The Evolution of the Human Diet

*From Wild Meat, Fruits, and Tubers to Candy, Donuts, and Pizza*

Bachelor in Public Health Nutrition
Oslo and Akershus University College
SERNB 3900: Bachelor’s thesis in Public Health Nutrition
Candidate number: 126. Class: H2012
Forewords

I chose the evolution of the human diet as the overarching theme for my bachelor’s thesis because I’ve long been interested in evolutionary medicine, a branch of medicine that’s based on the application of modern evolutionary theory to understanding health and disease. In particular, I’ve been concerned with how changes in the human diet over the past millennia have affected human health and what an evolutionary perspective can teach us about optimal human nutrition. This paper allowed me to bring together a lot of the research I’ve done in this area, and also dig deeper into certain topics that were particularly relevant to the research questions I chose to focus on. The research and accumulation of data for this thesis would have been impossible had it not been for the extensive work carried out by prominent scientists working within the areas of evolutionary biology and ancestral human nutrition. The published work of Dr. Staffan Lindeberg, Associate Professor of Family Medicine at the Department of Medicine, University of Lund, Sweden, Dr. Loren Cordain, former professor at the Department of Health and Exercise Science at Colorado State University, and Dr. Daniel Lieberman, Professor of Human Evolutionary Biology at Harvard University, has been particularly valuable to the research process that went into this bachelor’s thesis.
Abstract

Chronic non-communicable health conditions such as obesity, type-2 diabetes, cancer, the metabolic syndrome, and cardiovascular disease are among the biggest public health problems in the world today. Many, if not most, of these conditions can be classified as diseases of civilization or evolutionary mismatches, as they are rare or nonexistent among hunter-gatherers and traditional societies minimally affected by modern lifestyle habits and increase in prevalence as countries become more industrialized. Diet has been implicated in the pathogenesis of a wide range of chronic illnesses, and several lines of evidence show that differences in dietary habits can help explain the varying rates of chronic disease between non-westernized, traditional societies and industrialized populations. It's being increasingly recognized in the scientific literature that there has been inadequate time and selection pressure for the human genome to adjust to many of the rapid and powerful changes in the human diet over the last 10,000 years. The resulting mismatch between our ancient genome and our modern diet is particularly visible in countries where the Western dietary pattern, which is characterized by high intakes of fatty meats, refined sugars, alcohol, refined grains, and highly processed foods and low intakes of seafood, fruits, and vegetables, has been adopted by a lot of people. This type of diet sets the stage for chronic disease by adversely affecting gene expression, immunity, and the gut microbiota. Getting back to healthful diet in the 21st century requires combining modern science with an evolutionary perspective on nutrition and realigning our contemporary diet with the type of diet Homo sapiens sapiens evolved to eat.

Word count: 7991 (Excl. tables)
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**Introduction**

Obesity, type-2 diabetes, the metabolic syndrome, cardiovascular disease, and several other chronic, non-communicable health conditions are a major global health burden (WHO, 2011). The fact that most of these chronic disorders are rare or nonexistent among hunter-gatherers and non-westernized, traditional populations and seem to increase in frequency as countries become more industrialized suggests that it’s something about our modern environment that’s driving the high prevalence of these so-called diseases of civilization (Carrera-Bastos, Fontes-Villalba, O’Keefe, Lindeberg, & Cordain, 2011; Price, 2008). Several environmental factors have been implicated in the epidemic of non-communicable illnesses, with diet often being considered an especially important player (Cordain et al., 2005; Ruiz-Nunez, Pruimboom, Dijkstra-Brouwer, & Muskiet, 2013).

Modern diets are profoundly different from those consumed by our hunter-gatherer ancestors for millions of years prior to the Agricultural Revolution approximately 12,000 years ago (YA) (Konner & Eaton, 2010). Today, most of the food consumed worldwide is derived from domesticated plants and animals, as opposed to the wild varieties that made up the diet of preagricultural people, and an increased consumption of evolutionarily novel foods and innovations related to food manufacturing, storage, and processing have dramatically changed the overall makeup and nutrient composition of human diets (Konner & Eaton, 2010).

When measured on an evolutionary timescale, the powerful nutritional transitions that were triggered by the Agricultural Revolution – and even more so the Industrial Revolution some 250 YA - have been very rapid. The effects of these transitions are most dramatic in nations where the Western pattern diet, which is characterized by a high intake of saturated fat, omega-6, salt, and refined sugar and a low intake of fiber and omega-3, has been adopted by many people, and less so in traditional, non-westernized populations where people eat a more “prudent” diet higher in whole foods such as fruits, vegetables, and fish.

