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The Modern Caveman's Dilemma: Who Should Eat the Paleo Diet?

by
Heather K. L. Harden, Michael L. Foley, Rachel A. Poon, and Annie Prud'homme-Généreux
Life Sciences, Quest University Canada

Part I – Is the "Caveman Diet" Right for Karen?

"I'm bored all the time! What did you do when your kids left home for college?" Karen asked her friend Laura while out for coffee one day.

"I joined a gym," replied Laura. "Not only did I get into shape, I challenged myself every day, and I met a lot of interesting people. Those people are at the center of my social circle now. You should come with me to the gym tomorrow."

"I guess I'll give it a try," said Karen reluctantly. She had never really liked working out in gyms.

The next day, Karen joined Laura at the gym. Their instructor Kimberly was the strongest looking woman Karen had ever met. She challenged Karen throughout the workout, so that by the end Karen was completely exhausted but proud of her achievements. This encouraged her to return every day. At the end of the week, Kimberly congratulated Karen on a great workout.

"Great job today! I can see that you enjoy challenging yourself. If you want to see a more rapid improvement in your performance, I recommend the Paleo diet."

"The Paleo diet? What's that?" asked Karen.

"It's a diet based on the foods our ancestors ate. For most of our long history, we humans have been hunter-gatherers. We hunted, fished, and collected nuts and fruits. That was the prevailing lifestyle for over two million years, and it only ended about 10,000 years ago with the advent of agriculture. Our bodies evolved to live on these types of foods. Our gut is not adapted to live on grains and milk and other products of agriculture; our bodies have not had the time to evolve to digest these foods. It's called the Paleo diet because the period of time before the creation of agriculture is referred to by anthropologists as the Paleolithic era. A lot of people around here eat this way, including myself, and we all feel it helps us achieve our optimal athletic performance. We make dinners together from time to time and it adds to the sense of community."

When Karen thought of Paleolithic humans, she thought of broad shouldered hairy men who wore loincloths made of animal fur and grunted rather than spoke. She couldn't help but laugh to herself—Kimberly was suggesting a caveman diet!

When Karen got home, she did a quick search on the Internet to learn what the diet was really about. From her reading, Karen discovered that there were many versions of the Paleo diet, but she identified some of the main (and generally consistent) components:

- Reject all products of agriculture (i.e., milk and dairy products, grains, legumes, potatoes; sweet potatoes are OK).
- Cut out processed foods.
- Eat high quality, lean meats and seafood that are free of antibiotics and growth hormones.
- All vegetables can be consumed; however, high starch vegetables such as squash, beets, yams, and sweet potatoes should be consumed in moderation.
- All fruits can be consumed, but are often limited to less than 3 servings per day.
- Tend to eat nuts and nut milk (e.g., coconut milk).
- The net effect is that the majority of the energy comes from fats (i.e., meat sources) rather than carbohydrates (i.e., grains and high starch vegetable sources).

During her search, Karen noted that all books on the Paleo diet were recently published, an indication of its recent popularization. The sudden spike in popularity combined with the many Paleo blogs made Karen wonder if this could just be another fad diet.

A few days later, Karen's children came home from college for Thanksgiving. She was excited to tell them about her newfound love for the gym and to find out what they thought about the Paleo diet. Karen was sure that what they were learning and practicing in each of their academic fields would help her decide whether the diet was right for her.

Tommy, her oldest son, was studying to become a dietician. He was cautiously encouraging: "There are definitely good and bad ways to go about following the Paleo diet, and if this is something you want to do, you could probably find a healthy way to incorporate this philosophy into your lifestyle."

"Philosophy?" interjected Peter, an anthropology student, in a sarcastic tone. "I think one place where you will find the most issues with this diet is in its philosophy. You might want to think about whether eating 'like a caveman' has any evolutionary basis!"

Jenny, a student of sustainable farming, piped up: "I think that the idea of eating like our ancestors makes sense, but even if this diet doesn't exactly mimic the diet that our ancestors had access to, I think there are more important things that Mom should consider. Switching from processed foods to unprocessed plants and animals would lower her impact on the environment, and it might give her a chance to increase her support of local farmers."

