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**The effect of meat vs non-meat diets on cardiovascular disease risk factors, including
hypertension, diabetes, and obesity**

By

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Introduction/Background

Animal protein has been arguably the most vital aspect of the human diet throughout history, but could it be contributing to more deaths due to cardiovascular disease? Red meat remains the highest proportion of meat consumed in the U.S.¹ In fact, meat intake continues to exceed previous intake limits. According to the World Resources Institute, Americans consumed a record amount of animal meat in 2018.² Conversely, those who follow vegetarian and vegan diets, eliminating animal protein, comprise only 5% of the American population. Most Americans incorporate meat into their diets, although little is known about meat's health effects.

Recent research has developed questions regarding meat and its potential for increasing the risk for cardiovascular disease through increased incidence of its risk factors. For the purpose of this literature review, the term meat is divided into two categories, unprocessed vs processed meat. Unprocessed meat includes pork, beef, and lamb. Processed meat includes bacon, sausage, and ham. The term non-meat refers to diets consisting of no animal meat, regardless of dairy or other animal product intake (e.g. milk, cheese, honey).

Hyperlipidemia, hypertension, diabetes, family history, gender, and obesity are all well-established cardiovascular disease risk factors. Advancements are being made to investigate the role of diet as a modifiable risk factor, and to determine if adults who consume meat compared to those who do not consume meat are at higher risk for hypertension, obesity, and diabetes, thus increasing their cardiovascular disease risk. Because animal protein is ubiquitous in the modern diet, it is imperative that determinations are made in regard to either its benefits or its contribution to the burden of chronic disease. The clinical application of this research is to ultimately determine the most appropriate diet recommendations to provide to patients who are at an increased risk for cardiovascular disease.

Discussion

Cardiovascular Disease Impact Cardiovascular disease (CVD), including cerebrovascular accidents, aortic dissection, and myocardial infarctions, are among the most serious afflictions in America, remaining the leading cause of death and accounting for 1 in every 4 deaths in both men and women.³ Every minute, more than one person dies from a heart disease-related event.³ Because these conditions remain the most fatal ailments plaguing Americans today, it is of the utmost importance to investigate the ways in which cardiovascular disease occurs. Although it is known that non-modifiable risk factors like family history and gender can contribute to cardiovascular disease, modifiable risk factors like dietary patterns should be considered as well. This review will synthesize recent research that has investigated the correlation between meat intake and three known risk factors for cardiovascular disease, hypertension (HTN), diabetes (DM), and obesity.

Hypertension

Processed Meat Increases HTN Risk Hypertension is a known risk factor for cardiovascular disease. Researchers investigated the correlation between meat intake and hypertension incidence. A prospective cohort study of 44,616 French women between 1993 and 2008 focused on the association between unprocessed versus processed meat intake and hypertension incidence.⁴ In this study, an association was made between processed meat and hypertension. A likely mechanism of this result may be that higher levels of nitrites and sodium content found in processed meat leads to increased blood volume and therefore higher blood pressure. Meat has also been considered a risk factor for cardiovascular disease because of its saturated fat and cholesterol content. Conversely, no association was made between unprocessed meat and hypertension, likely due to its decreased nitrite and sodium concentration. As a result

of this study, recommendations were made to reduce salt and preservatives in adult diets, including processed meat intake. Similar studies further highlight the potential inverse relationship between a non-meat diet and hypertension incidence.

Nonmeat Diet Decreases HTN Risk Multiple studies reveal that those who follow a non-meat diet experience less incidence of hypertension.^{5,6} A matched cohort study of adult nonsmokers investigated the effect of a vegetarian diet on hypertension.⁵ After accounting for fasting glucose and waist circumference, this study found statistically significant evidence that non-meat diets were associated with less hypertension.⁵ Another study conducted in an outpatient cardiovascular center found that by following a strict non-meat diet, participants not only encountered lower blood pressure, but they also encountered an overall 40% decrease in the need of blood pressure medications⁶. This is impactful as the results of this study show that a non-meat diet both decreases the risk of hypertension and is correlated with the potential reversal of hypertension once a patient is diagnosed with it. This evidence suggests that following a non-meat diet may be protective against hypertensive occurrences.

