



AMERICAN JOURNAL OF PHARMTECH RESEARCH

Journal home page: <http://www.ajptr.com/>

A Bibliographic Analyzation on Positive and Negative Impact of Paleolithic Diet

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ABSTRACT

Paleolithic diet also known as stone-age diet, is based on those food items that were available during the Paleolithic period, which dated from 2.5 million years ago to 10,000 B.C. This diet includes food items such as meat, fish, fruits, vegetables along with a very small number of cereals, roots, eggs, nuts, and excludes items like dairy products, grains, sugar, legumes, processed or refined oils, salt, coffee or tea, and alcohol. On one hand, the Paleolithic diet is beneficial in the case of chronic conditions like type 2 DM, cardiovascular diseases, obesity, and other such conditions. On the other hand, adherence to the Paleolithic diet leads to a few adverse effects like calcium deficiency, iodine, vitamin D, and more due to exclusion criteria of some food. Furthermore, evidence of clinical trials on a large population are needed as several trials conducted on a small sample will only lead to poor results resulting in lack of evidence. On a separate note, alternative diets are also opted for compensate the lack of elements to avoid any further medical consequences. Upcoming studies should throw light on clinically analyzing the health quality of excluding certain food items in the context of Paleolithic nutrition.

Keywords: Paleolithic Diet, Benefits, Drawbacks, Clinical trials, chronic conditions, Alternative diets.

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Received 01 November 2024, Accepted 20 November 2024

Please cite this article as: Sabishruthi S *et al.*, A Bibliographic Analyzation on Positive and Negative Impact of Paleolithic Diet. American Journal of PharmTech Research 2024.

INTRODUCTION

The food habits of the current world consist of a lot of preservatives, artificial oil, and refined oil; diets which can create a terrible impact in the current and future lifestyle, especially with the increase of diseases such as obesity, stroke, type 2 diabetes mellitus, cardiovascular diseases, and several other conditions. Therefore, people in the developing and developed countries are being exposed to a certain lifestyle when it comes to food intake. People began their study with traditional food items that were used in the stone age period and it showed great results with positive outcomes¹. The present world deals with a serious health condition named obesity; a disease-causing worldwide impact by reducing an individual's quality of life and increasing healthcare costs. As it turns out, many chronic conditions like diabetes mellitus, cholesterol, cardiovascular problems, certain types of cancers, and other such critical conditions are likely to be the risk factors of obesity². Anthropometric markers such as weight, body mass index, and waist circumference also play an important role in the Paleolithic diet³.

The Paleolithic period (about 2.5 million years ago to 10,000 B.C.) information were obtained after the appearance of the species named *Homo sapiens* (Human being). Certain attributes of the Paleolithic dietary approach like its main principle, the proportions of nutrients, and the era-related lifestyles were derived from several reliable sources. The main goal of following the Paleolithic diet is to promote weight reduction^{4,5}. It is also known as the stone-age diet, hunter-gatherer's diet, and caveman's diet. The diet is based on such food items that were available during the Paleolithic period; and items that have gained popularity at the present time. It is the latest dietary regimen that involves consuming food items that have fewer carbohydrates and are richer in fat as well as protein content. Such food items include meat, fish, fruits, vegetables along with a very small number of cereals, roots, eggs, nuts and excludes food items like dairy products, grains, sugar, legumes, processed or refined oils, salt, coffee or tea, and alcohol^{6,7}. Although many randomized controlled trials (RCTs) have been recently published on the clinical benefits of the Paleolithic diet, there has been a lack of research concerning the clinical benefits and drawbacks of this type of food habit. The present review aims to briefly throw light on the benefits and drawbacks of the Paleolithic diet.

COMPONENTS OF DIET:

The majority of the calories come from seafood and meat while some of the calories come from fruits, vegetables, seeds, and nuts as well as the restricted intake of salt, sugar, dairy products, legumes, and almost all the grains. The composition of Paleolithic Diet were composed of approximately 37% protein, 41% carbohydrate & 22% fat⁸.

Below figure 1 & 2 shows list of some of the food items which should be included or excluded while following the Paleolithic diet^{2,4,9,10}.