While the human diet has changed dramatically over the last 12,000 years – and especially during the most recent decades, the human genome has remained relatively unchanged since the Paleolithic era (2.6 million years ago (MYA)-10,000 YA) (Carrera-Bastos et al., 2011; Lindeberg, 2011). This has led some researchers to propose that there’s a mismatch between our ancient genome and contemporary Western-style diets, a mismatch that is thought to manifest itself as chronic diseases of civilization, such as type-2 diabetes, cardiovascular disease, and some forms of cancer (Cordain et al., 2005; Ruiz-Nunez et al., 2013).

The overarching research questions for this paper are: How has the human diet changed since the Paleolithic era, and what are the implications of these changes to human health? The evolution of
the human diet and the impact of diet on health are broad and comprehensive topics that are impossible to cover in depth in a single review paper. This paper focuses specifically on the changes in the human diet that were triggered by the Agricultural and Industrial Revolution, as these are often considered to be the two evolutionary events with the most dramatic impact on human diets, and the broad implications of these changes to human health. Special attention is given to hunter-gatherer diets, traditional dietary patterns, and the Western diet. The purpose of applying this evolutionary perspective to nutrition and human health is to increase our understanding of how diet impacts health and how we should eat to achieve good health in the 21st century.

Methods

Literature review of relevant data. Sources include books, scientific articles, and other forms of literature covering topics related to the evolution of the human diet. Electronic searches of MEDLINE were performed. Key search terms include paleolithic nutrition, paleolithic diet, western diet, and traditional diets. Studies and reviews particularly relevant to the paper were identified using a combination of the following keywords: ‘evolution’, or ‘origin’, or ‘origins’ and ‘nutrition’ or ‘diet’, or ‘food habits’, or ‘western diet’. ‘paleolithic diet’, or ‘hunter-gatherers’, or ‘traditional diet’, or ‘western diet’, or ‘diet’, or ‘dietary pattern’, or ‘nutrition’ and ‘inflammation’, or ‘gene expression’, or ‘disease’, or ‘health’, or ‘gut microbiome’, or ‘gut microbiota’. Particular attention was given to review articles covering topics related to the evolution of the human diet and randomized controlled trials (RCTs), systematic reviews, and meta-analyses investigating the impact of diet on human health. The reference lists of the pertinent articles were also inspected.

The Paleolithic era

The Original Human Diet

Hunting-gathering was the common human subsistence mode for 99.5% of the evolutionary history of our genus (Homo), which is believed to have emerged approximately 2.5 MYA in Africa with the appearance of Homo habilis (Carrera-Bastos et al., 2011). One should be cautious not to draw firm conclusions about the way of life of our ancient ancestors, as detailed data about the diet and lifestyle of Paleolithic humans are naturally hard to come by. However, thanks to examinations of fossils, studies of contemporary hunter-gatherers, and genetic analyses there are a lot that can be said with a high degree of certainty.

Several lines of evidence suggest that an increased reliance on animal source foods starting approximately 2.4-2.6 MYA was largely responsible for fueling the rapid brain growth of early Homo
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(Cordain, 2007; Larsen, 2003). Some researchers have also proposed that an increased consumption of honey, which is one of the most energy-dense foods in nature, and cooked tubers and other plant foods was an additional force that allowed our ancestors to grow large, energetically expensive brains (Crittenden, 2011; Laden & Wrangham, 2005). However, while there’s no doubt that innovations related to food processing (e.g., cutting tools) and preparation played a key role in the shift to a higher quality diet, the theory that cooked foods were an important part of the diet of early Homo is brought into question by data which suggest that the ability to habitually produce fire didn’t occur until later in human evolution (Sandgathe et al., 2011; Sorensen, Roebroeks, & van Gijn, 2014).

The diets of extinct hominins (bipedal primates within the taxonomic group hominini) varied by climate, geographic locale, and ecologic niche (Cordain et al., 2005). When members of our species (Homo sapiens sapiens), which emerged in Africa approximately 200,000 YA, started migrating out into the rest of the world starting about 70,000 YA, they had to adapt to new environmental conditions, both through genetic and cultural evolution (e.g., clothes) (Lieberman, 2014). Ethnographic data of modern forager populations show that hunter-gatherers living in northern areas (tundra and northern coniferous forest) generally consume more animal source food, and hence more protein and fat, than hunter-gatherers living in desert and tropical grasslands (Strohle & Hahn, 2011).

While there was no single diet consumed by all Paleolithic hunter-gatherers, there are certain universal features that characterize all preagicultural hominin diets (Konner & Eaton, 2010). Several lines of evidence suggest that our ancient ancestors subsisted on wild plants and animals, and that meat, seafood, eggs, nuts, seeds, fruits, and vegetables (including roots and tubers) were the primary components of Paleolithic diets (Cordain et al., 2005; Konner & Eaton, 2010; Lindeberg, 2011). This translates into a diet that has a low caloric density, glycemic load, and sodium/potassium ratio (<1) and high antioxidant capacity and micronutrient density (Carrera-Bastos et al., 2011; Cordain et al., 2005). Recent estimates of the plant-to-animal economic subsistence patterns of historically studied hunter-gatherer societies suggest that the most plausible percentages of total energy from the different macronutrients would be 22–40% for carbohydrate, 19–35% for protein, and 28–58% for fat; levels that probably reflect the macronutrient ratio of most Paleolithic diets (Cordain et al., 2000). Hunter-gatherer diets are generally high in fiber (>70 g/day) and contain a roughly equal amount of omega-6 and omega-3 (Konner & Eaton, 2010).