"Of course reducing your intake of processed foods is good for you," agreed Hannah, a fourth-year exercise science student, "but will the Paleo diet really improve Mom's athletic performance as her trainer claims? I'm skeptical about how such a high fat, low carb diet affects athletes."

Karen felt a little overwhelmed. "Oh my!" she exclaimed. "This diet is much more complicated than I had imagined! Maybe I should just forget about it. I'm sure my current food choices are fine."

"Come on, Mom, this could be a really important decision for you to make! I'm sure that together we can determine whether this is a good choice for you," encouraged Jenny.

Part II – Sibling Analysis

1. Break into four groups. Each group will take on the role of one of the siblings in the family. Each group will be given a fact sheet summarizing the knowledge that that sibling can contribute on the subject.
2. Go over the fact sheet and answer the questions provided in your small groups. Do not share this information with any of your siblings (yet).
3. You will have 20 minutes for this section.

Part III – Family Dinner Role Play

1. Form groups of four people. One of every sibling must be represented in each group, reconstituting Karen's family.
2. Your instructor will provide you with an additional factor that your family must take into consideration (a different one for each family).
3. Over dinner, discuss whether your mother should adhere to the Paleo diet. Try to convince your siblings that your opinion of the Paleo diet is the most logical. Agree on a final decision and justify it.
4. You will have 20 minutes for this section.
5. Following this small group discussion, you will reconvene as a whole class and briefly present your conclusions. You may wish to identify a spokesperson within your group to report to the whole class.

Dinner Table 1: Hereditary Heart Condition

The father in your family has hypercholesterolemia, which is a condition where individuals have high levels of cholesterol in the blood. He always shares meals with Karen.

- Higher levels of low-density lipoproteins or "bad cholesterol" increase the risks of atherosclerosis and coronary heart disease.
- Hypercholesterolemia can be treated by lowering the amounts of saturated fats in the diet and increasing exercise.
- Meats are a source of saturated fats, and eggs a source of cholesterol

Dinner Table 2: Low Income Family

Your family is having a financial crisis and is trying to save money. Since all of her kids are in college, Karen only has to buy food for herself and her husband.

- Karen won a raffle for free gym training sessions for a year.
- Your family is in debt after sending all of the children to college.
- Your family is only able to spend under $4 per day per person (of 2001 dollars) on food.

Dinner Table 3: Wealthy Family

The father of your family is the CEO of General Mills (one of the world's largest food company and makers of such processed food brands as Cheerios, Green Giant, Pillsbury and Betty Crocker).

- Your family has an unlimited budget for food.

Dinner Table 4: Average Family

You are a middle-class family with no history of any particular health condition.

- You have money to spend on food; however, you do not want to spend an excess amount of your family's income on food.

Role-Play Sheet for Tommy *(Dietetics Student)*

Carbohydrates

By cutting out grains and starchy vegetables, the Paleo diet is a low carb diet. Many organs, notably the brain, can only use glucose (a carbohydrate) as an energy source. When it runs low, the body can resort to using fats, but in doing so creates ketone bodies, which acidify the blood and can increase the risk of gout, kidney stones, nausea, bad breath, and organ failure (Frigolet et al., 2011). Furthermore, very low carb diets have been linked with higher levels of anxiety, anger, stress, depression, and fatigue (Butki et al., 2003; Keith et al., 1991). Some studies suggest a positive effect of a low carb diet in the management of diabetes in the short term (< 1 year), but it is possible that it also results in organ damage in the longer term (Frigolet et al., 2011). One benefit of very low carbohydrate diets is that they may have an anticonvulsant effect on people with epilepsy (Huttenlocher, 1976).

