Causal Analysis:
Risk Factors of Coronary Heart Disease

To

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Figures, Tables, and Graphs

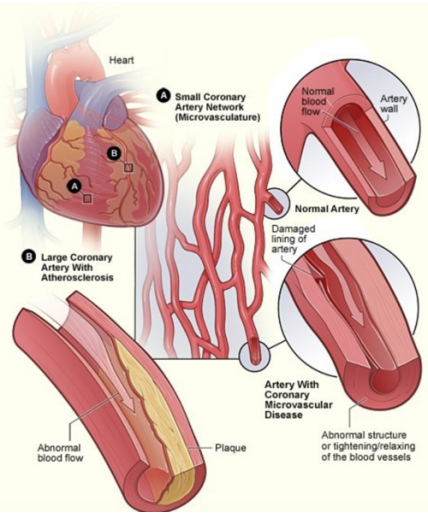
Abstract

Over the course of many years, scientists and medical doctors have conducted notable and incontrovertible longitudinal studies amongst various populations in the world to discover the causes of heart disease. Disease prevalence, mortality rates, lifestyle, diet patterns, and health conditions of populations from the U.S. and foreign countries have been studied both independently and comparatively, revealing a host of risk factors largely revolving around modifiable lifestyle and diet-related conditions and practices. The following report presents and analyzes information from the most highly regarded and comprehensive longitudinal studies on the contributing factors of heart disease in order to draw some conclusions on its causality. Considered the fundamental standard that set the precedent for all future cardiovascular disease studies, the Framingham Study tested and confirmed a collection of risk factors such as high blood pressure, high blood cholesterol levels, smoking, diabetes, obesity, lack of physical activity, unhealthy diet, and stress. The China Study compared the vastly differing mortality rates of 65 counties and 130 villages in rural mainland China with that of the U.S. and analyzed the prevalence of diseases from each population along with the etiologies of the diseases. The findings revealed the fact that meat intake dramatically contributes to heart disease, while a plant-based diet greatly reduces the risk. Finally, the report concludes by discussing the Adventist Health Study which tracks the lifestyle and outcomes of the Adventists, a Christian denomination regarded as one of the longest living people groups in the world. The study reveals some major findings on how the plant-based diet of many of the members in this group can counteract heart disease. The scientifically validated information presented also helps to contribute toward fact-based recommendations on proper action toward the causes that the report presents.

Introduction

According to the CDC, Centers for Disease Control and Prevention, heart disease is the number one leading cause of death for men and women across all racial and ethnic groups in the United States (CDC, 2019). 647,000 Americans die from heart disease annually which means that one person dies of heart disease every 37 seconds (CDC, 2019). Statistics such as these alone should speak to the severity and enormity of this problem, yet thousands upon thousands of Americans continue to succumb to this lethal disease. Simply put, heart disease results from an accumulation of plaque in the coronary arteries, also called atherosclerosis. This buildup can partially or fully occlude or block blood flow in the arteries of the heart, resulting in fatal or near-fatal heart attack. The following figure from the National Institutes of Health illustrates what the inside of an artery looks like when plaque buildup obstructs the blood flow.

Figure 1



Atherosclerosis or plaque buildup in the arteries

Source: Coronary Heart Disease. (n.d.). Retrieved from https://www.nhlbi.nih.gov/health-topics/coronary-heart-disease

A crippling problem surrounding this issue is that most people are either completely ignorant of the contributing factors toward this disease or are paralyzed by a confusing mixture of varying ideas. Most people do not routinely delve into medical journals and studies for the sake that they are quite erudite and overly technical for the average American. However, the information in modern day medical research contains an abundant supply of scientifically tested findings to address the problem of heart disease. Unfortunately, when people find themselves facing the occurrence of heart disease, it feels like a death sentence or an inexplicable curse. The fact that heart disease kills more Americans than any other cause known to man underscores the importance of having prime awareness of the causality of this threat to life and longevity.

