Validity of the paleolithic diet and its relative effectiveness for overall nutrition

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VALIDITY OF THE PALEOLITHIC DIET AND ITS RELATIVE EFFECTIVENESS FOR OVERALL NUTRITION

by

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JAMES GREGOIRE

ABSTRACT

The Paleolithic, or ancestral, diet was first proposed by Eaton and Konner in 1985, and it is based on the theory that humans have not diverged greatly from the physiology of the Paleolithic human. Eaton and Konner suggested a diet consisting of meats, fruits, vegetables, nuts and seeds while omitting food such as dairy, grains, legumes, refined sugar and processed foods. The latter of which are incongruous with the diet we evolved with and are likely the cause of the so-called “diseases of civilization” such as type 2 diabetes, coronary heart disease, obesity, osteoporosis and cancer (Konner & Eaton, 2010). This review will first elaborate on the Paleolithic lifestyle and the evidence presented on it before examining the evidence for and against other diet categories not included in the diet such as whole grains, red meat, grass-fed meat, dairy milk and soymilk. The aim of this study is to first evaluate the Paleolithic diet, based on nutrition and ability to address common public health diseases and then to appraise the value of other food categories not included in the lifestyle on the same factors, in order to determine their place in an ideal diet. This study concludes that the Paleolithic diet can lower total body weight, body mass index, cardiovascular risks, triglycerides and low-density lipoprotein among others while increasing insulin sensitivity and \(\omega-3\), iron, fiber, vitamins and
minerals, including improving the ω-6 to ω-3 ratio and the potassium to sodium ratio when compared to the typical Western diet. The results were consistent even when compared to other diets such as the Mediterranean or the diabetes diet. Studies showing the effectiveness of consuming other foods, such as whole grains, dairy or soymilk, with the intent on losing weight or preventing diabetes, on the other hand, have been inconclusive. Research on soy’s estrogenic isoflavone action has been inconclusive. Concerns over the consumption of red meat due to cholesterol and cancer are mitigated and review of the grass-fed literature reveals a potentially richer fatty acid profile with more healthy polyunsaturated fats and less cholesterol-raising saturated fatty acids. It is concluded that an ancestral diet of whole foods, made up of mostly fruits and vegetables, meats, especially grass-fed, nuts and seeds is strongly associated with significantly better outcomes for diseases such as type 2 diabetes and obesity as compared to a typical Western diet, Mediterranean diet or diabetes diet.
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INTRODUCTION

The Paleolithic, or ancestral, diet was first proposed by Eaton and Konner in 1985, and it is based on the theory that humans have not diverged greatly from the physiology of the Paleolithic human. Eaton and Konner suggested a diet consisting of meats, fruits, vegetables, nuts and seeds while incorporating moderate exercise approximating activities necessary as a hunter-gatherer, such as walking, jumping, sprinting and carrying objects across a distance. Absent from this diet are foods not likely to have been a part of the hunter-gatherer lifestyle such as dairy, grains, legumes, refined sugar and processed foods. These foods are incongruous with the diet we evolved with and are likely the cause of the so-called “diseases of civilization” (Konner & Eaton, 2010).

In 2004, obesity rates were on the rise worldwide, lifetime incidence of hypertension for Americans was at 90%, and 40% of Americans suffered from metabolic disease, most of which resulted from excess consumption of processed foods (O’Keefe & Cordain, 2004). Meanwhile, much research has been devoted to nutritional ways to address the public health concerns, focusing mainly on reducing fats, reducing red meat, increasing whole grains and fortifying with dairy or soy milk (Ferguson, 2009; Fulgoni III et al., 2011; Fung et al., 2002; Gardner, Newell, Cherin & Haskell, 2001). None of these tactics align with the ancestral diet, despite growing evidence that the Paleolithic lifestyle can positively influence obesity, risk
for cardiovascular disease and even osteoporosis while lowering cholesterol levels and insulin sensitivity (Frassetto et al., 2009; Jönsson et al., 2009; Lindeberg, 2012; Österdahl, Kocturk, Koochek & Wändell, 2008).

This review will first elaborate on the Paleolithic lifestyle and the evidence presented on it before examining the evidence for and against other diet categories not included in the diet such as whole grains, red meat, grass-fed meat, dairy milk and soymilk. The aim of this study is to first evaluate the Paleolithic diet, based on nutrition and ability to address common public health diseases such as type 2 diabetes and obesity and then to appraise the value of other food categories not included in the lifestyle on the same factors, in order to determine their place in an ideal diet.
PUBLISHED STUDIES

Paleolithic Diet

Evolutionary History

In order to understand the basis of an evolutionarily rooted diet and lifestyle, a brief history of our shared past is required. The Paleolithic era spanned from 2.5 million years ago to roughly 10,000 years ago, the time to which the birth of civilization and agriculture are attributed. While the transition between the Paleolithic and Neolithic Eras was by no means rapid by modern standards, once our ancestors began using tools, populations quickly began to spread out and humans began to both hunt larger prey and cultivate food for themselves (Stiner, 2001).

Evidence of stone, bone and, sometimes, wooden tools have been found from roughly 2.5 million years ago (Ambrose, 2001). These were chips of stone that were flaked off of larger ones, with marks suggesting they were used for butchery and cutting plants among other uses. Predating Homo sapiens, these tools are attributed to Homo habilis. Suspected not to be the work of chimpanzees, studies have found that the precision, forethought and physical ability required to craft these tools must have come from a further evolved species (Ambrose, 2001). Around 1.5 million years ago, evidence appeared of large cutting tools in the form of hand-axes, cleavers and picks. Between 1.5 and 1 million years ago, evidence suggests early
hominids began using fire, which would allow the cooking of meats and plants and allow the ingestion of many foods that are poisonous or unpalatable before cooking.

Beginning roughly 300,000 years ago, composite tools, combining wooden handles and stone tips etc., began to emerge, and were developed by Neanderthals and late archaic humans. These tools show another great advance in technology because they usually incorporated multiple parts, such as a handle and blade, and required the preconception of the finished product (Ambrose, 2001). 50,000-40,000 years ago, technology rapidly advanced and bone, shell and stone tools, which were cut, shaped and fashioned into larger weapons and projectiles allowed for the active hunting of small, live prey. Early humans also developed fiber-based objects such as nets, pouches and clothes (Ambrose, 2001).

Much of the existing evidence suggests that Paleolithic people were primarily carnivorous, however, due to the length of time elapsed, plant evidence would be expected to be scarce (Revedin et al., 2010). Revedin et al. (2010) examined digs in Italy, Russia and the Czech Republic and found plant traces (mostly fern and cattail, roots and seeds) on heavy-duty grindstones dating back approximately 30,000 years. Liu et al. (2013) discussed similar findings in China. They discovered residues and wear patterns suggesting that the users consumed grasses, beans, yams, seeds and snake gourd roots among other plants. While this evidence implies grain intake, it would be important to consider the scale of consumption of grain requiring mortar and pestle processing (Spreadbury, 2012).
Milton (2003) discussed the changes required of the human gut to move away from nearly all plant consumption in order to support brain growth and further evolution of the species. Great apes, our most recent common ancestors, including chimpanzees, gorillas and orangutans, are estimated to get between 87-99% of their annual diet from plant sources, such as fruits, leaves and flowers (Milton, 2003). The majority of known animal sourced food for great apes is the insect matter that is often inadvertently eaten as a product of eating plants, with dominant males only sparingly killing small vertebrates.

In general, an animal’s gut best suits it for its evolutionary diet (Milton, 2003). Apes have a much larger gut compared to humans and they have a proportionally much larger colon and smaller small intestine compared to humans. Apes also experience a shorter mean transit time for food to pass through the digestive system. These changes allow them to process a large amount of plant matter in the appropriate amount of time to gain the necessary nutrition. Carnivores have a shorter and much simpler digestive tract and shorter mean transit time compared to humans. This is because their food is very nutrient dense and they require less food in bulk. For herbivores, in order to sustain a large body mass, a large amount of food must be foraged, and the quality of that food is likely to decrease due to availability (Kuipers et al., 2010; Milton, 2003). For carnivores, large animals simply have to take down larger prey. In order for the human brain, with its heavy energy use, to evolve, a diet consisting of energy and nutrient dense meat was necessary to supplement the plant based diet of our ancestors. Reflecting
this need, the human gut evolved to handle more meat and less plant bulk (Kuipers et al., 2010; Milton, 2003).

This dietary change was not only necessary for the brain, but to support the growing number of members living together. The most nutrient-dense, plant-based foods such as fruits are seasonal and would require much more travel in order to forage enough to feed each member and maintain dietary quality. Consuming more animal products would also better support a child’s development needs and is presumed to have contributed to the rapid brain development during this time period (Milton, 2003). Research also suggests that in order for the brain to develop, an excess of energy would be useful, and the storage of fat could contribute to that development, leading to the theory of “survival of the fattest” (Kuipers et al., 2010). In order to make up for the growing brain’s metabolic tax, other physiological aspects were likely to decrease such as muscle mass and the gut, a notion consistent with the above conclusions (Kuipers et al., 2010).

**Modern Paleolithic Diet**

In 1985, Eaton and Konner published an article that examined human evolution and proposed a diet that would be more appropriate for modern humans, based on the lifestyle of our ancestors. The researchers justified this claim by citing research suggesting that genetic evolution, specifically regarding major physiology and digestion, could not have changed significantly since the birth of agriculture in the Neolithic era (10,000 years ago) and certainly not since the Industrial
Revolution 200 years ago. Both of these revolutions introduced new major food
groups that were not a significant part of the human diet up until that point (Eaton
& Konner, 1985; Stiner, 2001). The Neolithic period introduced grains, cereals and
cultivated produce, much of which was starchy, along with milk from domesticated
animals. The Industrial Revolution ushered in highly processed and refined foods
including sugars, flours and an abundance of pre-packaged foods. Eaton and Konner
(1985) call to attention the sharp rise in “diseases of civilization”, especially in the
past 200 years, such as atherosclerotic disease, type 2 diabetes, cancer,
hypertension, obesity and more, likely due to consistent overeating of energy dense
foods, particularly processed and refined foods, and a lack of physical activity.