There is another potential benefit of a low carbohydrate diet. Foods with a high glycemic load (foods high in carbohydrates that rapidly raise the level of glucose in the blood) may increase the risk of heart disease (Barclay et al., 2008). In particular, the consumption of a diet high in refined carbohydrates is associated with higher risks of heart disease (Beulens et al., 2007; Liu et al., 2000). Thus, the reduced consumption of foods with a high glycemic load in the Paleo diet could contribute to reduced cardiovascular risks.

Fats

Since animal products (particularly red meat and milk-products) tend to contain a lot of saturated fats, diets with a lot of meat deliver a greater amount. Saturated fats are known to increase blood cholesterol levels, leading to increased risk of heart disease (blood cholesterol can accumulate in artery walls and cause atherosclerosis (hardening of the arteries)) (Vannice & Rasmussen, 2014). Thus, a diet containing a lot of saturated fats may increase risks of heart disease. A potential way to avoid this is to replace saturated fat intake by polyunsaturated fat, which does not have this effect. Sources of unsaturated fats compatible with the Paleo diet are fish and nuts.

Foods high in the omega-3 fatty acids eicosapentaenoic and docosahexaenoic acid (EPA and DHA) are linked to anti-inflammatory effects and may help mitigate the risks of cardiovascular diseases, arthritis, psoriasis, and asthma (Beilin, 2004). These fatty acids are found in fish, which individuals on the Paleo diet typically consume in abundance. Also, grass-fed beef, advocated by Paleo diet proponents, contains less fat than grain-fed beef and is therefore a healthier alternative (Daley et al., 2010).

A study found that the Paleo diet lowers the risks of cardiovascular disease. However, the study lacked a control group, only six subjects completed it, and it lasted for only 21 days (Osterdahl et al., 2008).

Vitamins & Minerals

Paleolithic humans, with a diet rich in fruits and vegetables, consumed a sufficient amount of (most) vitamins and minerals (Jew et al., 2009). For example, Paleolithic humans consumed six times the amount of vitamin C that is typically consumed today (Jew et al., 2009). However, Paleo dieters have a lower intake of vitamin D (Jew et al., 2009). Vitamin D is important for absorption of calcium in the gut and is typically obtained from fortified milk. To obtain vitamin D, people on the Paleo diet should increase their consumption of fish or expose their skin to sunlight (our body synthesizes this vitamin using the energy of UV rays to convert a chemical in our skin into vitamin D).

In addition to vitamin D deficiencies (which can lead to impaired calcium absorption in the gut), the Paleolithic diet typically delivers only half of the requirement for calcium (Jew et al., 2009). Calcium is required to build and maintain teeth and bones, to make blood vessels, and assists with muscle function. Over time, low calcium may increase the risks of osteoporosis (brittle bones) (Reddy et al., 2002). Calcium deficiency results from cutting out dairy products. Other sources of calcium are compatible with the Paleo diet, notably the bones of fish (i.e., the whole fish must be consumed). For those on the Paleo diet, the risk of calcium loss is compounded by high protein consumption, which is known to cause kidneys to release calcium into the urine (Eisenstein et al., 2002).

Grains

Grains contain carbohydrates such as oligofructose and inulin that cannot be digested, but they feed the beneficial bacteria in our gut (Gaesser & Angadi, 2012). A healthy composition of bacteria protects the gut from some cancers, inflammatory diseases, and cardiovascular disease. Cutting out grains changes the composition of the bacteria in the gut, and preliminary studies have shown that this may negatively impact the immune system (De Palma et al., 2009). Furthermore, celiacs are intolerant to gluten (a protein found primarily in wheat, but also in barley and rye) and therefore have diets that are grain-free (so this mimics a Paleo diet in some respects). One study examined the long-term health effects of a gluten-free diet and found that most individuals were deficient in some important nutrients, including the B vitamin folate (Hallert et al., 2002). Folate deficiency can lead to anemia, neurological and behavioral disorders, and birth defects (Haslam & Probert, 1998).