In light of the need for proper awareness on the topic of heart disease, a proper causal analysis on the issue demanded action. Therefore, this report presents, analyzes, and evaluates highly credible and revered medical and scientific studies that have been conducted for the specific purpose of ascertaining the contributing causes of heart disease. Perhaps the most reputable studies done on the case of heart disease have been lengthy and comprehensive longitudinal studies, meaning they study a well-distributed population over many years. Though medical and scientific research has not found a single cause for heart disease, studies have shown there to be a host of risk factors that contribute toward the development of the disease. The objective of this report was to analyze the most reputable longitudinal studies available to answer specific points of inquiry that would facilitate better understanding of the causality of heart disease.

The scope of inquiry first consisted of discovering an assortment of risk factors from which to gain a broad perspective on the issue from which to make conclusions. Next, the aim was to study a type of cause and effect research comparing US incidence of heart disease and its

etiology along with that of another culture that differs from it. Thirdly, another goal was to home in on any dominant risk factor(s) and dig slightly deeper in research. The final element of the scope of inquiry was to come from a different angle and study a population with low incidence of heart disease in order to see what could be learned. Through the study of the Framingham study, the China Study, and the Adventist Health Study, the report concludes by extracting a variety of lifestyle and diet-related risk factors and reveals a strong indication toward meat intake as a major cause and catalyst for the cultivation of the disease.

Data Section

Assortment of Risk Factors

Before 1948, most Americans were more clueless about the causes of heart disease than ever before. Back then, heart disease was barely understood and there was a scarcity of studies done on the issue. Thanks to a team of scientists in Framingham, Massachusetts, the first pioneering study on heart disease was conducted that consisted of extensive physical examination and lifestyle interviews of 5,309 men and women between the ages of 30 and 62 (Framingham Heart Study, n.d.). In 1971, a second generation was enrolled in the study and since then subsequent cohorts continue to have been implemented as recently as April 2002 (Framingham Heart Study, n.d.). The Framingham study's impressive timeline of analysis established it as the gold standard by which all modern-day physicians and scientists look toward. It provided the medical community with an assortment of multiple risk factors proven through extensive and time-tested research.

The Framingham Study. While the Framingham Study (FHS) revealed unmodifiable factors such as age, family history, and race that contributed to heart disease, the preponderance of factors were modifiable factors such as high blood pressure (hypertension), high blood

cholesterol levels, smoking, diabetes, obesity, lack of physical activity, unhealthy diet, and stress. Physicians once thought that high blood pressure was a positive thing, calling it “benign essential hypertension” (Hajar, 2017). The Framingham study dispelled this notion and found an increased risk of heart disease morbidity with rising baseline blood pressure (Hajar, 2017). The researchers discovered that the risk of heart attack and stroke doubles for every 20-point jump in systolic blood pressure and 10-point rise in diastolic blood pressure (Hajar, 2017). High cholesterol, obesity, and diabetes, which are also risk factors of heart disease, were found to be more prevalent with hypertensive individuals than those who were not (Hajar, 2017). In addition, hypertensive individuals had more target organ damage, silent myocardial infarction, strokes, TIAs, and peripheral artery disease. 60% of men and 50% of women with hypertension in the Framingham study had one or more of the conditions just listed (Hajar, 2017). Through clinical as well as animal testing and observation, the FHS showed a directly proportional association between serum total cholesterol and cardiovascular risk (Hajar, 2017). Any changes of cholesterol levels were associated with a change in the incidence rate of heart disease which caused clinicians and epidemiologists to use total plasma cholesterol as a marker for predicting heart disease (NIH). Over a 20-year span during the FHS, a two to three-fold increase of atherosclerosis, plaque in the arteries, was reported for people with diabetes (Hajar, 2017). Findings from the FHS on diabetes have now found their way into the American Heart Association’s statistics that say that 68% of people age 65 or older with diabetes die from some form of heart disease and that they are two to four times more likely to die than a person without diabetes (Hajar, 2017). Like high blood pressure, diabetes is also linked to many of the other risk factors such as hypertension, high cholesterol, obesity, etc. Physical inactivity showed that those who already had heart disease were almost twice as likely to die of sudden death from acute

myocardial infarction, more commonly known as a heart attack (Hajar, 2017). And finally, obesity was found to alter metabolic profile and cause negative adaptions in cardiac structure and function in addition to contributing to a surge of other risk factors, including diabetes and hypertension (Hajar, 2017).