<u>FOOD ITEMS INCLUDED IN THE PALEOLITHIC DIET:</u>
Meat: Lean meat, Organic meat, Lamb, Skinless Chicken, Turkey, Pork, Bison, Buffalo, Duck, Mutton, Rabbit.
Seafood & Eggs: Fish, Fish oil, Prawn, Shrimp, Squid, Crab, Lobster, Shellfish or Clams, Spirulina.
Fresh vegetables & tubers: Onion, Tomato, Pumpkin, Eggplant, Carrot, Turnip, Beetroot, Parsnip, Potatoes, Sweet potatoes, Yams, and Others
Cruciferous vegetables: Cabbage, Cucumber, Cauliflower, Kale, Spinach, Boy choy, Broccoli, Brussels sprouts and similar green leafy vegetables
Fresh fruits: Apple, Banana, Kiwi, Mango, Lychee, Fig, Dragon fruit, Guava, Grape, Watermelon, Orange, Pear, Pineapple, Avocado, Strawberries, Blueberries, Cherimoya, and others
Citrus & stone fruits: Lemons, Oranges, Grapefruit, apricots, peaches, and the like.
Nuts: Almonds, Pistachios, Hazel nut, Macadamia nuts, Walnuts, etc.
Seeds: Sunflower seeds, Sesame seeds, Pumpkin seeds, Rapeseed, Hemp seeds, etc.
Fats & oils: Coconut oil, Olive oil, Avocado oil, Flaxseed oil, Walnut oil, Lard, Tallow.
Salt: Iodinated salt (little bit), Himalayan salt, etc.
Spices: Garlic, Turmeric, Green pepper, Red pepper, Yellow pepper, Rosemary, Fennel, Bell peppers, Sweet peppers, etc.

Figure 1: Food Items Included in the Paleolithic Diet

<u>FOOD ITEMS EXCLUDED FROM THE PALEOLITHIC DIET:</u>
Natural and Artificial sweeteners: Refined white sugar, high fructose corn syrup, Soft drinks, Fruit juices, Candy, Gummy candies, Sodas, Cakes, Pastries, Ice cream, Aspartame, Sucralose, Cyclamates, Saccharin, Mannitol, Maltitol, Refined brown sugar, Acesulfame potassium, and the like.
Grains: Includes breads & pastas, Oats, Corn, Wheat, Spelt, Rye, Barley, etc.
Legumes: Peas, Beans, Chickpeas, Lentils, Moong dal, Peanut, Snowpeas, etc.
Dairy products: Milk, Butter, Cheese, Yogurt, Curd, Cream cheese, Ghee.
Refined or processed oil: Sunflower oil, Soybean oil, Cottonseed oil, Corn oil, Grape seed oil, Safflower oil, Trans fats (hydrogenated or partially hydrogenated), etc.
Highly processed foods: Fast food items, Chips, Deep fries, and other junk food items. ^[2,4,8,9]

Figure 2: Food Items Excluded from the Paleolithic Diet

POSITIVE OUTCOMES OF THE PALEOLITHIC DIET:

A number of benefits are observed in participants who follow the Paleolithic diet. Additionally, many literatures reveal certain positive outcomes of the Paleolithic diet. Certain benefits are discussed to ensure our dietary benefits. Restricted sugar intake helps to balance our blood glucose levels which play a vital role in Type 2 diabetes mellitus patients. Consumption of food items that are low in carbohydrates and rich in fats help to reduce weight in patients suffering from obesity. Additionally, such food items promote leaner physique and stimulate muscle growth. Majority of the diets are taken for the reduction of weight. Hence, it also prevents obesity and obesity related problems ⁸.

According to the diet schedule, intake of fruits and vegetables should be high. Increased intake of fruits, vegetables, water, and others fluids keep our bodies hydrated and gives us a glowing and shimmering skin. It also contains a small amount of healthy fats especially the good cholesterol. HDL and fasting blood sugar were not affected. Increased intake of iron and vitamins such as A, C, and B prevents a few nutritional deficiencies. Increased intake of food items rich in antioxidants and phytonutrients help in boosting our immune systems and prevent infections like cancer. Restricted consumption of processed food items and elimination of refined carbohydrates help in the reduction of risks like cardiovascular problems, stroke, and diabetes mellitus ⁹.

Consumption of sodium ions must be reduced, as sodium can reduce the blood pressure levels in some of the individuals who follow the Paleolithic diet. Prevent auto-immune diseases like

multiple sclerosis, systemic lupus erythematosus, etc., which affect the quality of life. Maintains the digestive process and decreases acidity. Paleolithic diet is preventive against neuro-degenerative diseases like Alzheimer's disease, Parkinson's disease, and age-related dementia problems. Because the alteration in blood supply to brain due to clogging of the blood vessels is the primary cause of the condition. One of the best advantages of this diet is consuming a healthy diet free of preservatives, additives, and chemicals like caffeinated beverages, soft drinks, energy drinks, etc. Besides, a well-balanced meal comprising proteins, carbohydrates, and all sources of vegetables will leave one feeling refreshed and energetic. Paleolithic diet offers a feeling of fullness (thereby curbing the habit of eating more) and it is easy to follow as well. Paleolithic diet provides detoxifying effects by rejecting trans fats, refined sugar, and many other such harmful food items. Reduces stress by acting as a stress buster and decreases markers of inflammation. The diet promotes a healthier you with good amount of sleep¹¹⁻¹⁴.