Aggregating knowledge about ancient hunter-gatherers, Eaton and Konner
(1985) produced dietary guidelines consistent with the Paleolithic lifestyle. The diet
was made up primarily of lean meats, fruits, vegetables, roots, tubers, nuts and
seeds. Omitted from this list are cereals and grains, known only to be consumed
sparingly, dairy products and refined sugars, flours and processed foods. Revisiting
their proposed diet, Konner and Eaton (2010) suggested that fish and other marine
foods such as shellfish played a larger role than previously thought. In accordance
with Kuipers et al. (2010) and Milton (2003), Eaton and Konner suggest a diet
composed of 35% meat and 65% plant sourced. Kuipers et al. (2010), looking at
existing data about the early Homo species in a savannah setting, a coastal setting
and a combination of the two, found that early hunter-gathers consumed 25-29%
protein, 39-40% carbohydrates and 30-39% fat with higher than current Western
diet intakes of monounsaturated and polyunsaturated fats. Jew, AbuMweis and Jones (2009) estimate energy percentages as 37% protein, 41% carbohydrates and 22% fats. It is important to note that these percentages can vary from study to study because the diets differed depending on where the groups lived. A group living in the forest might have a significant vegetation intake, with less fats and protein whereas a group such as the Inuits had very infrequent vegetation and instead relied heavily on fish, high in polyunsaturated fats (Eaton & Konner, 1985).

Another important distinction is that due to the lack of domestication, by necessity, the meat obtained was wild game, known to possess more polyunsaturated fats (including ω-3s) and less cholesterol-raising saturated fats (Konner & Eaton, 2010). The proposed Paleolithic diet would be high in protein, moderately high in fats and consist of a moderate amount of carbohydrates, but only those found in fruits and vegetables. Due to the high consumption of fruits and vegetables, a fiber intake of 70 g per day would be expected, which is two to three times the recommended minimum value from the Institute of Medicine (Konner & Eaton, 2010). Concerns about losing minerals due to the high fiber consumption could be mitigated since the exclusion of grains, which contain phytic acid (known to negatively affect bioavailability of some minerals), would likely make up for the loss.

In Eaton and Konner’s model, sodium consumption would have been as much as ten times less and the potassium levels would be greatly increased compared to those of standard Western diets, significantly altering the Na/K ratio. Having a diet
rich in fruits and vegetables, and therefore potassium, would cause blood pH to be more alkaline, whereas consumption of grains and sugars as part of a Western diet would cause a more acidic pH. Having a less acidic pH or even an alkaline pH would be advantageous due to a decreased loss in skeletal calcium and easing the load on the kidneys (Konner & Eaton, 2010). This is demonstrated by the skeletal remains of Inuits, who, due to their environment, did not have abundant access to plant food sources, and instead relied on heavy meat and fish consumption, likely had a negative pH, and had a marked prevalence for osteoporosis (Eaton, Konner & Cordain, 2010). In addition to losing less calcium, Paleolithic people likely had a high level of dietary calcium, from both their meat and leafy vegetables (Eaton & Konner, 1985). A high intake of fruits, vegetables and meat would also be expected to contribute to high levels of vitamins C and B, iron, folate and many other trace elements.

A review by Lindeberg (2012) examined the Paleolithic diet's components and evaluated its worth in the prevention of disease. The author found that a large source of energy, based on the diets of great apes, could be based in fruits and, seasonally, honey. Although they do contain fructose, which has been shown, in large quantities, to contribute to type 2 diabetes and the metabolic syndrome, the majority source of fructose in America is processed foods using sucrose and high-fructose corn syrup (Lindeberg, 2012). Research has also shown that 60 g per day of fructose can be safe, even for diabetics, which, according to Lindeberg (2012), is the equivalent of about nine pounds of cultivated pineapple. The author's review does
include starchy roots and tubers as part of a Paleolithic diet, citing paleontological evidence that they have been consumed for millions of years. While starchy foods can raise post-prandial blood glucose levels, consumption of these starches has not been convincingly connected with diabetes or obesity (Lindeberg, 2012).

Lindeberg (2012) reports meat intakes for early humans ranging from 26-68% of their food intake with evidence of fish and other seafood consumption, especially for those living in Greenland and Canada. Nuts, containing significant amounts of monounsaturated fats, fiber, micronutrients and protein while being low in saturated fats, were likely a frequent source of energy (Lindeberg, 2012). Seeds were also consumed, however to a lesser extent than nuts. It is important to discriminate here between seeds from grasses such as wheat, rice and maize, which were not consumed to any great extent and larger, fattier seeds, which were. Legumes, such as beans, did not likely contribute to the diet until Neolithic agriculture. Lindeberg calls to attention the presence of lectins in many plants, specifically in the sprouts, seeds and beans of wheat, rice and rye. These phytochemicals have been found in greater concentrations in unrefined grains compared to refined grains and have been considered for contributing to cardiovascular diseases, diabetes and autoimmune diseases (Lindeberg, 2012).

Dairy foods were unlikely to have been consumed until the dawn of agriculture and domestication. Current research suggests that dairy milk, and specifically the main protein, casein, has been positively correlated with coronary heart disease and atherosclerosis (Lindeberg, 2012). Many benefits and concerns
have been raised about meats, grains and dairy and the current research for each will be addressed in later sections.

**Exercise**

While the focus of this study is on the nutrition of the Paleolithic diet, exercise must be considered as a crucial part of the Paleolithic lifestyle. Modern humans tend to live a very sedentary life compared to their ancient ancestors, due to the luxuries of mechanization and industrialization stemming from the beginnings of agriculture in the Neolithic Era (Eaton & Eaton, 2003). Ancient humans likely did not go for jogs or lift weights but instead derived their exercise from hunting, digging, gathering, carrying and other recreational forms such as dancing. Eaton and Eaton (2003) compare the Paleolithic form of exercise more to cross-training. The Paleolithic “work week” likely consisted of two to four days of relatively intense activity such as hunting, gathering, etc., while the rest of the days were for rest and other tasks (Eaton & Eaton, 2003). The concepts of feast/famine cycles and physical activity/rest cycles were discussed in an article by Chakravarthy and Booth (2004). Not only did they conclude that our ancestors experienced periods of an abundance of food and periods of starvation, but those periods coincided with periods of intense exercise in order to obtain that food. Research has found this type of exercise to be extremely beneficial. Recovered skeletal remains from the Paleolithic period have been compared to Olympic athletes due to their thickness and strength (Eaton & Eaton, 2003). In order to stay hydrated, early
humans would have drunk almost exclusively water (O’Keefe & Cordain, 2004). Tea, known to have been consumed for thousands of years at least, could have been consumed, and, today has been shown to have robust positive cardiovascular effects (O’Keefe & Cordain, 2004).

**Clinical Evidence**

The body of clinical trials and review articles concentrated on the Paleolithic diet is not as monumental as in other areas of nutrition, however, unlike areas such as meat, whole grains or dairy, the research conclusions are homologous and in favor of the lifestyle. Österdahl, Kocturk, Koochek and Wändell (2008) conducted a three-week trial on healthy volunteers in which participants followed the Paleolithic diet with a list of ad libitum foods, restricted foods and excluded foods and recorded their intake daily. Despite the study becoming underpowered due to illness and other factors, the results still showed a significant decrease in total energy, saturated fat, carbohydrate and sodium intake while intake of vitamins B6, C, E and potassium significantly increased. Mean weight, body mass index, waist circumference, systolic blood pressure and plasminogen activator inhibitor-I all decreased as well. The diet included an increase in antioxidants and a more favorable sodium to potassium ratio. While the results are favorable, the study should be looked at critically due to the lack of control group, small sample size and the underpowered results.
Frassetto et al. (2009) looked at the effects of switching to the Paleolithic diet after a period of eating a normal Western diet in sedentary, moderately overweight adults, controlling for weight loss by adjusting caloric intake as necessary. The study found significant reductions in blood pressure, 24-hour urine sodium excretion, fasting plasma insulin concentration, plasma insulin versus time area under the curve, total cholesterol, low-density lipoprotein and triglycerides. The study found significant increases in 24-hour urine potassium excretion and insulin sensitivity and found no change for high-density lipoprotein. Interestingly, the direction of the changes of effects when switching from a normal diet to the Paleolithic diet was identical in nearly all of the participants. Again, this study involved a small number of subjects, and so must be looked at critically, but showed strong, nearly unanimous amongst participants, positive results.

Jönsson et al. (2006) performed a fifteen-month study on pigs in which one group was fed a cereal diet while the other was fed a Paleolithic diet, identical to one that a human would consume. While no difference was found for fasting glucose, dynamic insulin sensitivity was significantly increased while the dynamic insulin sensitivity significantly decreased as did the C-reactive protein and diastolic blood pressure, weight and subcutaneous fat thickness at the sternum in the Paleolithic diet group compared to the cereal diet. In addition, more leukocytes were found in the pancreas indicating inflammation in the cereal group compared to the Paleolithic group. Because the Paleolithic diet pigs were within the healthy range for weight and no differences in body temperature were noted, dietary restriction was
not suspected as cause for the changes. Instead, the data suggest the cereal pigs as a model for human obesity, given their increased weight, fat distribution and insulin insensitivity, while the Paleolithic diet pigs showed a favorable alternative.

A study by Jönsson et al. (2009) found lower total energy, energy density, hemoglobin A1c, triglycerides, diastolic blood pressure, systolic blood pressure, fasting glucose, weight and waist-circumference in a Paleolithic diet group compared to a diabetes diet group in a three-month randomized cross-over study in diabetic patients. The diabetes diet encouraged whole grain, cereal and dairy products whereas the Paleolithic diet excluded them. Both diets encouraged fruits, vegetables and meat. The total energy data suggest that the Paleolithic diet was more satiating since less food was consumed, despite there being no limits on consumption. Calcium intake was low in both groups. The sample size for this study was low (thirteen patients) and the study length (three months in each condition) was relatively short. A long-term study with a larger sample size would greatly support the presented conclusions.

A significant improvement in glucose tolerance and greater satiety per calorie was found for subjects with ischemic heart disease who started on the Paleolithic diet compared to the Mediterranean diet (Jönsson, Granfeldt, Erlanson-Albertsson, Ahrén & Lindeberg, 2010). Further analysis, however, could not find any statistical basis for the mechanism of the Paleolithic diet’s greater satiety. No correlations for fiber, energy density, water intake or protein intake, among others, proved to be significant. Some trends, while not significant, suggest that bread and
milk products reduce satiety because they are particularly palatable, and therefore harder to resist overeating. Another correlation was found between cereal intake and leptin levels. It is hypothesized that, while leptin levels in both groups fell over the trial, carbohydrate intake, specifically cereals, could have caused the leptin level to fall less in the Mediterranean diet. Another very similar study by Jönsson, Granfeldt, Lindeberg and Hallberg (2013) measured the satiety of the Paleolithic diet against the diabetes diet in patients with type 2 diabetes. They found it was significantly more satiating per calorie, despite both groups reporting being satiated. Comments collected by the participants throughout suggested that while the Paleolithic diet helped them lose weight, it was also more difficult to adhere to it. Again, the mechanisms behind this finding are unknown.

