defatted milk. If the results of this diet were shown to be useful to more than just one individual, then we might have found the mechanism by which a plant-based diet reverses heart disease: it's the absence of high fat, not the plants themselves that are helpful. This would be a surprising finding but its validity, of course, is a question for further research to determine.

Cancer: Causes and Characteristics

Unlike the causes of heart disease, the causes of cancer are not well understood. They tend to share several basic characteristics: angiogenesis (Baenke, et. al. 2013); altered fat metabolism (McAnderew; Baenke, et.al.2013); a preference for anaeorobic over aerobic metabolism (Warburg, 2009); and perhaps even the capacity for immortality. What might lead an organism to develop these characteristics? One hypothesis, forwarded by Otto Warburg, is that cancers are caused by derangements in respiratory function. Other hypotheses include the theory that cancer is a type of viral infection, that cancer cells are stem cells that (for some reason) have been unable to mature, and that cancer is a product of localized and/or systemic inflammation. But whichever hypothesis we choose, we would have to explain, e.g., the cause of respiratory dysfunction, the inability of stem cell maturation, or the causes of inflammation.

Cancer and a Plant-Based Diet

Seventh Day Adventists generally—not just, as we saw earlier, Danish Adventists—have lower cancer rates compared to the general population (Lemon, et al., 1964). Further, even among Adventists, the type of vegetarian diet adopted affected their cancer rates. Among 69,120 participants of the Adventist Health Study-2, there were 2,939 cases of cancer. While a vegetarian diet is sometimes associated with cancers of the gastrointestinal tract, here, vegetarians were less like to get such cancers, particularly if they were lacto-ovo vegetarians. Likewise, vegetarians—particularly vegan vegetarians—had a lower risk of cancer compared to non-vegetarians (Tantamango-Bartley, et al., 2012).

When we turn to studies assessing the relationship between a plant-based diet and lowered cancer risk, we find that a vegetarian diet, in general, even among the non-religious, appears to have protective effects. A 1990s prospective study of 63,550 people in the United Kingdom found that, compared to people who ate meat, vegetarians were less likely to get cancer (except for colorectal cancer). For vegetarians, "the incidence rate ratio for all malignant neoplasms was 0.89" (Key, et al., 2009).

Further, increasing people's consumption of vegetables and whole grains may be beneficial even among people who have cancer. Case histories of cancer patients have revealed, for example, that pancreatic cancer patients who ate a low fat diet that included moderately high fiber and reduced calorie had a higher 1-year survival rate than patients who did not change their diets. Likewise, patients with stage D2 metastatic prostate cancer who followed such a diet survived longer and with improved quality of life compared to patients who did not change their diets (Carter, et al. 1993). Another study encouraged men with recurrent prostate cancer to eat more vegetables and whole grains. "Median intake of whole grains increased from 1.7 servings/d at baseline to 6.9 and 5.0 servings/d at 3 and 6 months, respectively. Median intake of vegetables increased from 2.8 servings/d at baseline to 5.0 and 4.8 servings/d at 3 and 6 months, respectively. The rate of PSA rise decreased when comparing the prestudy period (0.059) to the period from 0 to 3 months (-0.002, $P < .01$) and increased slightly, though not significantly, when comparing the period from 0 to 3 months to the period from 3 to 6 months (0.029, $P = .4316$). These results provide preliminary evidence that adoption of a plant-based diet is possible to achieve as well as to maintain for several months in patients with recurrent prostate cancer" (Nguyen, et al., 2006).

Additionally, a plant-based low-fat (10-15% kcal), high-fiber (30-40 g per 1,000 kcal/day) diet, combined with daily exercise, in just two weeks reduced overweight women's risk factors for breast cancer. This regimen reduced their serum estradiol, insulin, and IGF-I. Further, serum taken from these women after two weeks proved able to induce apoptosis of several variants of breast cancer cells in vitro (Barnard, et al., 2006).

These are just a few studies, but the evidence is quite suggestive. Plants have a number of protective properties (such as polyphenols) so simply increasing plant foods may be protective.