Throughout the following data, there is a common theme that the majority of the risk factors are due to modifiable causes cultivated through lifestyle. Another important point to note is that many of the factors are interrelated and occur in association and concurrence with other factors. For example, high blood pressure seemed to directly correlate with the prevalence in high cholesterol, obesity, and diabetes. And diabetes had the similar effect of increasing the risk of hypertension, high cholesterol, and obesity. There is an interesting feedback loop where one risk factor has an effect on stimulating the development of other risk factors, ultimately multiplying the aggregate risk. The interconnectedness of the data leads us to believe that some underlying factor(s) may be at work in the development of these causes of heart disease. Before making any conclusions, further research will be discussed to explore that issue more deeply. But one thing is for certain from the data and that is that much of the causality of heart disease is attributed to modifiable factors rather than fixed ones we cannot change.

Cause and Effect of the Disease and Etiologies in the US and China

In January of 2005, Cornell University Biochemist Dr. T. Colin Campbell published the 417-page longitudinal study called *The China Study* containing startling findings showing the strong connection between nutrition and disease. Over one million copies were sold, making it one of the best-selling books on nutrition in America. After the results from the Framingham study became firmly established, scientists could not help but notice that many of the factors seemed diet and intake related. It was when scientists began connecting the dots of the various risk

factors when Dr. Campbell assembled a team of investigators to collect and analyze the mortality data of over 50 diseases, heart disease among them, from 65 counties and 130 villages in rural mainland China. “Blood, urine, food samples, and detailed dietary data were collected from 50 adults in each village and analyzed for nutritional, viral, hormonal, and toxic chemical factors” (Campbell et al., 1998). What Campbell and his team found were that China and the U.S. were starkly different in their diet patterns and produced dramatically differing disease rates. The China study explores whether groups of diseases share common etiologies and conducts an extensively tested and confirmed cause and effect hypothesis on the dietary link with disease.

The China Study. To establish a proper foundation, the study conducted extensive data collection and analysis of nutritional, viral, hormonal, toxic factors, blood, urine, and food samples in addition to comprehensive and detailed dietary data (Campbell et al., 1998). Over 367 lifestyle, dietary and disease characteristics were garnered and proven to be reliable and mortality data from 50+ diseases over 65 counties and 130 villages were analyzed (Campbell et al., 1998). The following tables show the data on the differences in the dietary characteristics of the United States and China as well as the set of diseases that were directly correlated with each country.

Table 1

TABLE I Comparison of Diets in the United States and China (1983–1984)

	United States (2,360 Kcal)*	China (2,630 Kcal)*
Fat (%)	36	14
Carbohydrate (%)	42	71
Alcohol (%)	7	5
Fiber (g/day)	11	33
Protein (%)	15†	10‡
Animal protein (%)	~10	~1

*Equivalent of 30.6 Kcal/kg and 40.6 Kcal/kg body weight, respectively.
†70% of protein calories are from animal sources.
‡11% of protein calories are from animal sources.
Reprinted with permission from *Diet, Lifestyle, and Mortality in China: A Study of the Characteristics of 65 Chinese Countries.*[3]