Processed Foods

Paleo dieters eschew processed foods (foods prepared by the food industry, such as cookies and crackers). Abstaining from processed foods can have three health benefits. (1) It can lower the consumption of sodium, a mineral known to increase blood pressure and to be responsible for 62% of stroke and 49% of coronary heart disease (He & MacGregor, 2010). (2) It can reduce the consumption of trans fats, since most of these are consumed as part of processed foods, and these fats are known to elevate the risks of heart disease (Kuehn, 2013). (3) It can cut down on the consumption of refined sugars and energy-dense foods—foods that provide a lot of calories but few vitamins, minerals, and fibers—and there is general agreement that Americans eat too many calories, leading to the current obesity epidemic (Munoz-Pareja et al., 2013).

Ranking of Popular Diets

US News and World Reports asked 22 nutrition experts to rate 29 popular diets (e.g., DASH, Mediterranean, Weight Watchers) on criteria such as weight loss and nutrition (*Best Diets 2013*, 2013). The experts spent months examining medical journals and government reports and concluded that of the 29 diets studied, Paleo was the worst for weight loss; it was second-to-last for preventing and controlling diabetes; second-to-last for preventing or managing cardiovascular disease; and ranked 26th out of the 29 diets for nutritiousness, in part because it did not provide adequate amounts of calcium or vitamin D. Combining all of the criteria, the Paleo diet came in last overall.

Analysis of Cost and Nutritional Adequacy

Given that the Paleo diet requires access to different (and more expensive) foods than the typical American diet, a team of researchers used budgetary constraints guided by the United States Department of Agriculture's Thrifty Food Plan to determine if a low income person could meet all of his nutritional needs on the Paleo diet (Metzgar et al., 2011). On a budget of \$3.89[1] per day, the Paleo diet failed to provide enough calcium, fiber, and iron, but all other vitamins and minerals were provided in sufficient quantity. On a budget of \$4.25 per day, all vitamin and mineral needs could be met except for calcium.

Questions to discuss with other Tommys

1. Compared to a typical North American diet, how does the Paleo diet fare? In order to improve a person's health status, is the Paleo diet the best option?
2. Can you think of ways to remedy potential nutritional deficiencies while staying within the boundaries prescribed by the Paleo diet?
3. Come to a consensus on your character's opinion of the Paleo diet. Develop an argument, based on the evidence provided, that will convince your family that your perspective of the Paleo diet is the correct one.

1 The \$3.89 per day per person budget is in 2001 dollars, and is equivalent to \$4.91 in 2010 dollars.

Role-Play Sheet for Peter *(Anthropology Undergraduate)*

Misconception #1: Evolution Has Not Adapted Us to the Products of Agriculture

Paleo Diet Claim: Too few human generations have taken place since the advent of agriculture 10,000 years ago to allow evolution the time to adapt our digestive system to grains, milk, and other products of agriculture. Evolution works over millions, not thousands, of years—and for millions of years humans were hunter-gatherers. We should therefore strive to eat a diet similar to our Paleolithic ancestors because our body is optimally adapted to it.