Jew, AbuMweis and Jones (2009) proposed the concept of functional foods, foods and compounds known to promote health, that supplement or are added to existing food to strengthen the diet. All of the proposed foods are either encouraged or accepted in moderation as part of the Paleolithic diet. \(\omega-3\) fatty acids, found in fish, walnuts and flaxseed in abundance, have been shown to decrease risk for cardiovascular disease by lowering triglyceride and very-low-density lipoprotein (Jew, AbuMweis & Jones, 2009). Green and black tea contain flavonols, a kind of polyphenol, which have been implicated in many health benefits including preventing cancer and osteoporosis and lowering incidence rates of myocardial infarction and other cardiovascular risks. Olive oil, known for its healthy monounsaturated fats, also contains polyphenols and has been demonstrated to
raise high-density lipoprotein and prevent oxidation damage (Jew, AbuMweis & Jones, 2009). While olive oil may not have been widely produced until the Neolithic period, the health benefits have made it a preferred oil for the Paleolithic diet when used sparingly as a condiment (Konner & Eaton, 2010). Plant sterols, thought to reduce low-density lipoprotein, have been found in high amounts in sesame oil, wheat germ, corn oil and rapeseed oil (Jew, AbuMweis & Jones, 2009). While all oils should be used sparingly, sesame oil would be the most compatible in this list with the Paleolithic diet due to lower processing requirements.

Financial Feasibility

Several studies have examined the financial feasibility of the either the Paleolithic diet specifically or increasing fruits and vegetables to levels recommended by the United States Department of Agriculture, especially for low-income consumers (Cassady, Jetter & Culp, 2007; Metzgar, Rideout, Fontes-Villalba & Kuipers, 2011; Stewart et al., 2011). All three studies found that in order to fulfill the diet requirements, the budgets would be stretched, if not exceeded. Looking at the Paleolithic diet study, Metzgar, Rideout, Fontes-Villalba and Kuipers (2011) used food budget planning methods from the United States Department of Agriculture that specifically attempted to minimize divergence in food choices from the “observed” diet. A follow-up study that did not take into account this divergence and instead calculated the cheapest cost for the complete switch to a Paleolithic diet regardless of previous food preferences would be appropriate, although it may be
not the most realistic from a public health standpoint. The other two articles, which did not consider the Paleolithic diet specifically, found that most low-income families allocate 15-18% of the total food budget for fruits and vegetables and under this constraint, found it very difficult to satisfy the United States Department of Agriculture’s requirements for fruits and vegetables (Cassady, Jetter & Culp, 2007; Stewart et al., 2011). If, however, a fundamental change in food habits occurred, and families spent more money on fruits and vegetables proportionally, there would be no problem fulfilling this requirement.

**Summary**

The above studies have shown a net positive effect for subjects that adopt the Paleolithic diet coming from a traditional Western or even Mediterranean or diabetes diets (Frassetto et al., 2009; Jönsson et al., 2009, Jönsson, Granfeldt, Erlanson-Albertsson, Ahrén & Lindeberg, 2010; Jönsson, Granfeldt, Lindeberg & Hallberg, 2013). The Paleolithic diet has been found to lower total body weight, body mass index, cardiovascular risks, triglycerides and low-density lipoprotein among others while increasing insulin sensitivity and ω-3, iron, fiber, vitamins and minerals, including improving the ω-6 to ω-3 ratio and the potassium to sodium ratio when compared to the Western diet. The Paleolithic diet has also been proven to be more satiating per calorie than other diets (Jönsson, Granfeldt, Erlanson-Albertsson, Ahrén & Lindeberg, 2010; Jönsson, Granfeldt, Lindeberg & Hallberg, 2013). Calcium intake can be of some concern in the diet, however, Lindeberg
(2012) suggests that while consumption may be lower, excretion would be less because the phytate, abundant in diets full of grains and beans, blocks the absorption of calcium, which would not occur in Paleolithic diets devoid of grains. It is also suggested that appropriate calcium levels could be reached with significant consumption of leafy green vegetables (Lindeberg, 2012). Studies have shown, albeit indirectly, that with appropriate reallocation of food budget funds, the Paleolithic diet, with its high meat, fruit and vegetable requirements could still be feasible even in low-income families (Cassady, Jetter & Culp, 2007; Metzgar, Rideout, Fontes-Villalba & Kuipers, 2011; Stewart et al., 2011). While the studies conducted were small and usually held for only a couple of months at best, the results were still significant and encouraging. Further studies, however, would be needed to solidify the Paleolithic diet’s role in nutrition.

**Whole Grains**

While grains are not included in the Paleolithic diet, since the growth of agriculture, grains, cereals, flours, etc. have played a central role in diet and nutrition, especially in the Western diet. This is perhaps most famously demonstrated by the United States Department of Agriculture’s incorporation of grains as the base of the Food Guide Pyramid in 1992 along with the recommendation of consuming six to eleven servings daily. Even with the introduction of the MyPlate system and graphic in 2011, grains still comprise roughly 25% of the recommended daily intake (Sebastian, Enns & Goldman, 2009).
Since the Paleolithic diet and the recommended Western diet are at odds over the benefits of grains, it would be important to examine whether or not the inclusion of grains in one’s diet proves to have beneficial and/or therapeutic effects compared to a diet devoid of grains. Unfortunately, research comparing regular grain intake to no grain intake at all is sparse. There is, however, a large body of research concerned with the potential benefits of consuming whole grains compared to refined grains, specifically in relation to Type 2 Diabetes, obesity, weight gain and cardiovascular disease.

Grains, in general, consist of three major parts, the outer shell (bran), the middle layer (endosperm), and the core (germ) (de Munter et al., 2007). While the bran and the germ are known to be rich in fiber and other nutrients such as magnesium, vitamin E and folic acid, the endosperm is made up of mostly starch. As the grains are ground during the refining process, much of the bran and germ are lost along with the fiber, vitamins, lignans and phytochemicals while the starchy endosperm remains. The Food and Drug Administration requires that a food contain at least 51% whole grain ingredients by weight in order to claim health benefits from being whole grain (Food and Drug Administration, 2003). In a review study by Venn and Mann (2004), whole grain foods were defined as having at least 25% of the total content be whole grain or bran by weight. This definition is the standard used by most studies looking at whole grains.

One such study was a prospective cohort study looking at the effects of whole grain intake on the risk of developing type 2 diabetes (Fung et al., 2002). Whole
grain intake was measured by questionnaire in male members of the Health Professionals Follow-up Study along with other factors such as smoking and exercising. Subjects were followed for no more than twelve years and new cases of diabetes were recorded. The study found there was a 42% reduction in risk for developing diabetes for the highest intake group compared to the lowest intake group. When body mass index was factored in, that risk was lowered to 30%. There were no associations found for the consumption of refined grains. The authors suggested that the majority of the effect was due to the fiber found in the bran. It was hypothesized that the fiber would delay gastric emptying and would lessen the post-prandial spike in blood glucose. Another explanation for the effects is the increased amounts of magnesium found in whole grain foods. It was shown that patients with lower blood magnesium levels had higher glucose and insulin levels after an oral glucose challenge (Rosolova, Mayer & Reaven, 1997). Fung et al. (2002) acknowledge that the participants who consumed the largest amount whole grains also tended to be healthier in general: they were less likely to smoke or drink and more likely to exercise and take care of themselves.

Similar results were found by McKeown et al. (2002) when looking at whole grain intake with regard to the risk of developing type 2 diabetes. The researchers found that people who consumed the most whole grains had a smaller waist to hip ratio and lower total cholesterol, low-density lipoprotein and fasting insulin levels as compared to those who consumed the least. One explanation for why whole grains were more beneficial was due to their greater particle size and lower
glycemic index as compared to refined grains. By having larger particles and intact grains, it would take longer for the contents to be fully digested and absorbed leading to a slower rise in blood sugar. While the authors concluded that whole grains could be protective, specific components of the grains such as fiber and magnesium could better explain the results. After adjusting for fiber and magnesium intake, the lowered insulin results became much less robust. Further adjusting for body mass index and fruit and vegetable intake made the results even less convincing. This would again suggest that while the consumption of whole grains is healthier than that of refined grains, a healthier lifestyle overall may be more important for reducing the risk of diabetes.

Another large cohort study, looking at the effects of whole grain consumption on weight gain in women, found that the highest quintile of whole grain consumption gained less weight (an average of 1.52 kg) when compared to the lowest quintile (Liu et al., 2003). The study also demonstrated a positive correlation between refined grain intake and weight gain. Interestingly, despite a much greater intake of whole grains, those participants still gained weight, albeit less than those consuming mostly refined grains. Also important to note is the time over which these results were realized. The participants were followed for twelve years with the difference in weight gain between the highest and lowest quintiles being only 1.52 kg. In terms of clinical practice, a sole recommendation to switch from refined to whole grains would be virtually ineffective. Through the use of questionnaires, the study also found that the highest whole grain consumers also consumed the
most fiber, protein, fruits and vegetables while consuming the least amount of fats, cholesterol and alcohol, suggesting again that a healthy user affect could be at play.

Other studies support the previous findings, showing significant reductions in risk for diabetes and chronic disease with increased whole grain consumption (de Munter et al., 2007; Newby et al., 2007). Both studies also look to fiber, magnesium, vitamin E and other factors such as exercise and healthier eating in general to help explain the results. de Munter et al. showed that the bran alone had similar effects to the overall whole grain while the germ has much less association, suggesting that the bran was the most important factor for risk reduction. They also showed that interventions with bran lowered glucose levels in both healthy and glucose intolerant patients. Newby et al. found reductions in weight, body mass index, and cholesterol for both whole grain and cereal fiber in a short-term 7-day trial.