Table 2

TABLE II Consistently Correlated Disease Groups

Group A (More Typical of Developing Countries)	Group B (More Typical of Western Countries)
Pneumonia	Colon cancer
Intestinal obstruction	Lung cancer
Peptic ulcer	Breast cancer
Digestive diseases	Leukemia
Nephritis	Diabetes
Pulmonary tuberculosis (TB)	Coronary disease
Non-TB infectious diseases	Brain cancer (0–14 years)
Parasitic diseases	Stomach cancer
Eclampsia	Liver cancer
Rheumatic heart disease	
Metabolic and endocrine disease other than diabetes	
Diseases of pregnancy and birth other than eclampsia	

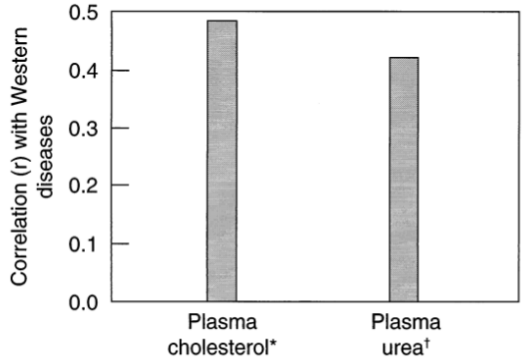
Adapted from *Ecol Food Nutr.*[4]

Campbell, T., Parpia, B., & Chen, J. (1998). Diet, lifestyle, and the etiology of coronary artery disease: the Cornell China Study. *The American Journal of Cardiology*, *82*(10), 18–21. doi: 10.1016/s0002-9149(98)00718-8

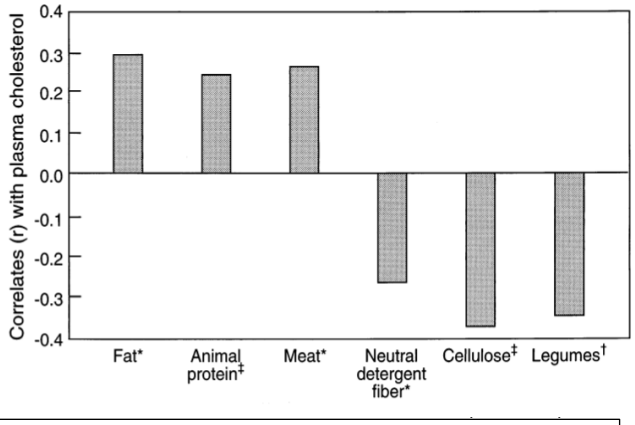
As the data above shows, there are noticeable differences between the nutritional and disease characteristics from the two studied populations. Coronary heart disease along with different types of cancers and diabetes, another risk factor of heart disease, were listed in group B. The diseases in that category are referred to as 'diseases of affluence' or as Campbell (1998) puts it, diseases of 'nutritional extravagance'. This is due to the fact that affluent countries such as the United States often have more ease of access to animal protein whereas more agrarian, rural countries often rely on a more vegetable and legume-based diet. As the tables above show, fat intake in China was less than half of the US and fiber intake was three times higher in the Chinese diet than that of the US (Campbell et al., 1998). The findings also indicated that the intake of animal protein and blood cholesterol were very low in China compared to that of the US and although calorie intake in china per kg. of bodyweight was 30% higher, the obesity rates were much lower (Campbell et al., 1998). Over the course of the study, Campbell and his team discovered that the variables associated with the western diseases of group B, heart disease among them, were total blood cholesterol and blood nitrogen (Campbell et al., 1998). Digging a little deeper, they found blood nitrogen to be directly associated with meat, milk, and eggs, while blood cholesterol was associated with the consumption of animal protein and meat (Campbell et al., 1998). What the data also showed was that high blood cholesterol levels were inversely associated with the intake of dietary fiber and legumes, meaning the more fiber and legumes were consumed, the lower the rate of cholesterol. The differences in mortality rates were staggering. What they found was that in China, 4 per 100,000 men and 3.4 per 100,000 women die of coronary heart disease while in the US 66.7 per 100,000 men and 18.9 per 100,000 women died of the same disease (Campbell et al., 1998). This translates to a 16.7- and 5.6-fold difference in heart disease incidence respectively. From the data gathered and analyzed in the