- Many generations have passed since the development of agriculture, giving evolution time to work. Assuming that a new generation occurs every 20 years (which is conservative, and likely was much smaller than this in the past), there have been over 500 generations since the advent of agriculture and the introduction of dairy, grains, and starches in the human diet.
- People assume that evolution only occurs over long periods of time, but this is a misconception. Evolutionary adaptations can occur rapidly if the evolutionary pressure to adapt to a changed environment is strong. In fact, evolutionary adaptation can occur over a single generation.
- We know that evolution can occur rapidly because we have observed it in finches (a type of bird). One year a drought made only certain seeds available to birds. Those birds that had a beak with the optimal size and shape to crack those seeds were able to feed themselves and survive while the others did not. Therefore, only birds with certain genes (for the optimal beak) passed their genes to the next generation of birds (who also had that beak size). Very rapidly, in a period as short as a year, researchers observed evolution in the finch population (Grant & Grant, 2002).
- An analysis of the human genome revealed that the rate of human evolution has accelerated in the past 20,000 years compared to the thousands of years before that time (Hawks et al., 2007). This conclusion was reached by counting the number of sites in the genome that are under selective pressure and by dating when the mutations became common in the population. These changes peaked around 10,000 years ago.
- In addition to creating an environment with new selective pressures, agriculture also allowed the human population to increase in size. The larger the population size, the more genetic variation exists in a population. Variation is the fodder for evolution by natural selection. "Think of mutations as lottery tickets: the vast majority of them are losers, but the only way to increase your chances of winning is to buy a larger number of entries […] Hence a bigger population can evolve faster" (Zuk, 2013, p. 55). Therefore, agriculture may have given evolution the raw materials on which it can act to adapt a population.
- In the 10,000 years since the introduction of agriculture, there have been demonstrated changes in our genome that allow us to digest dairy products, grains, and starch.
    - The breakdown of starches (the carbohydrate present in grains) relies on the presence of salivary amylase, an enzyme in saliva that initiates starch breakdown. Although people that are descendants from recent hunter-gatherer societies have a few copies of the gene that encodes this enzyme, people who are descendants from agricultural societies (e.g., Europeans who ate wheat and Chinese who ate rice) have several more copies of these genes, allowing them to produce more salivary amylase and digest starches more efficiently (Perry et al., 2007; Santos et al., 2012).
    - While babies and children can digest lactose (the sugar present in milk), the gene that makes this possible is turned off in late childhood. This makes adults lactose intolerant. However, in certain groups of people, notably in those whose ancestors domesticated goats and cows, mutations arose that allowed the gene to remain "on" into adulthood, giving adults the ability to digest milk. This conferred an advantage on those who had the mutation because they could extract energy from milk (it also provided a ready source of liquid to those who could drink it, which may have been important in desert-living tribes). This ability arose independently in different populations in the past 7,500 years suggesting that it confers a strong advantage (Tishkoff et al., 2006; Itan et al., 2009).
    - The gut microbes of Japanese individuals differ from those of people from the rest of the world. The bacteria in the gut of Japanese individuals have a unique gene that allows them to break down a carbohydrate that

is common in seaweed. The energy from this carbohydrate is otherwise unavailable to the human body (Hehemann et al., 2010).

Misconception #2: The Diet of Your Paleo Ancestors is Known

- The Paleo diet assumes that our body evolved to eat a particular diet, and that this diet is the one eaten by our ancestors. However, there is a fundamental problem with this assumption: which diet and which ancestors? Different groups of Paleolithic humans had very different diets due to their geographic locations and the surrounding flora and fauna (i.e., a Paleolithic human in sub-Saharan Africa had access to a very different diet than a Paleolithic human living in Siberia), making it difficult to determine what one means by "Paleolithic diet" (Marlowe, 2005). In addition, if the Paleo diet assumes that generations of our ancestors were slowly adapted to the diet of their surrounding area, which regional diet should a given modern human consume? An individual's DNA probably comes from Paleolithic humans from a variety of different locations.
- The composition of the diet of Paleolithic humans is currently debated and not known with certainty. There is evidence suggesting that early hominids and Paleolithic humans ate some meat, but the amounts of meat that our ancestors ate are undetermined due to incomplete and scattered archaeological evidence. Although bones have been found in some Paleolithic sites, the ratio of plant-to-animal consumption cannot be determined due to the fast decomposition of plant matter compared to bones (Nestle, 2000).
- Current hunter-gatherer societies (such as the !Kung peoples of the Kalahari desert in Africa) rely heavily on plant sources for food because they take minimal time and effort to acquire. In contrast, animals are hard to find and kill, making them a less dependable food source (Lee & DeVore, 1976). This heavily plant-based diet contrasts with the heavily animal-based diet of the modern Paleo diet.
- Many of the foods available to our ancestors are no longer available, and those that exist today have little in common with the progenitors that generated them (the ancestor of many of our common fruits are quite tart or otherwise unpalatable and were bred for their sweetness and other characteristics we enjoy) (Zuk, 2013). Strict Paleo eaters would not be able to find the fruits and vegetables that their ancestors ate because they are either unknown or no longer exist.