In contrast to the above findings, in their literature review, Flight and Clinton (2006) suggest that milled whole grains could actually be nutritionally superior to intact whole grains because the milling process makes it easier to digest and improves bioavailability of vitamins and minerals. They do, however, make the distinction between milled whole grain, which contains all three parts of the grain in their natural proportions, to refined grain, which has lost the bran and the germ and most of the nutrients along with them. The researchers also observed an inverse correlation between whole grain intake and stroke risk, however, when they adjust for the intake of magnesium, folate, vitamin E, vitamin K and fiber, the association is no longer significant.
Insoluble fiber was noted to be the focus of many studies in Flight and Clinton’s (2006) review, but they concluded that insoluble fiber alone was not enough to significantly prevent coronary heart disease or stroke. Soluble fiber, known for being the part of oats that can help reduce cholesterol, was also found to be beneficial, however the effects tended to be modest. Belobrajdic and Bird (2013) suggest that the soluble fiber found in oats and barley forms a viscous body which would slow the rate of carbohydrate absorption and ease the glycemic load and insulinenic response. They also posit that, while insoluble fiber is usually assumed to be a chief component, it could also simply be a marker for larger particle sizes, which, in turn, would be digested more slowly, and result in a similarly smaller spike in blood sugar.

A major portion of the review by Flight and Clinton (2006), a subject not focused on in many other studies, was the protective role of phytochemicals found in whole grains. Bound phytochemicals, mostly flavonoids and phenolic acids, can make it past the stomach and are likely the source of the majority of the antioxidant properties found in grains. Miller et al. (2000) tested the antioxidant levels in cereals and found them to be higher than any tested fruits and at least as high if not higher than the tested vegetables. Belobrajdic and Bird (2013) argue that because oxidative stress has been shown to contribute to the progression of metabolic disease, the consumption of antioxidants would be a logical way to combat the disease. They describe the pericarp seed coat and aleurone layers (parts of the bran) as being rich in phytochemicals, including phenolic compounds and flavonoids, in
comparison to the less nutrient dense germ and endosperm. While the processing of grains can lead to a loss of nutrients and phytochemicals, it often also increases their bioavailability, increasing their positive attributes. Cooking, however, leads to a substantial loss of phytochemicals. Despite all of this research, the authors call the response to whole grain phytochemicals “modest and transient” at best and call into question whether the amounts found in a typical diet can significantly bolster the immune system or alter the disease pathway.

Because inflammation and oxidative stress have been implicated in the development of obesity (Lakshman, Elks & Ong, 2012). Hajihashemi et al. (2013) studied the potential antioxidant effects of whole grains on inflammation markers in obese children. In adults, they have found that consumption of whole grains has been inversely related to serum levels of high-sensitive C-reactive protein and tumor necrosis factor receptor 2 along with reduced risks of diabetes and obesity, consistent with findings presented above. In this sixteen week, randomized cross-over study, 44 Iranian girls were split into two groups, one encouraged to eat at least half of their grain servings from a list of approved whole grains and the other group told to avoid whole grain foods altogether. After six weeks and a four-week washout period, the participants were placed in the opposite group for another six weeks. With no change in weight or body mass index, significant reductions in high-sensitive C-reactive protein, soluble intercellular adhesion molecule-1, serum amyloid A, and leptin were found in the test group compared to the control group.
Hajihashemi et al. (2013) found no conclusive mechanism of action for these results, however the authors suggest that a combination of factors such as fiber, vitamins, phytochemicals and magnesium have all been shown to have inflammatory effects. While they do conclude that whole grains have an anti-inflammatory effect, the authors concede that the markers they examined are not true markers of inflammation, but simply adhesion molecules. Evidence showing that a reduction of markers such as interleukin-6, tumor necrosis factor-α or interleukin-1 β was associated with increased consumption of whole grains would prove more convincing. In contrast to this study's findings, Andersson et al. (2007) did not find a reduction of inflammation associated with whole grain consumption in adults and de Punder and Pruimboom (2013) concluded that wheat and cereal grain consumption might actually contribute to inflammation in adults.

Spreadbury (2012) made the connection between acellular carbohydrates, such as flours and sugars, and leptin insensitivity, obesity and inflammation. Despite consuming 60-70% of their diet as carbohydrates, the Kitavan Islanders have virtually no incidences of overweight, cardiovascular disease or atherosclerosis and maintain significantly lower insulin sensitivity and leptin levels as compared to Westerners. This is managed by not having access to Western foods and the carbohydrates consumed are whole food, roots, fruits and vegetables. When they gain access to Western foods or depart from their lifestyle, Kitavan Islanders quickly and invariably develop the aforementioned diseases.
Spreadbury (2012) hypothesizes that the consumption of refined sugars and flours overloads the microbiota of the small intestine, alters their composition with time, and produces an endotoxemia-induced inflammation due to the bacterial lipopolysaccharides, which are significantly raised after consumption of Western carbohydrates. This response has been found in both the mouth and the gut, explaining dental health decline with Industrialization as well as metabolic decline (Spreadbury, 2012). Further, it has been shown in rats that gastrointestinal inflammation affects the afferent vagal nerve first, contributing to leptin resistance and decreasing satiety, before affecting central leptin sensitivity. In addition, the microbiota can be altered by diet, differing between people following Western or ancestral diets (Spreadbury, 2012). Even people of European descent, who have developed some genetic adaptations to better handle grain consumption, are not protected against obesity and diabetes when replacing fruits and vegetables with carbohydrates not protected within plant cell walls such as flours and refined sugars (Spreadbury, 2012).

A study by McKeown et al. (2008) is interesting for a number of reasons. The studies mentioned so far have all focused on young and middle aged adults. This study examined the effects of whole grain intake on older adults, specifically looking at abdominal adiposity. They found that consumption of whole grains was inversely correlated with central abdominal adiposity and body mass index, but there was no correlation with respect to refined grains. Interestingly, the authors did not find any interaction between fruit and vegetable intake and adiposity, which led them to
conclude that only the insoluble fiber found in grains could account for the redistribution of body fat. Again, a healthy user effect could help interpret these findings as acknowledged by the authors. McKeown et al. also cite a study that uses rye pasta to intentionally cause a low post-prandial insulin response to support their fiber argument (Kallio et al., 2007). The study finds that the diet of rye pasta can cause a 21% decrease in adipocyte size after twelve weeks. While this could suggest that a fibrous diet made up of carbohydrates with a low glycemic load could be most beneficial, it would stand to reason that a Paleolithic diet that is high in fiber, high in protein with only a moderate amount of carbohydrates could elicit even more convincing results. This is an area of research with much potential.

In their review article, Venn and Mann (2004) present some findings that contradict the general consensus presented in the studies above, and while they conclude that consuming a variety of whole grains and legumes can be useful in the prevention and treatment of diabetes, their evidence may actually indirectly support a Paleolithic diet. The authors argue in favor of whole grains because they provide food with a lower glycemic index compared to refined grains, which is beneficial when considering type 2 diabetes. In agreement with McKeown et al. (2002), Venn and Mann (2004) attribute the lower glycemic index to a higher percentage of intact kernels and grains, which are harder to digest. They found that the insulin response was lower when subjects consumed 80% intact whole barley grain as opposed to milled barley flour. While they do cite the many studies suggesting insoluble fiber as being instrumental in whole grain’s effects, they do concede that many of the studies
either directly encourage an increase in fruits and vegetables along with the desired whole grains, or that the increase is an indirect result of eating healthier and replacing refined foods. This can make the interpretation of the studies’ findings more difficult and further supports the healthy user effect. In a nine year study, looking at the effects of a traditional low-fat, high-carbohydrate, high-fiber diet, only 8% of subjects fasting glucose levels improved significantly compared with the 24% that improved on the antidiabetic drug sulphonylurea (Turner, Cull, Frighi & Holman, 1999). The authors also suggest that soluble fibers such as psyllium, guar gum, pectin and β-glucan can reduce the rate of glucose absorption by forming a thick, viscous substance in the small intestine.

Brand-Miller, McMillan-Price, Steinbeck and Caterson (2007), in their review, discussed the merits of a low glycemic index diet. While diets with increased glycemic index are linked with insulin insensitivity, metabolic syndrome and cardiovascular risk, diets with low glycemic index showed opposite, protective effects. Low glycemic indexes have also been proven to be effective in lowering hemoglobin A1c levels in children and pregnant women. In contrast to the conclusions by Venn and Mann (2004), this review cautioned the intake of whole grains without establishing their respective glycemic indices because most common whole grain foods such as cereals and breads can have glycemic indices of 72 (glucose is rated at 100 and white bread at 69) (Brand-Miller, McMillan-Price, Steinbeck & Caterson, 2007; Jenkins et al., 1981). Pereira and Liu (2003) proposed a diet intended to reduce the risk of cardiovascular disease and type 2 diabetes. They
suggested a diet high in whole grains, fruits and vegetables, with the intention of consuming considerable amounts of fiber and to only include foods with a low glycemic index. This is based on studies showing that a high intake of fruits and vegetables can lower cardiovascular risk, independent of body mass index, and research that showed that diets with a high glycemic load and low fiber more than doubled the risk of type 2 diabetes in nurses (Brand-Miller, McMillan-Price, Steibeck & Caterson, 2007). This study is consistent with the findings of Venn and Mann (2004), but again did not include concerns about most whole grain products having high glycemic indices (Brand-Miller, McMillan-Price, Steinbeck & Caterson, 2007).

Another study demonstrated negative effects of grains on high-density lipoprotein (Siri-Tarino, 2011). This review found that refined carbohydrates and added sugars can exacerbate atherosclerosis and greatly lower high-density lipoprotein. Glycemic load did not affect levels of high-density lipoprotein. Importantly, when carbohydrates were replaced with fats, especially saturated fats, high-density lipoprotein increased and when fats were replaced with carbohydrates, those levels dropped, indicating an advantage to lower carbohydrate, higher fat diets.