But part of the protection may be also the result of reducing the consumption of other foods, particularly processed foods, meat, and added fats. It is striking that people such as McDougall, Ornish, and Pritikin emphasize the importance of keeping dietary fat low, not just of increasing the amount of plant matter.

This makes sense to some extent since some fats themselves might contribute to the development of cancer. For example, prostate cancer is detected among men in the United States at a rate that is fifteen times higher than the rate of detection among men in Asian countries, who eat a lower-fat diet than American men (Parkin, et al., 1990). And, as mentioned earlier, when Asian men move to the United States and presumably increase their intake of fat, they develop prostate cancer at a higher rate than their peers at home (Cook, et. al., 1999). Further, compared to subjects who ingested less fat compared to the controls, lowering fat intake led to the development of smaller tumors as well as to tumors that grew more slowly—at least in immunodeficient mice who were able to eat ad libitum (Tung, 2014). It is worth noting that different types of fat may have different effects. In the study just cited, the mice on both the high-fat and low-fat diets ingested omega-6 fatty acids in the form of corn oil. In contrast, among mice whose main source of fat was saturated, there was little difference in the development of tumors in mice fed a diet high in fat (40 percent) versus those fed a diet low in fat (12 percent). This would suggest, as the authors of this study do, that lowering saturated fats does not slow the growth of prostate tumors, but reducing omega-6 fats might be beneficial (Lloyd, et al. 2010).

Cancer and Ketogenic Diets

Before we too hastily conclude that fat is carcinogenic, we should recognize that there is some evidence that ketogenic diets, which have been shown to be protective against epilepsy, might be protective against cancer too. Some scholars hypothesize that since cancer cells thrive on glucose, depriving them of it might, in principle, lead to their eventual death. On the other hand, since normal cells are able to run on ketones, a very high fat, low carb and low protein diet should be harmful only selectively (to cancer cells, not to normal cells) (Allen, 2014). There are very few human studies that demonstrate the purported benefits of a ketogenic diet. One of these studies included two young girls who had advanced-stage brain tumors that remained even after they were subjected to radiation and chemotherapy. Although the chemotherapy and radiation were not successful, the tumors were able to be managed long-term by using a ketogenic diet. (Nebeling, 1995). Thomas Seyfried has replicated these results among mice with brain tumors (Seyfried 2008; Seyfried 2003). Further studies on mice suggest that a ketogenic diet reduces blood glucose and slows the growth of tumors, a result that is compounded when used in conjunction with hyperbaric oxygen therapy (Poff, 2013).

There is not enough evidence to determine which one is more effective, but it seems that a very high fat diet, just as a low fat plant-based diet, might be effective, to some extent, against cancer.

High Fat or Low Fat?

On first glance, this seems to be a surprising result: two diets that could not be more different from each other both seem to exert some protective effects against cancer. Perhaps the same conclusions can be drawn as was earlier when confronted with the fact that non-Western people who consumed radically different diets nevertheless had similar low rates of cancer: the protective effects of different diets may be due less to their component parts than to their shared avoidance of certain foods, such as processed meats or artificial ingredients. Or it might be that a ketogenic diet is protective against certain type of cancers, but not others, while a low-fat, plant-based diet is more protective against other types of cancers. It should be noted that all of this is based on Warburg's considering that all types of cancer have the same type of causes. But it is possible that each cancer has a different cause and that therefore resolving it would require a diet targeted for that particular cancer. It might even be that cancers themselves might evolve in slightly different ways so that someone who has stage-1 breast cancer might respond well to one kind of diet while the same person with a stage-4 breast cancer might respond badly to the same diet.

However, bracketing that possibility for now, another hypothesis might be that certain foods—or food groups—are protective but only when taken alone such that combining them with another type of food might weaken their protective effects, or even cause negative ones. According to this hypothesis, perhaps a very high fat alone may be protective, as is high-carb plant food diet. Combining both fat and plant-based carbs, on the other hand, might have a different effect. This is a topic for future research.