NEGATIVE OUTCOMES OF PALEOLITHIC DIET:

Every good book comes with a few bad pages. On a similar note, the Paleolithic diet has a few drawbacks as well. This part of the review will focus on the drawbacks. Since, dairy products are excluded from the diet, this will lead to a lack of calcium and vitamin D intake in participants of Paleolithic diet which, in turn, leads to increased risk for osteoporosis, osteopenia, and demineralization. Lack of nutrition will follow due to the restricted intake of legumes and beans, a condition which may lead to muscle weakness and loss of muscle mass. Less amount of salt intake may lead to thyroid dysfunction. Over boiling or cooking destroys the essential nutrients from the food. The Paleolithic diet is too expensive for participants belonging to low socio-economic groups^{9,14,15}.

Jospe et al also performed a study by comparing Mediterranean Diet (MD), Intermittent Fasting (IF), and Paleolithic Diet (PD) in overweight adults over 12 months. The result of his study showed the greatest improvement in glycemic control were seen in MD, while compared to PD. The author concluded that in a real-world setting with minimal support, IF and Mediterranean diets were modestly effective & sustainable for weight loss, while compared to the Paleo diet in this free-living population¹⁶.

The Paleolithic diet is based on the hypothesis that the human genome has not adapted to consume agricultural products. While total fiber intake can be maintained on a Paleolithic diet through fruits and vegetables, it alters the fiber profile by reducing resistant starch intake. Resistant starch consistently improves markers of bowel health like increased short-chain fatty acid levels. The rationale for examining the long-term impacts of Paleolithic diets on gut health and potential

cardiovascular risk factors, given the elimination of certain food groups and changes to fiber intake profiles ⁶.

ROLE OF PALEOLITHIC DIET IN CARDIOMETABOLIC DISORDERS:

Diabetes Mellitus:

Here we will present the observations from some of the literature reviews and Randomized controlled trials RCTs. Mohammadi M, *et al* reveals a report from his systemic review of meta-analysis on RCTs by evaluating the effects of the Paleolithic diet on glycemic markers. His pooled analysis showed that adherence to the Paleolithic diet led to a reduction of fasting blood glucose (FBG) concentrations, although it was not statistically significant (WMD = -0.31, 95% CI: -0.70, 0.07, P = 0.11). He concluded that adherence to the Paleolithic diet had no significant effect on the glycemic markers, but the reduction was observed in FBG levels ¹⁷. Manheimer, *et al* evaluated whether there was a greater short-term improvement in metabolic syndrome components than did guideline-based control diets.

Paleolithic nutritional pattern improves the risk factors of chronic disease more than other dietary interventions by a systematic review of RCTs especially in metabolic syndrome ¹⁸. Otten J *et al* determined the study on parallel single-blinded randomized control trials by comparing the Paleolithic diet alone with the combination diet and exercise in individuals with type 2 diabetes. He concludes that participants of the Paleolithic diet have reduced liver fat and Intramyocellular lipid content, at the same time there was a tissue-specific heterogeneous response when the participants were in exercise training ¹⁹. Otten J *et al* performed a single-center, parallel-group 2-year trial on weight loss by comparing the impacts of different diet plans on postprandial levels of glucagon-like peptide 1 (GLP – 1), glucose-dependent insulintropic polypeptide (GIP), and glucagon. He reveals that postprandial GIP levels increased only after the Paleolithic diet was introduced. Reduced postprandial glucagon suppression may be caused by a catabolic state ²⁰. Jamka M *et al* reports the evidence that the Paleolithic diet did not differ from other types of diets commonly perceived as healthy, in its effect on glucose and insulin homeostasis with respect to altered glucose metabolism. Hence, these are some of the evidence reports that highlight the benefits of Paleolithic diet, especially in type 2 diabetes mellitus owing to the low consumption of sugar, salt, and carbohydrates ¹⁰. Rydhog B *et al* compared a study with Paleolithic diet to a diabetes diet in 13 patients with type 2 diabetes using a randomized crossover study. The Paleolithic Diet Fraction (PDF) was calculated as the fraction of intake from Paleolithic food groups divided by intake from all food groups. Mean PDF for energy was 77% for the Paleolithic diet and 38% for the diabetes diet. Higher PDF was associated with improvements in several

health markers such as lower weight, waist circumference, total cholesterol, triglycerides, HbA1c, and leptin. His study reports that ~80% PDF for the Paleolithic diet was similar to a previous study, indicating good reproducibility. The associations between higher PDF and improved health markers suggest the shift away from Paleolithic food groups may be unhealthy²¹.