Finally, a Cochrane review was published by Priebe, van Binsbergen, de Vos and Vonk (2008) that examined one randomized trial and eleven cohort studies in order to determine the effects of whole grains on diabetes risk. The review concluded that the evidence available for whole grain's effects was either too prone to bias or not conclusive enough in order to make any serious changes to clinical
practice. The sole randomized trial considered was dismissed despite its positive effects on diabetes risk because of its short duration (6 weeks), its small sample size (12) and significant potential for selection, attrition and detection bias. Review of the cohort studies shows unanimous results, all demonstrating decreased risk for type 2 diabetes and/or weight loss. The researchers, however, took issue with some of the methods, specifically the use of questionnaires found in a majority of studies. These questionnaires were not specifically designed for the task of measuring whole grain intake, and so, did not include an exhaustive list of options and would not likely accurately record all of the foods consumed. In addition, only five out of eleven studies repeated the questionnaires several times in order to reduce measurement error. As noted in many of the above investigations, the Cochrane review appreciated the many potential confounders that can be present in studies looking at dietary interventions. Because adjusting for factors such as baseline weight or body mass index, physical activity or intake of fruits and vegetables can attenuate the trends shown by many of the cohort studies, the review did not consider the available evidence compelling enough to actively recommend whole grains as a preventative measure or treatment for diabetes.

Grains, in the form of breads, pastas, cereals and flours, have become a major staple in a Western diet and are rapidly supplementing the daily consumption of rice in Asian and Hispanic diets. Concurrently, rates of type 2 diabetes are growing rapidly and are expected to grow from 366 million to 552 million cases worldwide in the next twenty years and, in 2008, roughly 25% of men and women in the
Americas were obese (Belobrajdic & Bird, 2013; World Health Organization, 2008). Westerners, especially, have grown accustomed to consuming grain products each day, often with each meal, looking to the base of the Food Guide Pyramid for dietary guidance (Dietary Guidelines Advisory Committee, 2005).

The studies presented above all suggest a simple replacement of refined grain products with whole grain products in order to derive health benefits. While the data presented does make it clear that whole grain products are healthier in general when compared to refined grains, none of the studies above included a third category, one that eliminated grains from the diet altogether, in order to compare the effects of moving to whole grain foods to moving to a more Paleolithic-style diet. The hypothesis put forth by Spradbury (2012), involving gut inflammation as a result of acellular carbohydrate consumption, could explain many factors relating to the effectiveness of carbohydrates in the diet, such as why calorie-restriction proves difficult in a Western diet (leptin resistance) especially when a low-fat diet is compared to a Paleolithic diet, both ad libitum, and why supplementation with vitamins, fiber and minerals cannot be substituted for fruits and vegetables concurrent with a regular Western diet.

From a public health standpoint, persuading patients to simply swap one grain for another would be much easier than convincing them to give up grains entirely, and would likely result in higher adoption rates, even if the benefits are debatable. Nevertheless, further research is required in this field in order to draw more concrete conclusions about the proper direction of public health. Future
studies must be more aware of the “healthy user” effect and explicitly adjust for those related factors. Also, more randomized controlled trials should be conducted, considering a longer time frame, population size and including a third condition which encourages the participants to, instead of consume more of or avoid whole grains, to avoid grains altogether.

**Red Meat**

As one of the largest sources of energy, protein, amino acids, vitamins and minerals, meat plays an important role in the daily nutrition of the Paleolithic diet. With many options including chicken, beef, pork, lamb and other more exotic meats, there exists enough variety to sustain palatability and enjoyment while still maintaining similar nutrient intakes. In addition to standard cuts of raw meat, other traditional forms of meat exist under the umbrella term of processed meats. Ferguson (2009) defines processed meats as those preserved using techniques such as salting, smoking or curing. Common foods that fall into this category are ham, bacon, sausages, hot dogs and many deli meats such as pastrami. Most of the foods mentioned are made with pork, however could be prepared with any desired meat.

Popular concern over the intake of red meat and its potential role in cancer or other ailments, however, should give the Paleolithic dieter pause. With the United States Department of Agriculture ruling pork as a red meat (United States Department of Agriculture, 2013), three out of four of the above mentioned unprocessed meats may have the potential for being carcinogenic, leaving only
chicken and other poultry designated as “safe”. There is also concern that processed meats may also significantly contribute to the development of cancer beyond the risk inherent in the meat. Because red meats can play such a central role in the diet (Eaton and Konner, 1985), in order to be able to endorse the Paleolithic lifestyle as feasible and safe, a review of the current literature related to red meat consumption is necessary.

In 2008 the World Cancer Research Fund/ American Institute for Cancer Research published a study drawing ties between red and processed meat consumption and the development of colorectal cancer. It suggested that red meat intake be limited to 500 g per week and processed meats should be avoided entirely. Another article suggested that for every 100 g increase in daily red or total meat consumption, the risk for colorectal cancer increases by 12-17% (Ferguson, 2009). The same study showed a 49% increase in risk when increasing daily consumption of processed meats by 25 g. A study by Norat et al. (2002) concluded that participants with the highest red meat consumption had an increased risk of colorectal cancer of 1.35 when compared to the lowest consumption group. A meta-analysis of studies looking at endometrial cancer risk compared to animal product intake demonstrated an increased risk of 1.51 per 100 g/day for red meat and 1.03 per 100 g/day for poultry (Bandera, Kushi, Moore, Gifkins & McCullough, 2007).

While there are several theories as to how meat consumption could cause or contribute to the risk of cancer, some have more available evidence than others. Ferguson (2009) suggests that one reason could be the high fat content found in
diets rich in meat, especially red or processed meats. The author draws the link in the epidemiological literature between high fat intake and colorectal cancer, but also acknowledges that the data could be interpreted as “inconsistent” at best. The study by the World Cancer Research Fund/ American Institute for Cancer Research (2008), looking at small intestinal cancer, reported that saturated fat intake, not red meat specifically, was linked with the development of carcinoid tumors. The high fat content of some meats, especially domesticated beef and processed meats, results in many meat products having a high energy density. A lifestyle that incorporates many high energy density foods such as fats, margarines, butters, and meats and while reducing other dietary components such as fruits and vegetables can lead to obesity and has been shown to increase risk of breast cancer (Schulz et al., 2008). Many studies have drawn links between obesity and cancer risk: Goodman et al. (2009) for endometrial cancer, Calle & Kaaks (2004) and Alexander & Cushing (2009) for kidney cancer and also the World Cancer Research Fund/ American Institute for Cancer Research (2008) for small intestinal cancer.

One of the more compelling links between meat and cancer is the effect of heterocyclic amines and polycyclic aromatic hydrocarbons. When meat is cooked at very high temperatures, especially for long periods of time, such as grilling, barbecuing, frying, etc., amino acids and creatine combine to form heterocyclic amines and polycyclic aromatic hydrocarbons (Ferguson, 2009). These compounds are known alkylating agents and can damage DNA, potentially leading to cancer. Garcia-Closas, Castellsague, Bosch & Gonzalez (2005) found that polycyclic aromatic
hydrocarbons were in meats smoked over wood. Looking at prostate cancer risk, Koutros et al. (2008) found that despite no significant associations between specific meat types or cooking methods, those who consumed very-well done meats had a 1.26 fold increase in risk for developing cancer. Similar results were recorded by Norrish, Ferguson, Knize, Felton and Jackson (1999) who found a 1.68 fold increase in risk for developing prostate cancer.

In contrast to the findings above, Alaejos, Gonzalez and Afonso (2008) concluded that the available evidence did not support a link between dietary intake of heterocyclic amines, however Ferguson (2009) suggested that these findings were confounded because the authors did not take into account other factors such as co-carcinogens and anti-carcinogens found in meat and other foods along with genetic susceptibility to different levels of heterocyclic amines. One example of a co-carcinogen could be heme iron (Sesink, Ttermont, Kleibeuker & Van de Meer, 1999). The authors argue that it could contribute to cancer development by increasing the proliferation of mucosa cells. In contrast, a meta-analysis by Alexander, Morimoto, Mink and Cushing (2010) argues that the evidence linking heterocyclic amines and polycyclic aromatic hydrocarbons to breast cancer is inadequate with only a few articles in support of the association. A prospective study of close to 4000 subjects found no associations between well-done meat, meat cooked at high temperatures, polycyclic amines and breast cancer (Kabat et al., 2009).

An aspect of processed meats that has gained popularity is the presence of N-nitroso compounds. Found in smoked and cured meats such as ham, bacon and
sausages, N-nitroso compounds have been implicated in colorectal and gastric cancer (Ferguson, 2009). One study found an increased overall risk of 2.12 for subjects consuming the highest amounts of N-nitrosodimethylamine compared to those consuming the least (Knect, Jarvinen, Dich & Hakulinen, 1999). Nitrates, nitrites and nitrosodimethylamine have also been connected to high rates of stomach and liver cancer in Thailand (Mitacek et al., 2008). Supporting heme iron’s role as a co-carcinogen, Santarelli, Pierre and Corpet (2008) note that heme iron can increase the rate of N-nitroso compound formation inside the digestive tract.

In order to minimize potentially harmful effects of eating a meat-rich diet, Ferguson (2009) offered several suggestions. In order to reduce the amount of fat being consumed, the author recommended trimming the meat of any excess visible fat while also choosing leaner cuts of meat. Besides altering the cooking method, in order to reduce charring and producing heterocyclic amines, other dietary components that are rich in antioxidants such as green tea, white tea, and caffeine can help prevent or inhibit the effects of heterocyclic amines (Carter et al., 2007). Vitamins C and E have been shown to be effective in combating the formation of N-nitroso compounds as well as stopping cellular transformation (Mirvish, 1986).

Not all research however, supports the connections between meat and cancer. While cigarette smoking and obesity have become strong identifying factors in the likelihood of developing kidney cancer, other factors such as red and processed meat consumption have not been supported as generously by the literature (Alexander & Cushing, 2009). Alexander and Cushing (2009) advanced the
research performed by the World Cancer Research Fund/ American Institute for Cancer Research (2008) by performing a meta-analysis of two case-controlled studies, a cohort study of 500,000 subjects and thirteen prospective cohort studies published since 2007 in order to better understand the etiology of kidney cancer. In Alexander's and Cushing's (2009) findings, when associations for red meat did not take into account body mass index, smoking and energy intake, the risk was 1.39 fold for red meat consumption. Taking into account those factors, the risk dropped to a range of 1.02 – 1.19. When the notable amount of heterogeneity between study designs was accounted for and when all three major risk factors were adjusted for, there was no association between red meat intake and kidney cancer. For processed meats, the results were more inconclusive due to significant heterogeneity effects between studies that controlled for body mass index, smoking and energy intake.

In a similar meta-analysis study focused on the effects of red and processed meats on the risk of breast cancer, Alexander, Morimoto, Mink and Cushing (2010) found little evidence for an association between the two. While the risk ranged from 1.00 to 1.10 in an analysis of eighteen studies, and some of the meta-analyses were marginally significant, the authors conclude that due to the large amount of heterogeneity between studies and demonstration of publication bias skewing data in the positive direction, the evidence for any association between red or processed meats was not clinically significant.