Diabetes

Meat Increases DM Risk According to the American Heart Association, diabetes remains one of the seven controllable risk factors for cardiovascular disease.⁷ While obesity and a sedentary lifestyle contribute to the development of diabetes, research has sought to determine the impact of diet on the risk for diabetes. This disease accounts for 11% of US adults, making it pervasive in today's society. Recent studies have shown a positive relation between unprocessed meat and diabetes risk. However, debate remains regarding causative versus correlative associations. One meta-analysis synthesized three prospective cohort studies to analyze meat consumption and diabetes type two risk associations.⁸ After adjustment for other factors, the

updated meta-analysis suggested that a diet consisting of 100g per day of unprocessed meat accounted for 19% increased risk for diabetes. The study also found that one increased serving per day of processed meat was associated with 32% increased risk for diabetes. While these associations are significant, there are a few theories regarding explanations for these results.

Why Meat Increases DM Risk A review of these studies describes possible mechanisms for the relation between unprocessed meat intake, processed meat intake, and diabetes risk. The presence of heme-iron found in meats might increase the oxidative stress on the body and subsequently damage pancreatic beta cells, thus pushing the body toward a diabetic state.⁸ Another suggested mechanism describes the conversion of nitrites and nitrates into nitrosamines, which destroy pancreatic beta cells. Nitrites are also connected to endothelial dysfunction and impaired insulin response. Also, higher saturated fat content in meat leads to increased intracellular lipid accumulation, particularly in muscle and liver cells, that contributes to increased insulin resistance. Lastly, meat intake was positively linked to increased BMI, suggesting that meat intake has a correlation with obesity, and obesity is a known risk factor for diabetes.⁹ In addition to providing a direct relationship between meat intake and risk for diabetes, research has also shown an inverse relationship between non-meat diet and risk for diabetes.

Non-meat Decreases DM Risk Substantial evidence shows that following a non-meat diet is associated with a decreased occurrence of diabetes. A meta-analysis of 12 observational studies investigated the effect of a non-meat diet on incidence of diabetes.¹⁰ This analysis concluded that non-meat diets were associated with less incidence of diabetes. There are a few possible explanations for these findings. While first attributing these results to lower BMI in non-meat eaters, results remained statistically significant after adjusting for BMI. This suggests that there are further mechanisms responsible for the decreased occurrence of diabetes in those

who followed a non-meat diet. One possible mechanism is lower levels of intramyocellular lipids, which leads to insulin resistance. Also, individuals who consume non-meat diets were observed to have higher insulin sensitivity than those who consume meat diets. In addition, non-meat diets are rich in possible risk-reducing foods, including whole grains, vegetables and fruits, which could be providing a protective effect against the risk of diabetes. While there are a variety of potential reasons for these results, further studies need to be conducted to identify the causative or correlative connection between non-meat intake and lower incidence of diabetes.

OBESITY

Meat Diet Increases Obesity Risk Obesity is a growing epidemic in America, which will undoubtedly contribute to an elevated occurrence of cardiovascular disease. As of 2016, nearly 40% of American adults were obese.¹¹ Obesity has been known to increase risk of not only cardiovascular disease, but its risk factors as well, like hypertension and diabetes. Questions remain pertaining to the impact of meat intake on obesity. In a seven-year follow up study, 1,730 participants were evaluated for meat intake and incidence of obesity, independent of any other macronutrient intake.¹² Results revealed a positive correlation between meat intake and obesity as well as an inverse correlation between non-meat intake and obesity. Because obesity leads to a multitude of complications, not just cardiovascular disease, clinicians should recommend diets lower in meat intake to further decrease the potential incidence of obesity. Other studies show the inverse relationship between non-meat diet and BMI.

Nonmeat Eaters Have Lower BMI Because meat intake has a positive relation with increased obesity incidence, it is imperative to investigate if non-meat intake has an equally inverse relation with obesity. A narrative review analyzed multiple studies regarding non-meat diets and obesity.¹³ This review found BMI of non-meat eaters to be lower than those of meat

eaters. Also, average annual weight gain was reduced when animal product intake was limited. A potential explanation for this is the likely increased resting energy expenditure of non-meat diets. This review also describes a 4.4 kg weight loss over 6 months with a non-meat diet compared to 0.4 kg weight loss with a meat diet.¹³ The non-meat diet includes fiber, folate, antioxidants, phytochemicals, whole grains, soy, and nuts, which can possibly explain the associated low cholesterol, and lower saturated fat. In addition to promoting exercise and other dietary changes, clinicians should recommend decreasing meat intake in their diet.