study, Campbell and his team of researchers discovered that mortality rates of coronary disease in China for both men and women is inversely associated with the frequency of the intake of green vegetables (Campbell et al. 1998). As for the risk factors, mortality rates were found to be positively associated with a combined index of salt intake, urinary sodium, and most importantly, apolipoprotein B, which is positively associated with animal protein intake and the frequency of the meat intake (Campbell et al. 1998). However, vegetables, plant protein, and legumes were inversely associated with the heart disease-inducing apolipoprotein B. In the following graphs, graph 1 depicts the direct correlation between plasma cholesterol and western diseases such as heart disease. Graph 2 shows that animal protein and meat are directly correlated to plasma cholesterol. Therefore, animal protein and meat are responsible for increasing the rate of heart disease.

Graph 1



Graph 2



Source: Campbell, T., Parpia, B., & Chen, J. (1998). Diet, lifestyle, and the etiology of coronary artery disease: the Cornell China Study. *The American Journal of Cardiology*, *82*(10), 18–21. doi: 10.1016/s0002-9149(98)00718-8

The China Study's findings were groundbreaking in that it provided structure and a common theme to help tie the many risk factors of the Framingham Study together. The theme that emerged through this research was most significantly that of the tie between nutrition and heart disease risk. Nutrition proved to play a massive role in the cultivation of the underlying biochemical components of the cultivation of heart disease. Specifically, animal protein and meat

seemed to greatly contribute toward not only the development of heart disease but also many types of cancers and diabetes, one of the chief risk factors of heart disease. Knowing what we learned from the Framingham study of how diabetes, high cholesterol, high blood pressure, and obesity are all interconnected and directly associated, makes the findings on the health threat of animal protein all the more impacting. Singlehandedly, animal protein and meat consumption have the ability to instigate a ruinous domino effect of one risk factor leading to another until the risk factors have proliferated out of control, thereby dramatically multiplying one's risk for heart disease. Seeing the pathway lead from animal protein intake to plasma cholesterol to a multitude of associated risk factors, shows that the link between diet and heart disease is integral to understanding its causality and prevention. Equally as important as the causality of the disease is how that data can be used to prevent and substantially reduce the likelihood of acquiring this disease. One of the major findings of the China Study was how it showed the inverse relationship between heart disease incidence and the intake of a plant-based diet of vegetables, dietary fiber, plant protein, and legumes. Not only does this provide a way out towards the prevention of this terrible disease, but it also offers a counterpoint by which to obtain further understanding on the causality of the disease. The next and final study of this report will tie in research done to show a population of people that adheres closely to a plant-based diet and the tremendous outcomes they have experienced as a result. In so doing, the findings will hopefully seek to affirm what we know thus far and shed light on fact-based recommendations in tackling the causes of heart disease.

The Nutritional Link: Nutritional Risk and Prevention Factors of Heart Disease

In November 2005, *New York Times* best-selling author and researcher Dan Buettner of the *National Geographic* magazine published the award-winning research story entitled "The

Secrets of Long Life" identifying five places in the world where people live the longest and are the healthiest (Buettner, n.d.). Dubbed the 'Blue zones', Okinawa, Japan; Sardinia, Italy; Nicoya, Costa Rica; Ikaria, Greece; and Loma Linda, California were the locations comprising this enviable standing of health and longevity. Loma Linda, California, the only blue zone within the United States, is home to a population of people called the "Adventists", who are a protestant Christian denomination who uphold values such as healthy living, a sense of community, and faith. An excerpt from the *National Geographic* article states: "From 1976 to 1988 the National Institutes of Health funded a study of 34,000 California Adventists to see whether their health-oriented lifestyle attached their life expectancy and risk of heart disease and cancer. The study found that the Adventist's habit of consuming beans, soymilk, tomatoes, fruit… reduced the risk of heart disease. And it found that not eating red meat had been helpful to avoid both cancer and heart disease" (Buettner, 2005). The spotlight the National Institutes of Health and the highly-publicized *National Geographic* article placed on the Adventists resulted in the establishment of this study, The Adventist Health Study, an ongoing longitudinal study designed to continually study subsequent cohorts of Adventist people in order to continue learning about the characteristics of avoiding the causes of disease.