A review of thirty case-control studies by Truswell (2002) found that twenty of them did not find a significant relationship between red meat consumption and
colorectal cancer. The results of the other ten studies were more ambiguous. Some found a significant relationship between only colon or only rectal cancer. Some found a greater trend for pasta and grains and others were rejected due to use of inadequate questionnaires.

A further consideration when consuming red meat is the potential connection to cardiovascular disease, including coronary heart disease. A study by Hu et al. (1999a) found that when age was controlled for, there existed a significant association between red meat consumption and cardiovascular disease. When other related factors such as body mass index, smoking, alcohol consumption and energy intake were considered, however, that correlation was no longer significant. McAfee et al. (2010) conducted a review on the effects of red meat on cardiovascular disease and found it difficult to directly compare the many studies due to differences in study methodologies. Exact measurements of meat were often not reported and so relied on the subjects’ reporting of servings and portions. Cosgrove et al. (2004) argue that the amount of meat that is actually consumed may have been overestimated by as much 43% in national surveys due to the failure to disassociate the weight of the meat in a meal from the non-meat foods. While saturated fats, including myristic acid, palmitic acid and stearic acid, have been found to be associated with cardiovascular disease (Hu et al., 1999a), other later studies have suggested that stearic acid contributes neither positively nor negatively to cholesterol levels as is simply neutral (Daley, Abbott, Doyle, Nader & Larson, 2010; Kelly et al., 2002).
There also exists evidence that the fatty acids and micronutrients within red meat can be beneficial to one’s health. According to McAfee et al. (2010), just under half of the intramuscular fat is comprised of unsaturated fats, mainly the monounsaturated fat oleic acid, the n-6 and n-3 polyunsaturated fatty acid linoleic acid and alpha-linolenic acid. The authors also report that increasing the daily intake of unsaturated fatty acids, especially when watching intake of saturated fatty acids, can lead to a lowering of total cholesterol, low-density lipoprotein and plasma triglycerides. α-linolenic acid and other sources of ω-3 such as eicosapentaenoic acid and docosapentaenoic acid have been shown to promote cardiac health by improving factors such as platelet aggregation and vasodilation (Mann et al., 2006).

Ruxton, Reed, Simpson & Millington (2004) demonstrated that sources of ω-3 polyunsaturated fatty acids also had positive effects on inflammation, vision and the central nervous system. Conjugated linoleic acid, also found in red meat, has been connected to anti-carcinogenic and anti-atherogenic properties as well as positive effects on the immune system (McAfee et al, 2010). Despite positive effects in animal studies as well as investigations showing that consumption of red meat contributes to the levels of ω-3 polyunsaturated fatty acids and conjugated linoleic acid in the blood in humans, McAfee et al. (2010) acknowledge that research that shows the amount of these fatty acids obtained from red meat needed to be significant enough to produce the desired physiological benefits has yet to be conducted. Beyond the potentially beneficial fatty acid profile of beef and other read meats, other micronutrients including heme iron, zinc, vitamin B12, selenium and
retinol have been shown to be both present in red meat in physiologically meaningful amounts and often more bioavailable compared to other dietary sources (McAfee et al., 2010).

The studies presented above offer evidence both in favor and against the hypothesis that an increased consumption of meat, often specifically red or processed meats, can contribute to an increased risk of many forms of cancer, including colorectal, kidney, liver, stomach and breast cancer. Red and processed meats have also been suspected of causing increased risk for cardiovascular disease including coronary heart disease. As was the case with the investigation of whole grains, when the studies were examined closely, it was often found that correlations between red meat consumption and disease were attenuated if not negated when other related factors were taken into account such as body mass index, smoking and alcohol consumption. In addition, many cohort studies compare the highest quartile to the lowest quartile, which means that the average consumer is not always represented by the data (McAfee et al., 2010). Research has also shown that it is important to take into account the cooking method when investigating food consumption since compounds such as heterocyclic amines and polycyclic aromatic hydrocarbons can confound the findings.

These three factors should call into question the validity of claims that say red meat should be restricted in a healthy diet. In support of red meat, studies have found that it can contain a number of monounsaturated and polyunsaturated fatty acids including ω-3s and conjugated linoleic acid that have been associated with a
lowering of cholesterol and positive cardiovascular and neurological effects (McAfee et al., 2010). In addition, red meat has many vitamins and minerals, some of which are better absorbed by the body when consumed in red meat, such as heme iron.

An important caveat to the research presented which supports the regular consumption of red meat is the strong likelihood of experimenter bias. Two of the reviewed studies were sponsored by the National Cattleman’s Beef Association and the National Pork Board (Alexander & Cushing, 2009; Alexander, Morimoto, Mink & Cushing, 2010). Another study, conducted in Northern Ireland, was sponsored by Agrisearch and the Livestock and Meat Commission for Northern Ireland, both organizations that sponsor research using money collected from beef and sheep producers in order to promote the industry (McAfee et al., 2010). While the former two studies deny any involvement from the sponsors beyond funding, the latter study does not divulge the extent to which the sponsor was involved. Nevertheless, it is important to study the literature both carefully and critically, knowing that, intentional or otherwise, bias in favor of the red meat industry could be present.

Meat, in all of its forms, plays a large role in the Paleolithic diet alongside fruits, vegetables, nuts, seeds and seafood. Beyond nutritional diversity, eating red meats in a rotation with poultry and other white meats would be advantageous in order to maintain long-term interest, palatability and variety within the lifestyle. Taking into account the potential for bias, recent research has not presented convincing enough data to support claims that red meat inherently causes cancer, cardiovascular disease, etc. Evidence does more strongly condemn the consumption
of processed meats, and these should be eaten sparingly until further research confirms or denies (Ferguson, 2009). When consumed in moderate amounts and high-temperature cooking techniques such as charring, grilling or pan-frying are avoided, red meat can be a valuable source of protein, iron, vitamins, minerals, monounsaturated fatty acids and polyunsaturated fatty acids, which can be both protective and complementary to the Paleolithic lifestyle.

**Grass-Fed Meat**

Grass-fed meat, whether for concerns of animal welfare, sustainability, more favorable nutrient profiles or simply taste, has quickly grown in the consumer market (United States Department of Agriculture, Agricultural Marketing Service, 2007). Until the 1950s, cattle were raised on a natural diet, either in pastures or given grass and silage to feed on (Daley, Abbott, Doyle, Nader & Larson, 2010). Increased industry demand for beef that was more tender, had greater marbling and was cheaper to produce led farmers to develop the feedlot, where cattle are mass-fed grains, consisting of mostly corn, and other high-energy supplements to quicken growth. U.S. consumers have become accustomed to the taste and texture of grain-fed beef and studies have shown that compared to grass-fed beef, they tend to prefer it (Scollan et al., 2006; Daley, Abbott, Doyle, Nader & Larson, 2010). This is not the case in other parts of the world where grass-fed meat is more traditional (Scollan et al., 2006). A review of the current research was conducted in order to assess the value of including grass-fed meat in one’s diet. It is important to note that
while this section focuses on beef, the results should be similar when extrapolated to other ruminants such as sheep (Leheska et al., 2008).

Overall, cattle that were grass-fed tend to be about 200 lbs. lighter than grain-fed (Leheska et al., 2008). While this difference does include muscle mass, grass-fed cattle tend to be significantly leaner compared to their intentionally fattened counterparts, both externally and intramuscularly (marbling).

Nutrient profiles, including fatty acids, have been shown to vary in beef depending on the finishing method (Leheska et al., 2008; Daley, Abbott, Doyle, Nader & Larson, 2010; Van Elswyk & McNeill, 2014). While the reviews of Daley, Abbott, Doyle, Nader and Larson (2010) and Van Elswyk and McNeill (2014) report reduced levels of saturated fatty acids in grass-fed beef, the study by Leheska et al. (2008) reported higher levels of saturated fatty acids. Of the three main saturated fatty acids found in beef however (myristic acid, palmitic acid and stearic acid), all three reviews agreed that cholesterol-raising myristic and palmitic acids were lower and stearic acid, which has been found to have neutral effects on cholesterol (Kelly et al., 2002), was significantly higher in grass-fed beef.

Both review articles (Daley, Abbott, Doyle, Nader & Larson, 2010; Van Elswyk & McNeill, 2014) and the study by Leheska et al. (2008) found that grass-fed beef contains significantly less monounsaturated fats compared to grain-fed beef, specifically oleic acid, the most abundant in beef. Van Elswyk and McNeill (2014) attribute this finding to the fact that oleic acid increases as intramuscular marbling increases. Many studies have demonstrated the potential health benefits to
consuming monounsaturated fats instead of saturated fats including lowering risk for cardiovascular disease and improving glucose tolerance (Kris-Etherton, 1999; Dietary Guidelines Advisory Committee, 2010). The Food and Agriculture Organization of the United Nations (2010) found that when monounsaturated fats are substituted for carbohydrates, levels of high-density lipoprotein increase. Daley, Abbott, Doyle, Nader and Larson (2010) and Leheska et al. (2008) found that grass-fed beef has significantly greater amounts of trans-vaccenic acid, a monounsaturated precursor of conjugated linoleic acid.

Conjugated linoleic acid is a polyunsaturated fatty acid that has been shown to be anti-carcinogenic, anti-atherosclerotic and anti-diabetic (Daley, Abbott, Doyle, Nader & Larson, 2010), immunomodulating, and promoting of both growth and lean body mass production (Tanaka, 2005). Besides being converted from trans-vaccenic acid de novo, conjugated linoleic acid is also produced by bacteria in the stomachs of ruminants (Pariza, Park & Cook, 2000). Because the foraging diet produces a less acidic environment in the rumen than a grain-fed diet, bacterial production of conjugated linoleic acid is increased in grass-fed beef.

The essential polyunsaturated fatty acids found in beef are linoleic acid and alpha-linolenic acid (Enser et al., 1998). Also important are the long-chain fatty acids such as arachidonic acid, eicosapentaenoic acid, docosapentaenoic acid and docosahexaenoic acid. All of the polyunsaturated fatty acids mentioned are classified as ω-3s except for linoleic acid, which is an ω-6. Because the pathways for synthesizing ω-3s and ω-6s share two enzymes (delta-5-desaturase and delta-6-
desaturase), it is important to maintain a proper ratio of \( \omega-6 \) to \( \omega-3 \) (Daley, Abbott, Doyle, Nader & Larson, 2010). Recommendations for that ratio range from one to six times the amount of \( \omega-6 \) to \( \omega-3 \) (Daley, Abbott, Doyle, Nader & Larson, 2010; Leheska et al., 2008) while many Americans consume a diet consisting of eleven to thirty times more \( \omega-6 \).