Questions to discuss among the Peters

1. Should people be concerned about the evolutionary basis of this diet?
2. Is there convincing evidence that the modern-day version of the Paleo diet is an accurate portrayal of what our ancestors ate? Does this matter?
3. Come to a consensus on your character's opinion of the Paleo diet. Develop an argument based on the evidence provided that will convince your family that your perspective is the correct one.

Role-Play Sheet for Jenny *(Environmentalist, Sustainable Farming)*

Jenny is passionate about minimizing the human impact on the environment. She believes that individual choices can bring about larger changes in the world.

Sources of Food for the Paleo Diet

- Paleo dieters eat game meats or seafood, obtained by hunting or fishing. Some Paleo dieters also eat grass-fed animals obtained from local small-scale farmers.
- The products of industrial agriculture (e.g., wheat, corn, soybean, potato, and milk) are not consumed. Ideally, people on the Paleo diet should gather local fruits and vegetables (e.g., berries or mushrooms from local forest), and they are encouraged to grow their own food in a garden or to obtain their food from local small-scale farmers.

Meat Consumption

Organisms are inefficient in extracting energy from the food they eat. Typically, they are able to extract only 10% of the energy stored in their food source to make more of themselves (the rest is lost to incomplete digestion and respiration) (Lindeman, 1942). Thus, if a herbivore such as a cow eats 1,000 kcal of grasses, it will only make about 100 kcal of new cow tissue. A similar waste is observed when carnivores consume prey animals. This means that when a man eats meat from a cow, he is wasting 90% of the energy stored in the cow, and that animal already had wasted 90% of the energy stored in the chemical bonds of the grass it ate; or in other words, a carnivorous man is accessing only 1% of the energy originally stored in plants. It is more efficient to consume the plant directly. Thus, a vegetarian diet is more sustainable than a carnivorous one, but the Paleo diet encourages the consumption of meat.

Nut Consumption

Many modern humans on a Paleo diet replace their consumption of milk with substitutes such as almond and coconut milk. They also consume tree nuts (e.g., cashews, macadamia, pistachios), since these healthy foods are allowed in a hunter-gatherer diet. However, these nuts and their products must be transported, sometimes across great distances (e.g., coconuts grow in Thailand, almonds in California, macadamia nuts in Australia, etc.), making this a fossil-fuel-dependent eating habit. Thus, the consumption of nuts can contribute to making this diet unsustainable.

Fish Consumption

The Paleo diet promotes the consumption of fish and seafood. However, current fishing practices have led to stock depletions that threaten the survival of many species in both inland fisheries (Allan et al., 2005) and marine ecosystems where 28–70%[1] of all stocks are overexploited and where 7–30% of all stocks are collapsed (Branch et al., 2011).

Industrial Food System

Following the principles of the Paleo diet should reduce a person's reliance on the industrial food system (the large scale production of food). (*Note:* most of the foods available in a typical grocery store come from the industrial food system.) Here are some of the shortcomings of the industrial food system (Horrigan et al., 2002).

- Environmental Degradation
  - Many pesticides and fertilizers used to increase agricultural yields contaminate the soil, water, and air, leading to unintended effects on the health of wildlife (Kohler & Triebskorn, 2013). Similarly, livestock waste contains large amounts of nutrients such as phosphorus and nitrogen that contaminate water runoff and lead to noxious algal blooms; insecticidal agents that are used to protect livestock from parasites and may have

1 The large variability depends on the methods used to assess these values.

detrimental effects on non-target insects (Lumaret et al., 2012); and antibiotics that can affect bacterial species in the environment (Burholder et al., 2007).

- The use of monocultures (growing only one crop on a farm) makes it easy for the farmer to tend to the crops: the uniformity of the crop means that mechanized equipment can be used to sow and harvest the crops and this maximizes the amount of food that can be produced on a given piece of land. However, monocultures reduce diversity and decrease the crop's resilience to environmental stressors such as pests and climate change.