Conclusion

Western countries have the highest incidence of atherosclerosis. Not coincidentally, these countries have easy access to an abundance of foods that are high in fat, sugar, starch, and cholesterol. If North America and Europe claim to have the most advanced medical care, what are these health care systems doing to prevent atherosclerosis, in particular, and heart disease, in general? In 1989, the National Research Council created a report called "Diet and Health," which recommended keeping cholesterol levels under 200 mg/dL and dietary fat to 30 percent of one's caloric intake. However, these guidelines are contestable, since it is possible that "a greater reduction [of cholesterol and dietary fat] would confer additional health benefits."

(Ornish, 1998). The suggestion that cholesterol levels between 150 and 200 might be too high is supported by a study showing that 35 percent of patients with ischemic heart disease had a cholesterol level between 150 and 200 (Castelli, 1996). The National Research Council, the American Heart Association, and the National Cholesterol Education Program recommend a diet that includes oil, low-fat milk, butter, and cheese. But if atherosclerosis and heart disease in general are closely linked to high cholesterol, their recommended diet by may be too lax to lower cholesterol levels. In light of the evidence, it would appear that in order to prevent and reverse heart disease, we would be well advised to adopt a very low fat, plant-based diet.

Adopting a low-fat, plant-based diet might also help reduce our chances of getting cancer, but there is also evidence suggesting that a high-fat ketogenic diet might be advantageous. Which diet should we prefer? Given differences in our genetics and physiology, some people might be better off on a ketogenic diet while others might fare better on a low-fat plant-based diet. Current knowledge does not tell us who would do better on which diet, but it is reasonable to suppose that people whose ancestors ate a certain type of diet might be more adapted to that diet than other people. The Inuit, for example, over the generations might have evolved the capacity to be able to process huge amounts of fat safely. But other than a few groups whose ancestral diet is known, what should the average Indo-European person do?

Given our lack of knowledge about the long-term effects of ketogenic diets, it might be best to adopt a low-fat diet instead. We have no evidence comparable to that of long-term vegetarian diets, that a long-term ketogenic diet is safe or prevents the development cancer (as opposed to attenuating its growth). We cannot point to the Inuits in support of the safety of a ketogenic diet since, although they ate a high-fat diet, it was nevertheless not on a ketogenic one: they ate some carbohydrates and enough protein that could then be converted, via gluconeogenesis, to glucose. Therefore, it is wise for many of us to adopt a low-fat plant-based diet, especially since it appears to be beneficial in reducing heart disease.

References

Baenke Franziska, Barrie Peck, Heike Miess, and Almut Schulze. Hooked on fat: the role of lipid synthesis in cancer metabolism and tumour development. Dis Model Mech. 2013 Nov; 6(6): 1353–1363.

Barnard R. James, Jenny Hong Gonzalez, Maud E. Liva, and Tung H. Ngo. Effects of a Low-Fat, High-Fiber Diet and Exercise Program on Breast Cancer Risk Factors In Vivo and Tumor

Cell Growth and Apoptosis In Vitro. NUTRITION AND CANCER, 2006; 55(1), 28–3.

Brown William Redman, Arild Edsten Hansen, George Oswald Burr, and Irvine McQuarrie. Effects of prolonged use of extremely low-fat diet on an adult human subject. Journal of Nutrition (1938), vol. 16, no. 6.

Carter JP, GP Saxe, V. Newbold, CE Peres, RJ Campeau, and L. Bernal Green. Hypothesis: dietary management may improve survival from nutritionally linked cancers based on analysis of representative cases. J Am Coll Nutr. 1993: 12(7): 209

Cook, L. S., Goldoft, M., Schwartz, S. M., and Weiss, N. S. Incidence of adenocarcinoma of the prostate in Asian immigrants to the United States and their descendants. J. Urol., 161: 152–155, 1999.

de Lorgeril Michel; Patricia Salen; Jean-Louis Martin; Isabelle Monjaud; Jacques Delaye; Nicole Mamella. Mediterranean Diet, Traditional Risk Factors, and the Rate of Cardiovascular Complications After Mocardial Infarction, the Final Report of the Lyon Heart Study. Circulation 1999;99:779-785