Non-alcoholic Fatty Liver Disease (NAFLD):

M. H. Sohoulí *et al* determined a case-control study provides evidence that a Paleolithic-style diet and lifestyle may protect against NAFLD development. NAFLD patients had significantly higher BMI, weight, waist circumference, fasting glucose, triglycerides, and LDL cholesterol compared to controls. They had lower HDL cholesterol. Higher PD scores were associated with higher intake of protein, fruits, vegetables, nuts, and fish, and lower intake of refined grains. The authors conclude that adherence to a PD alone and in combination with healthy lifestyle factors was associated with reduced risk of NAFLD in this Iranian adult population. Although the authors note prospective studies are needed to further investigate this association²².

Metabolic Disorders:

M. H. Sohoulí *et al* performed a systemic review & meta-analysis on the effects of the Paleolithic diet on glucose metabolism and lipid profile in patients with metabolic disorders. The review analyzed data from 10 randomized controlled trials with a total of 342 participants with metabolic disorders. The author concluded the Paleolithic diet may improve glucose metabolism, lipid profiles, blood pressure and inflammation in patients with metabolic disorders, but more high quality studies are needed to confirm the findings²³.

Cardiovascular Disorders:

Jonsson *et al* performed a randomized cross-over study in participants with type 2 diabetes mellitus. He split them into two groups; the first group consisted of participants who followed the Paleolithic diet while the second group consisted of those who followed a diabetic diet. He came to the conclusion that the Paleolithic diet is more efficient in improving several cardiac related factors and controlling glycemic index when compared to a diabetic diet²⁴. Jonsson *et al* demonstrated a study in piglets and suggested that a Paleolithic based diet conferred higher insulin sensitivity, lower C-reactive protein, and lower blood pressure compared to a cereal based diet²⁵. Jonsson *et al*, B. Rydhog *et al*, and Lindeberg *et al* demonstrated a randomized trial in ischemic heart disease patients. Patients were categorized into Mediterranean diet intakes and the Paleolithic diet intakes. Later they concluded that participants of the Paleolithic diet were satisfied than participants following the Mediterranean diet²⁶⁻²⁸. Otten and Anderson *et al* performed a study in obese and overweight subjects with type 2 diabetes mellitus. He reported that exercise training along with a

Paleolithic diet reduced myocardial triglyceride levels and improved the left ventricle remodeling in overweight and obese subjects with type 2 diabetes mellitus ²⁹. Ghaedi *et al* reported in a systemic review and meta-analysis of randomized controlled trials. The study was performed to assess the effects of a Paleolithic diet on cardiovascular disease risk factors including anthropometric indexes, lipid profile, blood pressure, and inflammatory markers using data from randomized controlled trials. He states that the evidence obtained was insufficient to confer whether Paleolithic diet improves cardiovascular risk factor ³⁰. Marinangeli CPF & Jones PJH demonstrated the data obtained from review and reported that a Paleolithic diet reduces the risk of cardiovascular diseases ³¹. Rydhog B *et al* done a large prospective cohort study examining associations between the Paleolithic Diet Fraction (PDF) and mortality and cardiometabolic disease outcomes in 24,104 participants from the Malmo Diet and Cancer Study. The median PDF in this cohort was 40%. Higher PDF was associated with significantly lower risks of all-cause mortality, Death from tumors, cardiovascular disease, respiratory disease, neurological disease, digestive disease & Coronary events. There were non-significant trends toward lower risk of ischemic stroke and type 2 diabetes with higher PDF. For all-cause mortality, each 10% increase in PDF was associated with a 4.5% lower risk of death. The authors observational study found that eating a diet more aligned with Paleolithic diet principles was associated with lower mortality and cardiovascular disease risk in this population. The results expand on previous smaller intervention studies showing benefits of Paleolithic-type diets on cardiometabolic risk factors ³².