- Human Health Concerns
  - Feedlots maintain animals in high density, have high concentrations of animal wastes, and use grain-based feed on ruminant animals (i.e., they feed corn to cattle that is evolutionarily adapted to eating grass). This makes the animals more likely to be sick and necessitates the extensive use of antibiotics (almost 80% of all antibiotics used in North America are used on livestock and poultry) (Loglisci, 2010). This overuse of antibiotics leads to the evolution of antibiotic-resistant strains of bacteria. This eventually leads to the failure of our current arsenal of antibiotics to defend us against pathogenic bacteria (Neu, 1992).
  - Industrial agriculture relies on the use of pesticides. Pesticide residue can be left on food. Furthermore, repeated low-level exposure to pesticides may lead to impaired neurodevelopment. Children are particularly at risk due to their tendency to put things in their mouth (Eskenazi et al., 1999).
- Unsustainability
  - The average American industrial farm exerts 10 kcal of fossil fuel energy to produce 1 kcal of processed food (Pollan, 2006). The fossil fuel is used to produce fertilizers and pesticides, to fuel the farm machinery necessary for planting and harvesting, and to transport the food to the consumer. We are running an energy deficit, paid for using the stored energy of fossil fuel, and this is not sustainable.

Local Small-Scale Farms

- Small-scale farming operations are less likely to use antibiotics and growth hormones, in part because their animals are not kept in as close quarters as in large feed lot operations (McCluskey et al., 2005).
- Although more expensive, the produce purchased from small local farms promotes the local economy. Industrial farmers see little of the profits from their crops as the profits are mostly made from processing food, not growing it (Hinrichs, 2000; Pollan, 2006).

Questions to discuss among the Jennys

1. Do you think the Paleo diet is environmentally sustainable? What are some caveats to your answer?
2. Does Jenny have any reason to reject the Paleo diet?
3. Come to a consensus on your character's opinion of the Paleo diet. Develop an argument based on the evidence provided that will convince your family that your perspective is the correct one.

Role-Play Sheet for Hannah *(Exercise Science Student)*

There is no published research on the effects of the Paleo diet on athletic performance. However, since the Paleo diet cuts out grains and starchy vegetables, which are rich sources of carbohydrates, the Paleo diet is generally one of reduced carbohydrates. The emphasis on game meat and fish also make it a high protein diet. There is data on the effects of these types of diets on athletic performance.

High Protein Diet and Athletic Performance

Energy in food is obtained from one of three sources: proteins, carbohydrates, or fats. Current recommendations suggest that 10–35% of the total energy come from protein sources (Institute of Medicine, Food, and Nutrition Board, 2002). It is estimated that in the diet of Paleolithic humans, proteins accounted for 37% of the energy, making it a high protein diet (Eaton et al, 1997).

Do athletes need more protein? This is a hotly debated topic. While some data obtained from studies of nitrogen balance (i.e., how much nitrogen is taken in from protein in the diet and how much nitrogen is excreted because it was in excess of what the body needed) support the idea that endurance[1] and resistance[2] athletes require more proteins, other researchers have found that habitual exercise increases the efficiency of protein utilization by the body and therefore *decreases* the need for protein in the diet (Tipton & Wolfe, 2004).

Whether or not athletes need more proteins in their diet, we do know that the ingestion of essential[3] amino acids stimulates the synthesis of muscle proteins after resistance exercise (and possibly after endurance exercise, but this is less clear) (Tipton & Wolfe, 2004). Since large muscles are an advantage in resistance but not endurance sports, high protein diets may or may not benefit the athlete depending on his or her goals.