Esselstyn CB Jr, Ellis SG, Medendorp SV, et al. A strategy to arrest and reverse coronary artery disease: a 5-year longitudinal study of a single physician's practice. J Fam Pract. 1995;41:560-568

Esselstyn CB Jr. Prevent and Reverse Heart Disease. New York; New York: Penguin Group;2007

Esselstyn CB Jr. Updating a 12 year experience with arrest and reversal therapy for coronary heart disease (an overdue requiem for palliative cardiology) Am J Cardiol. 1999;84:339-341, A8

Esselstyn CB Jr. Resolving the coronary artery disease epidemic through plant-based nutrition. Prev Cardio.2001;4:171-177.

Esselstyn Jr MD, Gina Gendy MD, Johanthan Doyle MCS, Mladen Golubic, Michael F. Roizen. A Way to reverse CAD? The Journal of Family Practice. 2014;Volume 63 No 7

Friborg Jeppe T, Mads Melbye, Cancer patterns in Inuit populations. The Lancet Oncology. Vol. 9, issue 9. September 2008: 892-900

Gurven Michael, Aaron D. Blackwell, Daniel Eid Rodríguez, Jonathan Stieglitz, Hillard Kaplan. Does Blood Pressure Inevitably Rise With Age? Longitudinal Evidence Among Forager-Horticulturalists. Hypertension. 2012. DOI: 10.1161/HYPERTENSIONAHA.111.189100

Heuch Ivar, Bjarne K. Jacobsen, Gary E. Fraser. A cohort study found that earlier and longer Seventh-day Adventist church membership was associated with reduced male mortality. Journal of Clinical Epidemiology 58 (2005) 83–91.

Jansen, A.A.J., S. Parkinson, and A.F.S. Roberston. Food and Nutrition in Fiji: A Historical Overview, vol. 2. Dept. of Nutrition and Dietetics, Fiji School of Medicine; Inst. Of Pacific Studies; U. of S Pacific. 1991.

Key TJ, Appleby PN, Spencer EA, Travis RC, Roddam AW, Allen NE. Cancer incidence in vegetarians: results from the European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford). Am J Clin Nutr. 2009 May;89(5):1620S-1626S.

Lampe J.W. Interindividual differences in response to plant-based diets: implications for cancer risk. Am. J. Clin. Nutr. 2009. Volume 89, Issue 5; Pages 1553S-1557S

Lemon F, Walden R, Woods R. Cancer of the lung and mouth in Seventh-day Adventists. Preliminary report on a population study. Cancer 1964;17: 486–97.

Lemogoum Daniel, William Ngatchou, Christophe Janssen, Marc Leeman, Luc Van Bortel, Pierre Boutouyrie, Jean Paul Degaute, Philippe Van de Borne. Effects of Hunter-Gatherer Subsistence Mode on Arterial Distensibility in Cameroonian Pygmies. Hypertension. 2012. DOI: 10.1161/HYPERTENSIONAHA.111.187757

Linher K and Singh G . Abstract P4-03-02: Establishing a Relationship between Breast Cancer, Prolactin and Altered Fat Metabolism. Cancer Res 2010;70(24 Suppl):Abstract nr P4-03-02.

Lloyd Jessica C., Jodi Antonelli, Jean-Alfred Thomas, Tameika E. Phillips, Susan H. M. Poulton, and Stephen J. Freedland. Effect of Isocaloric Low-Fat Diet on Prostate Cancer Xenograft Progression in a Hormone-Deprivation Model. Journal of Urology. 2010 April; 183(4): 1619–1624.

McAndrew P. F.. Fat Metabolism and Cancer. Surg Clin North Am. 1986 Oct;66(5):1003-12.

McKeown Pascal P., Karen Logan, Michelle C. McKinley, Ian S. Young and Jayne V. Woodside. Session 4: CVD, diabetes and cancer: Evidence for the use of the Mediterranean diet in patients with CHD. Proceedings of the Nutrition Society (2010), 69, 45–60.