Adventist Health Study. In one of the NIH published studies conducted by the Adventist Health Study, researches homed in on a protein-based factor analysis comparing the impact of animal protein versus protein from a plant-based source. 81,337 men and women were studied over the course of multiple years and techniques such as food frequency questionnaires, factor analysis, and cox regression analysis were employed to accurately and thoroughly examine and interpret the data (Tharrey et al., 2018). What they found was a 61% higher risk of cardiovascular disease (CVD) death due to the meat protein factor and a 40% lower risk of CVD

death for those in the plant-based protein factor from nuts and seeds (Tharrey et al., 2018). No significant associations were found for the grains, legumes, and vegetables (Tharrey et al., 2018). This is due to the fact that the study was exclusively isolating its analysis on the effect protein, from animal and plant sources, had on heart disease mortality risk. Therefore, specifically in regard to the plant protein, the findings indicated high benefit in protein derived from nuts and seeds while the protein derived from legumes, grains, and vegetables had a neutral effect. In another study conducted by the Adventist Health Study, evidence from three cohorts in North America consisting of the Adventist Mortality Study, Adventist Health Study 1, and Adventist Health Study 2, the selected health outcomes of varying degrees of the vegetarian diet were studied (Le et al., 2014). For the non-vegetarian category, fully non-vegetarians and semi-vegetarians were studied while for the vegetarian category, pescatarian (fish, milk, eggs; no red meat or poultry), lacto-ovo- (eggs and milk; but no red meat, fish or poultry), and vegan (no red meat, fish, poultry, dairy, eggs) vegetarian diets were analyzed. The results showed an upward trend in all-cause mortality reduction, meaning there was a lowering of mortality rates for all causes. Lacto-ovo-vegetarians had a 9% reduction in all-cause total mortality while vegans had a 14% lower risk of all-cause mortality (Le et al., 2014). Lacto-ovo vegetarians gained a 23% heart disease mortality risk reduction while vegans experienced a 42% risk reduction in heart disease mortality (Le et al., 2014).

The findings provided by the Adventist Health Study greatly solidify the fact that a plant-based diet is perhaps the most effective diet and lifestyle to prevent, avoid, and reduce the risk of heart disease. It also reinforces the fact that a diet high in animal protein is one of the most harmful and destructive influences on the cultivation of a proliferation of risk factors toward heart disease, putting the human body in a compromised state. The step-like progression of the

findings from the varying grades of vegetarian diets show the linear relationship diet has upon cardiovascular disease. The more animal protein is introduced the greater the risk swells, while the more animal protein is eliminated, the risk dwindles. These findings validate the science behind recommending a plant-based diet as a way to combat heart disease. When thinking of recommendations in fighting this disease, the role nutrition plays is certainly a factor worth considering.

Conclusion

Summary of Findings

In this report, research has been presented, discussed, and evaluated for the purpose of discovering and analyzing the causality of heart disease. The Framingham Study showed that a collection of factors such as high blood pressure, high blood cholesterol levels, smoking, diabetes, obesity, lack of physical activity, unhealthy diet, and stress play a role in developing heart disease. It also showed that many of the risk factors are interconnected with each other and occur in association. This became the basis for further study on the risk factors that contributed to causing heart disease.