Animal protein, particularly red meat, is a good source of branched chain amino acids (BCAA).[4] Consuming BCAA has been shown to increase testosterone levels in men, which is generally linked with improved athletic performance (Sharp & Pearson, 2010). Some researchers think that ingesting BCAA increases an athlete's mental focus because BCAA lower the brain's production of serotonin, which is a neurotransmitter associated with fatigue (Fernstrom, 2005). This would suggest that BCAA are beneficial for athletes, but this idea is under contention. Conversely, BCAA have been shown in rats to lower the production catecholamines, which are neurotransmitters necessary for athletic performance (Choi et al., 2013). It is therefore unclear whether eating foods high in BCAA is beneficial for athletes.

Carbohydrates and Athletic Performance

While the current dietary recommendation is that 45–65% of calories come from carbohydrates (Institute of Medicine, Food and Nutrition Board, 2002), it is estimated that Paleolithic humans typically consumed about 41% of their energy from carbs (Eaton et al., 1997), making the Paleo diet a lower carb diet. Typically carbohydrates are obtained from grains, potatoes, or legumes, which are not part of the Paleo diet. Acceptable sources of carbohydrates for Paleo dieters are yams and sweet potatoes.

The carbohydrate glucose is the only energy source that the brain can use. Therefore, low carb diets may negatively impact mood and to cause fatigue (Butki et al., 2003; Grant et al., 2009). For example, a study on women cyclists on a low carb diet found them to be more depressed, more tense, more fatigued, and to have less vigor than when they were on a high carb diet (Keith et al., 1991). However, the evidence for this varies between studies and others have found no effect (Halyburton et al., 2007). It therefore remains to be determined whether low carbohydrate diets impact mood.

1 Endurance exercise is that which is generally aerobic. Examples include long distance running, cycling, and swimming.
2 Resistance exercise is generally anaerobic and involves strength training. An example is weight lifting.
3 The building blocks of proteins are amino acids. Some of them can be synthesized by the body (non-essential amino acids), and some cannot be made by human cells and must be ingested (essential amino acids).
4 BCAA include leucine, isoleucine, and valine.

The ingestion of carbohydrates and proteins following a bout of resistance training improves muscle protein balance, but this is only observed if carbohydrates are present (Miller et al., 2003). This effect seems to be caused by the secretion of the hormone insulin in the blood, which is caused by the presence of carbohydrates and signals the muscle that it is time to build up (Biolo et al., 1999).

Carbohydrates are stored in the form of glycogen in the liver and muscles. This is the primary form of fuel during exercise. Traditional exercise training for endurance athletes recommends "carbohydrate loading," which is a technique by which the glycogen stores are maximally built up before a sporting event (e.g., this is why runners eat pasta the night before a marathon) (Hawley et al., 1997). Eating a low carb diet for less than a week depletes the glycogen stores and has been shown to reduce the performance of endurance athletes (Evans & Hughes, 1985; Burke & Hawley, 2002; Cook & Haub, 2007). However, after a longer period of eating a low carb diet, the body adapts and this diet no longer has a negative effect on endurance sport performance (though people on a low carb diet do not exceed their performance on a high carb diet) (Helge, 2000; Cook & Haub, 2007). This has been observed among endurance athletes for cycling (Kavouras et al., 2004) and running (Pitsiladis et al., 1996) and also on the strength performance of gymnasts (Paoli et al., 2012). Eating a low carb diet decreases glycogen stores, and it has been proposed that in adapting to this state the body learns to use other sources of energy such as fats. The reduced use of glycogen stores could have a sparing effect, and in so doing, improve endurance. However, performance benefits have not been consistently found (Phinney, 2004).

Questions to discuss among the Hannahs

1. Given that Karen's one-hour workouts at the gym involve "bootcamp-style" exercises (e.g., 50 sit-ups, followed by 20 burpies, followed by 20 jumping jacks, etc.) and that her goal is to improve her athletic performance (both in terms of strength and in terms of aerobic capacity), would eating a lot of protein be a desirable thing?
2. Given the type and duration of exercise that Karen engages in at her gym and her stated goal, would eating a low carb diet be a desirable thing?
3. Come to a consensus on your character's opinion of the Paleo diet. Develop an argument based on the evidence provided that will convince your family that your perspective of the Paleo diet is the correct one.

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