Research has shown that a diet rich in \( \omega-3 \) fatty acids can help prevent atherosclerosis, heart attack, depression, cancer, rheumatoid arthritis, memory loss and Alzheimer’s disease. They have also been shown to be an especially healthy energy source for the brain (Daley, Abbott, Doyle, Nader & Larson, 2010). Most studies have found that grass-fed beef, while maintaining similar levels of total polyunsaturated fatty acids, contains significantly higher percentages of \( \omega-3 \) fatty acids, and so a significantly more favorable \( \omega-6 \) to \( \omega-3 \) ratio compared to grain-fed beef (Leheska et al., 2008; Daley, Abbott, Doyle, Nader & Larson, 2010; Van Elswyk & McNeill, 2014). Leheska et al. (2008), however, question whether the total amount of \( \omega-3 \) fatty acids would be elevated compared to conventional beef due the lower amount of total fat overall in grass-fed beef.

In addition to the differing fatty acid profiles between grain-fed and grass-fed beef, grass-fed beef has been shown to contain between 1.5 and 7 times the amount of \( \beta \)-carotene (a precursor to vitamin A) and 3 times the amount of \( \alpha \)-tocopherol (a form of vitamin E) along with increased levels of the antioxidants glutathione and superoxide dismutase when compared to grain-fed beef (Daley, Abbott, Doyle,

Eating more natural foods is central to the idea of the Paleolithic lifestyle. United States Department of Agriculture certified grass-fed beef, and other meats such as lamb, come from animals that were guaranteed to have a more natural diet (grass and other forage) and to have constant access to the pasture when growing (United States Department of Agriculture, Agricultural Marketing Service, 2007). The above studies also show that grass-fed beef generally has a more favorable saturated fat profile (less overall, more stearic acid), increased levels of polyunsaturated fats, a more favorable ratio of ω-6 to ω-3 fatty acids and elevated levels of vitamins and antioxidants when compared to grain-fed beef. While one study (Leheska et al., 2008) raised the issue of lower total fat content in grass-fed beef contributing to lower levels of fats overall such as ω-3 fatty acids and monounsaturated fats, the majority of studies examined suggested a more advantageous nutritional profile for grass-fed beef and advocated for the switch from grain-fed beef, when possible, as a healthier addition to both the Western diet and the modern Paleolithic lifestyle.
**Dairy and Soy**

Because the domestication and husbandry of farm animals such as dairy cows was not known to occur before the Neolithic period, dietary intake of dairy products such as milk, cheese and yogurt is presumed to be practically non-existent in early humans beyond breast-feeding during infancy (Lindeberg, 2012). Today, instances of intolerance to lactose, a sugar found in dairy milk, are on the rise and are thought to both be contributing to a voluntary reduced consumption of milk (Fulgoni III et al., 2011) and also to be evidence that milk and other dairy products may not be as appropriate for daily consumption as Western culture and the dairy industry once believed (Lindeberg, 2012; Melnick, 2012). Dairy products, especially milk, are known to be both caloric and nutrient dense, making the consumption a double-edged sword (Faghih, Abadi, Hedayati & Kimiagar, 2009). In response to this issue, soy products, also a product of the Neolithic era, have been suggested as an alternative to dairy milk (Gardner, Newell, Cherin & Haskell, 2001). Due to the nutritional fortification of soy and the potentially positive hormonal actions from the natural isoflavones found in soy, many studies encourage the use of soy (Keshavarz, Nourieh, Attar & Azadbakht, 2012; Messina & Messina, 2010). In order to conclude the nutritional value of milk and soy products and determine whether they deserve a place in the Paleolithic diet or a regular Western diet in general, a review of the current literature was conducted.

Dairy milk is known to be a rich source of many vitamins and minerals including: vitamin A, vitamin D, vitamin B12, riboflavin, calcium, potassium,
phosphorus, magnesium and zinc (Fulgoni III et al., 2011). Because of this, the United States Dietary Guidelines for Americans suggest at least three cups of milk per day in order to fulfill daily nutritional requirements (Dietary Guidelines Advisory Committee, 2010). Data from Fulgoni III et al. (2011) suggests that Americans only consume roughly 60% of the daily-recommended servings of dairy products. The Dietary Guidelines Advisory Committee (2010) has drawn connections between decreased dairy consumption and cardiovascular disease, increased risk of type 2 diabetes and bone diseases such as osteoporosis.

In the two part study by Fulgoni III et al. (2011), idealized dietary intakes based on the United States Department of Agriculture’s MyPyramid (the 2005 replacement for the Food Guide Pyramid, now known as MyPlate) were manipulated to examine the nutritional effects of adding or subtracting the servings of dairy consumed as well as examining national survey data, based on a questionnaire, to determine actual intake and the nutritional ramifications (Dietary Guidelines Advisory Committee, 2005; Dietary Guidelines Advisory Committee, 2010). The Fulgoni III et al. (2011) study concludes that while other sources of calcium, such as orange juice, leafy greens and bony fish, do exist, they are not nutritionally equivalent to milk and do not provide the same amount of vitamins and minerals that are already lacking in an American diet such as potassium, magnesium, vitamin A, vitamin D and vitamin B12. The authors also argue that the bioavailability for some nutrients such as calcium differ between foods and are more advantageous in milk, citing the synergistic effects of vitamin D and calcium in
milk compared to the antagonistic effects of oxalate on calcium found in the otherwise calcium-rich source of leafy greens such as spinach.

Fulgoni III et al. (2010) further claim that because other healthy options such as bony fish and leafy greens are not frequently consumed by Americans, it would make more sense to increase milk consumption, despite acknowledging that that increase would be concurrent with an increase in both fat and calories. When evaluating the statements put forth by Fulgoni III et al. (2010) it is important to note the potential for experimenter bias in favor of dairy consumption due to the declared funding provided by the National Dairy Council.

Lindeberg (2012) presented evidence advocating against dairy milk. Recent studies have linked dairy milk to atherosclerosis, myocardial infarction, coronary heart disease and type 2 diabetes as well as possible links to breast and prostate cancer. Lindeberg (2012) indicates the primary milk protein, casein, and possibly lactose (both found in the nonfat portions of the milk), as the link between milk consumption and increased risk of mortality. In addition, the author reports that evidence suggesting milk’s role in preventing osteoporosis is unconvincing in that its effects on bone remodeling have been overstated. No studies performed on modern hunter-gather societies (no milk intake) have shown incidences of osteoporosis (Lindeberg, 2012). Further, in contrast with Fulgoni III et al. (2010), while compounds within milk might be synergistic, beans, grains, cereals and other acid-producing foods contain phytate, which is known to impede absorption (Lindeberg, 2012).
Soy products, as alternatives to dairy products, have historically been popular in Asian countries, especially within the past few decades (Messina & Messina, 2010). Average soy intake per day in Japan can range from 6 g to 11.3 g while average American soy intake is only about 2.2 g/day, of which a majority comes from soy additives for preservation. Used in many applications, ranging from edamame to soymilk to meat substitutes and condiments, soy can play a versatile role in nutrition. Compared to other legumes, soy also has more digestible protein and a higher level of fat, including both linoleic acid (ω-6) and α-linolenic acid (ω-3) (Keshavarz, Nourieh, Attar & Azadbakht, 2012; Messina & Messina, 2010). Soy protein has also been shown to directly lower cholesterol (Food and Drug Administration, 1999), however more current research suggests that those effects are overstated (Messina & Messina, 2010).

The reason such extensive research has been performed concerning the soybean is because it contains a number of biologically active flavonoids with properties similar to estrogen called isoflavones (Messina, 1999). The three main isoflavones present in soy are genistein, daidzein and glycine, with genistein being the most prevalent. Isoflavones bind to estrogen receptors with less affinity than estrogen and transactivate estrogen receptor β more strongly than estrogen receptor α, which classifies them as selective estrogen receptor modulators (Messina & Messina, 2010). Research has shown that increased estrogens, either endogenously or through diet, can contribute to the development of estrogen receptor positive breast cancer (Hilakivi-Clarke, Andrade & Helferich, 2010).
Hilakivi-Clarke, Andrade and Helferich (2010) also report that Asian women who regularly consume more soy have a three to five fold reduction in breast cancer rates when compared to Caucasian women who do not regularly partake of soy.

Many studies reconcile these two conflicting statements by addressing the nature of the two estrogen receptors throughout life (Dong & Qin, 2010; Hilakivi-Clarke, Andrade & Helferich, 2010; Messina & Messina, 2010). Activation of estrogen receptor α is assumed to mediate proliferative actions while activation of estrogen receptor β is assumed to inactivate estrogen receptor α. While genistein has greater binding affinity for estrogen receptor β compared to estrogen receptor α, at physiological doses, it tends to activate estrogen receptor α, only partially activating estrogen receptor β at very low doses (Hilakivi-Clarke, Andrade & Helferich, 2010). Lifelong intake of soy, starting at least at puberty, increases the expression of both estrogen receptor α and β. While this might suggest an increased susceptibility for breast cancer in Asian women, genistein has also been shown to be a powerful tyrosine kinase inhibitor, inactivating the complex pathway required for estrogen-stimulated tumor growth (Hilakivi-Clarke, Andrade & Helferich, 2010). Dong and Qin (2010) have also found that when daidzein is metabolized, equol, a very potent antioxidant, is produced and the enzyme required to produce equol is more prevalent in Asian populations. Despite one study’s findings that genistein can interfere with the estrogen receptor antagonist tamoxifen in the treatment of human breast cancer cells in mice (Ju et al., 2002), other evidence finds no
association or even positive outcomes when taking soy with tamoxifen (Dong & Qin, 2010; Hilakivi-Clarke, Andrade & Helferich, 2010; Messina & Messina, 2010).