The China Study furthered the research by taking into consideration that many of the factors in the Framingham Study seemed to be induced through food intake. Therefore, it comparatively analyzed two populations of dramatically differing nutritional and intake related characteristics and analyzed both for the role it played on the development of diseases. They discovered a high rate of risk and causality of heart disease with the consumption of animal protein and meat. It was shown to have the ability to multiply the mortality rate of heart disease by spurring a chain reaction of a series of different risk factors and causes of heart disease. The

study also revealed the inverse effect plant-based nutrition had on the incidence of heart disease. The more a plant-based diet was incorporated, the rates of heart disease fell in direct association.

Finally, the Adventist Health Study showed the comparison of people who consume meat versus a people group who closely follow the recommended plant-based approach to lifestyle and diet. The findings of this study revealed dramatically different cardiovascular health outcomes than those who eat meat and showed a linear decline in heart disease occurrence and mortality the more meat is minimized from the diet.

Interpretation of Findings

The studies that this report have presented began on a slightly broader note and steadily funneled into the evaluation of deeper and more precise research findings. Throughout the process, some noticeable themes and unifying characteristics began to emerge, allowing some definitive conclusions to be drawn. First and foremost, the data unequivocally shows an irrefutable and unavoidable link between nutrition and heart disease. Namely, animal protein and meat consumption has proven to be an overwhelming cause in the development and proliferation of multiple, compounding risk factors. As mentioned in the Framingham study, many of the risk factors of heart disease are modifiable, meaning they are completely within our control to manage based on the lifestyle and dietary decisions we make. The subsequent longitudinal studies that were discussed reinforced the idea that proper nutrition has the potential to either fertilize or stifle the cultivation of heart disease. The findings give a clear message that animal protein and meat undoubtedly function as one of the most fundamental and far-reaching elements of heart disease causality. However, the discovery of the nutritional link to heart disease has enlightened a path toward fact-based recommendations leading to positive health outcomes without cardiovascular disease.

Recommendations

In light of the data presented and analyzed, it would be highly recommended and advantageous for public health agencies and lay people alike to propagate the scientifically proven findings hereby discussed. America is in need of factual clarity in fighting heart disease, the #1 leading cause of death.

Less time should be given toward listing a long delineation of risk factors and more time should be applied toward discussing the root cause. Something as integral to daily life as food intake should be something that a majority of Americans are able to manage healthfully and according to the proper understanding. Simply put, a plant-based diet must continue to be promoted while always attaching it to the scientific and factual foundation upon which it rests.

In recent years, a plant-based diet has been gaining popularity as the science is gradually beginning to disseminate more and more throughout the country. The incorporation of the Impossible™ Burger and Beyond Meat™ in large-scale fast food chains such as Burger King and Carls Jr. is a testament to the fact that plant-based protein is beginning to enter popular demand. As the public exposure to a plant-based diet increases, more plant-based food options should continue to be implemented, providing consumers with food choices that foster longer, healthier, heart disease-free lives.

The cooperation of all is required for the facts to reach as many people as possible. Every level of society must do their part in advancing the truth about heart disease. There are many ways society can propagate the spread of these findings such as advocating for more initiatives with hospitals to provide patients with plant-based preventative medicine, lobbying with governmental bodies such as the Food and Drug administration to work more with the NIH to make their findings more palatable for non-technical audiences, and encouraging more plant-

based nutrition in food services at schools, nursing homes, and company cafeterias. However, the purpose of this analytical report is not to brainstorm methods to combatting the problem. Rather, the purpose of this causal analysis report was to present and analyze factual research on the causes of heart disease from broad to specific so that members in community, governmental, and professional realms may have the evidence they need to deal with this problem.

In helping to make an informed decision in handling the causes of heart disease, the takeaway theme of the research is to clearly acknowledge the causal relationship between nutrition and heart disease. The research in this report has shown, as will many other corroborating studies on this topic, that a diet heavy in meat and animal protein leads to the proliferation of many risk factors of heart disease. The science on this topic is an undeniable presence of a truth that cannot be ignored. Ultimately, there are two paths one can take, either turn a blind eye to the research or seek deeper understanding about the food we eat. The choice is ultimately in our control, one day and meal at a time.

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