Conclusion

Global Summary The evidence presented in these studies supports the claim that following a meat inclusive diet can contribute to increased risk for hypertension, diabetes, and obesity. Conversely, based on existing evidence, following a non-meat diet may be protective against risk for cardiovascular disease. In fact, it is likely that non-meat diet is associated with a longer life expectancy compared to a meat diet.¹¹ Because the discussed risk factors are so prominent in society, and because cardiovascular disease has been the most fatal disease in America, understanding ways to limit the occurrence of these conditions is paramount to changing the makeup of the future medical environment. Changing dietary patterns is a preventive, inexpensive, and a safe measure that is proving to be a powerful deterrent of cardiovascular disease. Medical providers should be utilizing this knowledge when considering patient care plans.

Clinical Applications Implications of these reports apply to clinicians in their diet recommendations to patients who are both at increased risk of cardiovascular disease as well as those interested in following preventative measures. Through application of these published results into recommended diets, clinicians should have a better understanding of which diets

provide more cardiovascular protection than others. Patients should be encouraged to follow a non-meat diet as much as possible. While non-meat diets have been shown to provide cardiovascular benefits, clinicians should consider certain limitations with such recommendations.

Limitations and Conflicts Clinicians need to consider certain downfalls of the non-meat diet when providing patient education in regard to dietary prevention of cardiovascular disease. Non-meat diets, which include lacto-vegetarian, ovo-vegetarian, pescatarian, and vegan diets, have shown to decrease risk for cardiovascular disease.¹⁴ These diets include foods rich in vegetables, fruits, grains, and oils, all associated with a healthy diet. Unfortunately, a non-meat diet is not exclusively synonymous with a healthy diet. Within the non-meat diet guidelines, it is still possible to produce a diet that is rich in processed ingredients. Also, this diet excludes foods rich in vitamin B12, calcium, and vitamin D, which have been linked to increased cardiovascular disease if deficiency is present.¹⁴

Patient compliance is another limitation that needs to be considered. Clinicians should help patients determine realistic expectations of changes to their individual diets. This may include fully excluding meat, or it may include limiting the number of servings per week. Decreasing 1-2 servings of processed or red meat per week and replacing with 1-2 servings of fruit and leafy vegetables could provide a significant reduction in risk for cardiovascular disease. Regardless, joint decision-making is imperative when helping the patient make an informed decision about their diet plans.

Conflicts Although there is sufficient evidence to establish a correlation between meat intake and cardiovascular disease, multiple well-known medical institutions continue to recommend diets with processed meats. The United States Drug Administration (USDA),

endorsed by the Department of Agriculture, hosts choosemyplate.org, a website that recommends healthy diets for Americans. Within the protein portion of their recommendations, pork, beef, sausage, ham, lunchmeat and lamb are among the recommended sources of protein.¹⁵ Another institution, The American Diabetes Association (ADA), includes a variety of meal plan options for those patients diagnosed with diabetes. Steak and ham are included among the recommended food options.¹⁶ These ingredients have shown through the aforementioned studies to increase risk for diabetes as well as cardiovascular disease. The conflicting recommendations of these institutions may not be evidence-based and clinicians should take this into consideration when using them as a medical reference. Further discussion needs to take place in order to standardize dietary recommendations throughout these medical institutions.

Evidence Summary The articles, reviews, and meta-analyses of this synthesis proved to provide strong quality of evidence to this discussion. Multiple strengths are noted, including larger sample sizes, duration of follow up for most and accounting for potential covariates. Limits to some of these articles include self-reporting participants and questionnaires. Other limitations include lack of genetic predisposition investigation, cross-sectional designs inhibit the ability to provide causative relationships. Regardless of these limitations, the evidence provided statistically significant results in all areas except for unprocessed meat and hypertension. The results of these studies prompt questions for continuing research.

Future Research Further research is required regarding the effects of other types of meat, such as white meat (chicken and fish) on cardiovascular disease. Analysis of these studies revealed conflicting evidence to support unprocessed meat and increased risk for cardiovascular disease, thus calling for future investigation. Research should also be completed with regard to duration of adherence to these diets. Although discussions regarding this topic require further

attention, current studies have successfully shown a correlation between meat intake and risk for cardiovascular disease. While there is still conflicting evidence to support the direct causation between meat and CVD, many studies have found correlations that support the benefits of a non-meat diet over a meat diet in order to decrease risk of CVD.

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