Mahmoud, Yang and Bosland (2013) reported on the role and effects of soy on the development and treatment of prostate cancer. Asian populations regularly consuming soy tend to have lower incidences of prostate cancer. Prostate cancer, like breast cancer, involves an up-regulation of estrogen receptor α (in high-grade prostatic intraepithelial neoplasia). For androgen-dependent prostate cancer, estrogen has been shown to be a useful hormone treatment, although it is possible that it is also implicated in the development of prostate cancer. (Mahmoud, Yang & Bosland, 2013). The authors conclude that while the research reviewed suggests that soy intake (and specifically the isoflavones) does appear to protect against prostate cancer, the available research is thin and more work needs to be done to elucidate the pathways and possible mechanisms further before any concrete treatment suggestions be made.

Much research has been conducted suggesting that soy could be useful in the treatment or prevention of osteoporosis (Messina & Messina, 2010; Reinwald and Weaver, 2006; Taku et al., 2011). Messina and Messina (2010) suggest that consuming soy protein, compared to protein from other sources such as meat, could help reduce the amount of calcium lost due the presence of fewer sulfur amino acids in soy protein. Sulfur amino acids are known to break down into sulfate and hydrogen, which would result in renal net acid excretion and encourage the bone to release phosphate in order to correct the balance. Evidence, however, confirming
protein’s role or soy protein’s lessened role in renal net acid excretion has been scarce and conflicting at best (Messina & Messina, 2010).

Due to their estrogenic effect, isoflavones have also been implicated in treating osteoporosis. In 2006, Reinwald and Weaver found evidence in rats, and to a lesser extent, in humans, suggesting that isoflavones would be effective for treating or preventing osteoporosis. Isoflavones have been found to significantly increase the bone mineral density of the lumbar spine (Taku et al., 2011). The authors also found, however, that the effects were less robust compared to current osteoporosis treatments, including estrogen. Increased bone mineral density was only found in the lumbar spine and not in other measured regions such as the neck, femoral hip or trochanter. Messina and Messina (2010) were less optimistic, citing conflicting evidence. While two of the prospective epidemiological studies they reviewed offered positive results for soy isoflavone treatment, many of the clinical studies they reviewed found less than favorable results. The authors suspect many factors at play causing the conflicting data such as life-long intake of soy, trials using intact soy foods compared to purified genistein, or a healthy user effect.

While the estrogenic effects of soy can be protective in some cases, concerns have been raised that a consumption of soy could lead to feminization and/or infertility in men (Messina & Messina, 2010). These concerns have stemmed from a popular case study (Martinez & Lewi, 2008) in which a 60-year-old man had developed gynecomastia assumed to be from the consumption of three quarts of soymilk per day. It was confirmed that his estrogen levels were significantly
elevated and likely the cause of his physiological changes, however the presumed level of isoflavones being consumed was roughly nine times as much as in a typical daily Japanese diet. Messina and Messina (2010) offer several studies to the contrary suggesting that amounts as much as four times the average Japanese diet do not cause as adverse physiological symptoms and even one case of a man unable to conceive who does so after six months of isoflavone treatment. Interestingly, due to the potential physiological action, Reinwald and Weaver (2006) also raise the question as to whether soy baby formulas, containing up to six to eleven times more soy than adult consumption, could pose a danger.

Given the information presented above, the question then arises whether or not it is more advantageous to consume dairy milk, soy products such as soymilk, some combination of the two, or whether it is even necessary to include these in one’s diet. Many studies have conducted trials comparing the effectiveness of soymilk to dairy milk in areas such as weight gain/loss, body fat distribution and cholesterol levels (Berger et al., 2014; Faghih, Abadi, Hedayati & Kimiagar, 2009; Gardner, Newell, Cherin & Haskell, 2001; Keshavarz, Nourieh, Attar & Azadbakht, 2012; Lukaszuk, Luebbers & Gordon, 2007). Effects on weight loss and waist circumference reduction have been found to be, at least partially, due to increased calcium (Faghih, Abadi, Hedayati & Kimiagar, 2009). When calcium levels are high, vitamin D levels are lowered. Vitamin D is known to stimulate lipogenesis and inhibit lipolysis.
Faghih, Abadi, Hedayati and Kimiagar (2009) conducted a study in which dairy milk, calcium fortified soymilk and a diet containing a calcium supplement were compared when part of an energy-deficit diet for overweight or obese women. The researchers found that while each intervention (and the energy-deficit control group) lost a significant amount of weight, the results for soymilk and the calcium supplement were no different from the control, and the reduction in weight, body mass index, waist to hip ratio and waist circumference was significantly higher for the dairy milk condition compared to the soymilk. Because both the dairy milk and the soymilk had similar calcium levels, the authors proposed that the presence of branched chain amino acids (such as leucine) and other bioactive compounds in dairy milk were the cause of the differences.

In contrast, Keshavarz, Nourieh, Attar and Azadbakht (2012) found that a diet with soymilk led to a reduction in waist circumference when compared to a diet with dairy milk. No significant change in weight loss or other factors was observed. Interestingly, the authors controlled for volume of milk in this study rather than have consistent levels of calcium. Gardner, Newell, Cherin and Haskell (2001) found that in moderately hypercholesterolemic post-menopausal women, while total and low-density lipoprotein cholesterol were significantly reduced in diets containing soy with isoflavones compared to soy without isoflavones, the reductions were also the same for the milk group, suggesting that milk and soy with isoflavones had equal efficacy. The authors conclude that the milk results were either due to chance or the reduction in all three groups was due to some facet of the study itself and ultimately
determine that the research does not support the role of soy isoflavones on the reduction of cholesterol.

Lukaszuk, Luebbers and Gordon (2007) found that 720 ml per day of either skim milk or soymilk led to decreases in weight, body fat percentage and abdominal circumference. Both drinks had the same amount of calcium and protein, although a leucine supplement was necessary to equate the protein levels in the soymilk.

Faghih, Abadi, Hedayati and Kimiagar (2009) commented on these findings suggesting that the leucine supplement (a branched-chain amino acid) could be responsible for part of the soymilk group’s weight loss.

Berger et al. (2014) studied the effects of soy protein/isoflavones shakes and casein (milk protein) shakes on weight loss in female college freshman. This study is important because it is one of the few studies that examined normal weight females in this age range (most studies use post-menopausal women, usually overweight or obese) and also because college freshman tend to gain a significant amount of weight during that year. In contrast to the other weight-related studies, this study found that both groups actually gained weight by similar amounts, however, the authors noted that the weight gain for both was lower than average reported amounts for freshman.

The evidence presented above is inconclusive at best as to whether dairy milk or soymilk is nutritionally better. While some studies fall in favor of milk (Faghih, Abadi, Hedayati & Kimiagar, 2009; Fulgoni III et al., 2010), others favor soymilk or find no conclusions at all (Berger et al., 2014; Keshavarz, Nourieh, Attar
& Azadbakht, 2012; Lukaszuk, Luebbers & Gordon, 2007). No studies were found that compare either dairy milk or soymilk to the equivalent calcium and nutrients found in fruits and vegetables, the source for an ancestral diet. Also, diets were not monitored for other confounding compounds such as phytate in grains (Lindeberg, 2012).

Regarding isoflavones, the research, again, is ambivalent at best. The most convincing finding is that Asian women who consume a large amount of soy products from an early age tend to have lower incidences of breast cancer compared to Western women (Hilakivi-Clarke, Andrade & Helferich, 2010). This is supported by the finding that when Asian women, with a life-long intake of soy, come to America, the incidence of breast cancer approximates that of American women (Hilakivi-Clarke, Andrade & Helferich, 2010).

Overall, the evidence does not overwhelmingly suggest consumption of either dairy milk or soymilk in an attempt to prevent weight gain, cardiovascular diseases or osteoporosis. Research, does, however, suggest that a diet free of dairy and, to a lesser extent, soy can dramatically improve weight loss, cardiovascular risks and prevent osteoporosis (jönsson et al., 2009; Lindeberg et al., 2012).
DISCUSSION

In the above sections, the pertinent literature relating to the Paleolithic diet and the effects of consuming other foods such as whole wheat, red and grass-fed meat, as well as dairy and soymilk was presented. Studies on the Paleolithic diet agree that adhering to this lifestyle can result in substantial weight loss as well as substantial reduction in cholesterol, insulin sensitivity and risk for cardiovascular disease and osteoporosis (Frassetto et al., 2009; Jönsson et al., 2009; Jönsson, Granfeldt, Erlanson-Albertsson, Ahrén & Lindeberg, 2010; Jönsson, Granfeldt, Lindeberg & Hallberg, 2013; Lindeberg, 2012). The diet, however, can be a radical departure from the usual Western diet and, while seeing positive results, some participants in trials report struggling to stay on track (Jönsson, Granfeldt, Lindeberg & Hallberg, 2013).

Studies showing the effectiveness of consuming other foods, such as whole grains or dairy or soymilk, with the intent on losing weight or preventing diabetes, on the other hand, have been inconclusive (Berger et al., 2014; Keshavarz, Nourieh, Attar & Azadbakht, 2012; Lukaszuk, Luebbers & Gordon, 2007; Priebe, van Binsbergen, de Vos & Vonk, 2008). Even diets intended for therapeutic reasons such as the Mediterranean diet or the diabetes diet do not show the same conclusive changes in risk factors as an ancestral diet does (Jönsson et al., 2009; Jönsson,
Further, concerns about the consumption of red meat (Ferguson, 2009) have been addressed. When meat is trimmed of external fat, cooked at lower temperatures, and not charred, smoked or preserved, red meat, in tandem with antioxidants such as tea and fruit and vegetable sources of vitamins C and E, can play an advantageous role in the nutrition of the hunter-gatherer diet (Carter et al., 2007; Mirvish, 1986). This is especially true when the meats are grass-fed. Besides being the more natural way for cows to be raised, grass-fed beef has been shown to have more polyunsaturated fats, including conjugated linoleic acid, and a more favorable ω-6 to ω-3 ratio, as well as containing more vitamins, minerals and antioxidants when compared to grain-fed beef (Daley, Abbott, Doyle, Nader & Larson, 2010; Van Elswyk & McNeill, 2014).

Overall, none of the studies reviewed refuted the avid consumption of fruits and vegetables, a major source of energy and nutrients in the Paleolithic diet. When consumed with lean, preferably grass-fed meats, nuts and seeds (to the exclusion of grains, dairy, refined sugars and processed foods) in conjunction with an conducting an active, rather than sedentary, daily routine, a Paleolithic lifestyle can use the past to help positively influence our rapidly worsening public health concerns, as well as significantly improve the quality of many lives.
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