Ngo Tung H., R. James Barnard, Pinchas Cohen, Stephen Freedland, Chris Tran, Frank deGregorio, Yahya I. Elshimali, David Heber, and William J. Aronson. Effect of Isocaloric Low-fat Diet on Human LAPC-4 Prostate Cancer Xenografts in Severe Combined Immunodeficient Mice and the Insulin-like Growth Factor Axis. Clinical Cancer Research 2003; 9: 2734–2743.

Nguyen Jacquelyn Y., Jacqueline M. Major, Cynthia J. Knott, Karen M. Freeman, Tracy M.

Downs, and Gordon A. Saxe. Adoption of a Plant-Based Diet by Patients with Recurrent Prostate Cancer. INTEGRATIVE CANCER THERAPIES 5(3); 2006 pp. 214-223.

Ornish, D., Brown, S. E., Billings, J. H., Scherwitz, L. W., Armstrong, W. T., Ports, T. A., ... Brand, R. J. (1990). Can life-style changes reverse coronary heart disease? The Lancet, 336(8708), 129–133.

Panagiotakos DB, Pitsavos C, Polychronopoulos E et al. (2004) Can a Mediterranean diet moderate the development and clinical progression of coronary heart disease? A systematic review. Med Sci Monit 10, 193–198

Parkin, D. M., Pisani, P., and Ferlay, J. Estimates of the world-wide incidence of 25 major cancers in 1990. Int. J. Cancer, 80: 827–841, 1999.

Pollin Toni I., Wen-Chi Hsueh, Nanette I. Steinle, Soren Snitker, Alan R. Shuldiner, Braxton D. Mitchell. A genome-wide scan of serum lipid levels in the Old Order Amish. Atherosclerosis 173 (2004) 89–96.

Robertson A. F. S.., ed. Food and Nutrition in Fiji: Nutrition-related diseases and their prevention (1991).

Rudel LL, Parks Js, Sawyer JK. Compared with dietary mono-unsaturated and saturated fat, polyunsaturated fat protects African Green Monkeys from coronary artery atherosclerosis. Arterioscler Thromb vasc Biol 1995;15:2101-2110

Sorkin John, Wendy Post, Toni I. Pollin, Jeffrey R. O'Connell, Braxton D. Mitchell, Alan R. Shuldiner. Exploring the genetics of longevity in the Old Order Amish. Mechanisms of Ageing and Development 126 (2005) 347–350.

Stefansson Vilhjalmur. Cancer, Disease of Civilization (1960).

Tantamango-Bartley Y1, Jaceldo-Siegl K, Fan J, Fraser G. Vegetarian diets and the incidence of cancer in a low-risk population. Cancer Epidemiol Biomarkers Prev. 2013 Feb;22(2):286-94

Thygesen Lau Caspar, Niels Christian Hvidt, Helle Ploug Hansen, Andreas Hoff, Lone Ross, Christoffer Johansen. Cancer incidence among Danish Seventh-day Adventists and Baptists Cancer Epidemiology 2012; 36:513–518

Tuso Phillip, MD, FACP, FASN; Scott R Stoll, MD; William W Li, MD. A Plant-Based Diet, Atherogenesis, and Coronary Artery Disease Prevention. Perm J 2015 Winter; 19(1):62-67

Westman Judith A., Amy K. Ferketich, Ross M. Kauffman, Steven N. MacEachern, J. R. Wilkins III, Patricia P. Wilcox, Robert T. Pilarski, Rebecca Nagy, Stanley Lemeshow, Albert de la Chapelle, Clara D. Bloomfield. Low cancer incidence rates in Ohio Amish Cancer Causes Control (2010) 21:69–75

Yip Jeannie, Francesco S. Facchini, and Gerald M. Reaven. Resistance to Insulin-Mediated Glucose Disposal as a Predictor of Cardiovascular Disease. Journal of Clinical Endocrinology and Metabolism. 1998. Vol. 83, No. 8