Víctor de la *et al* performed this study on the Paleolithic diet and cardiovascular disease risk. This prospective cohort study examined the association between adherence to a Paleolithic diet pattern and risk of cardiovascular disease (CVD) in a Spanish cohort of young adults. After a median follow-up of 12.2 years, there were 165 incident cases of CVD among 18,210 participants. this study found evidence that greater adherence to a Paleolithic-style diet pattern was associated with lower cardiovascular disease risk in a Spanish cohort, especially when combined with Mediterranean diet adherence ³³.

Multiple Sclerosis:

Multiple sclerosis (MS) is a debilitating disease, and current pharmacologic treatments have limitations in treating symptoms and progression. Due to limitations of medications, many people with MS seek non-pharmacologic interventions like specialized diets and supplements. Diet quality may impact MS development and severity more than genetics. Few high-quality studies have examined the safety and efficacy of dietary interventions for MS. Recent pilot studies found a multimodal program including a modified Paleolithic diet improved various outcomes in

progressive MS, but it's unclear how the diet specifically contributed. This study aimed to Compare its effects on fatigue, quality of life, cognition and physical function to a modified Paleolithic diet. This study extends prior research on non-medication interventions for MS and fills a gap by directly comparing two dietary approaches ³⁴.

Titcomb T J *et al* performed a study on nutrient intake of people with multiple sclerosis (MS) following a modified Paleolithic diet. Average calorie intake was 1820 kcal/day, with 38% from carbs, 18% from protein, and 44% from fat. Intake of most micronutrients from food exceeded recommendations, with a few exceptions such as Vitamin D, choline, and calcium intakes were below recommended levels for most participants & Many did not meet recommendations for vitamin E, pantothenic acid, iron (especially women), and zinc. Serum levels showed significant increases in vitamins D, B12, K1, K2, and folate, while homocysteine decreased. The author concluded the diet has minimal nutritional risks but advised caution with supplement use ³⁵.

ROLE OF PALEOLITHIC DIET IN OTHER NON-COMMUNICABLE DISEASES:

Klement *et al* states that the inclusion and exclusion of components in Paleolithic diet could be the reason for its superiority compared to other healthy diets in small randomized trials, particularly legumes and grains; because they are associated with the disruption of intestinal barrier integrity and the promotion of auto-immune and inflammatory non-communicable diseases such as cancer and obesity ³⁶. Menezes *et al* demonstrated the study to analyze the influence of the Paleolithic diet on the prevention and control of chronic non-communicable diseases in humans, specifically on anthropometric markers through a systematic review with meta-analysis. His result showed a positive association of adopting the Paleolithic diet in relation to weight loss ³.

Parente *et al.* done a study aimed to compare the effects of a Paleolithic Diet (PD) vs. a Guidelines Substantiated Diet (GSD) on anthropometric indicators in obese individuals. The methods appear to be appropriate for addressing the study's objective. The randomized design, similar groups at baseline, and assessment of both anthropometrics and dietary intake are strengths of his study. The sample size and follow-up duration are reasonable compared to other PD studies, though longer follow-up would be ideal. Overall, this seems to be a well-designed trial to compare these two dietary approaches for obesity treatment ³⁷.

FUTURE OUTCOMES:

Various clinical trials infer that the Paleolithic diet can reduce the risk factors of cardiovascular diseases, cholesterol levels, type 2 diabetes mellitus, obesity, and other such conditions. However, we have inadequate evidence to make a strong outcome regarding the efficacy of a Paleolithic diet. Furthermore, a number of evidence-based clinical trials are needed in a large population; because

many trails done in small population only leads to a lack of evidence^{30,31}. Upcoming research and clinical trials should give an outcome on micronutrients including dietary intakes and iodine. The study should throw light not only on the positive aspects of the intervention but also on the risks of micronutrient deficiencies, which could further help physicians to develop better methods for treating patients.

CONCLUSION:

The Paleolithic diet may assist in reducing weight and controlling other chronic conditions like type 2 diabetes, cardiovascular problems, etc. However, further trials and studies are necessary to confirm the clinical benefits of the Paleolithic diet and alternative diets are also suggested to compensate for the intake of vitamin D, calcium, and other elements to avoid any other consequences such as osteoporosis, muscle weakness, etc. Upcoming studies must clinically analyze the quality of health in excluding certain food groups in the context of Paleolithic nutrition.

Conflict of Interest:

No Conflict of Interest

Acknowledgement:

Special thanks to Tagore College of Pharmacy for permit us to do this review.

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