**Hunter-gatherers: Health and physical fitness**

Examinations of ancient fossils have revealed that Paleolithic humans generally had strong bones, well-developed shoulders, broad dental arches, straight teeth, and good dental health (Carrera-Bastos et al., 2011; Cordain, 1999; Lieberman, 2014). Many of the chronic health conditions...
that afflict contemporary humans were probably rare or absent among Paleolithic hunter-gatherers, a statement that is supported by the fact that historically studied hunter-gatherers, and other non-westernized populations minimally affected by modern lifestyle habits, exhibit superior physical fitness compared with industrialized populations and have very low incidence of cardiovascular disease, myopia, type-2 diabetes, obesity, and many other chronic, non-communicable diseases and disorders (Carrera-Bastos et al., 2011; Price, 2008; Spreadbury, 2012). This holds true even for the older parts of the population, as hunter-gatherers of age 60 or beyond rarely show signs of the chronic, degenerative diseases that afflict the majority of elderly in industrialized countries (Carrera-Bastos et al., 2011). When traditional people make the transition to a more westernized lifestyle their health quickly deteriorates and their risk of many chronic, non-communicable diseases increases dramatically (Carrera-Bastos et al., 2011; Lieberman, 2014; Price, 2008). The fact that even the elders in these populations have relatively low rates of degenerative disease and that hunter-gatherers experience a rapid decline in health if they adopt a more westernized lifestyle suggests that neither the low average life expectancy at birth nor a genetic protection can explain the low prevalence of chronic diseases in these cultures (Eaton, Cordain, & Lindeberg, 2002).

On the flip side, one should be cautious not to label this way of life as a utopian existence. Hunter-gatherers are constantly exposed to the elements and have little to no access to modern sanitation and medicine. Infections and high childhood mortality tend to be major health challenges among hunter-gatherers and isolated, traditional societies and can largely account for the short average life expectancy at birth in these populations (Eaton et al., 2002).

The Kitava study carried out by Staffan Lindeberg, Ph. D. and colleagues in 1989 is one of the most comprehensive and well-known studies of non-westernized people eating Paleolithic-style diets. In this study, the researchers documented the diet and health of the Kitavans on the Island of Kitava, one of the Trobriand Islands in Papua New Guinea’s archipelago. The Kitavans eat an ancestral diet composed exclusively of fish, root vegetables, fruit, vegetables, and coconuts, with a macronutrient distribution of approximately 69% carbohydrate, 21% fat, and 10% protein (Lindeberg, Berntorp, Nilsson-Ehle, Terent, & Vessby, 1997).

Dr. Lindeberg and his team of Swedish researchers carried out a wide range of health analyses and found that stroke, ischaemic heart disease, diabetes, dementia, congestive heart failure, and overweight were either rare or absent in this population (Lindeberg et al., 2003; Lindeberg et al., 1997; Lindeberg, Nilsson-Ehle, Terent, Vessby, & Schersten, 1994). Moreover, the Kitavans exhibited superior health markers when compared with industrialized populations, including much lower diastolic blood pressure, cholesterol, and serum insulin and leptin levels (Lindeberg et al., 2003; Lindeberg et al., 1997; Lindeberg et al., 1994). Child mortality from various infections was
relatively high in this Melanesian population, and the dominant causes of death were accidents, infections, pregnancy complications, and old age (Lindeberg et al., 1997).

While not all studies of societies with diets and lifestyles resembling that of our Paleolithic ancestors have revealed equally superb health markers as those found in the Kitava study, these types of studies consistently show that hunter-gatherers and non-westernized populations eating Paleolithic style diets have very low rates of non-communicable, chronic disease when compared with industrialized societies (Carrera-Bastos et al., 2011; Spreadbury, 2012). The lifestyle of hunter-gatherer societies would have varied due to differences in geography and ecological niche, among other things. However, they all have certain characteristics in common, such as regular sun exposure (with a few exceptions), sleep patterns synchronized with the natural variation in light and dark, low levels of chronic stress, regular physical activity, low exposure to pollutants, and consumption of fresh, minimally processed, and nutrient-dense food (Carrera-Bastos et al., 2011). While all of these factors are thought to contribute to the good physical fitness and low incidence of lifestyle diseases among these people, diet is often considered to play an especially important role (Cordain et al., 2005; Lindeberg, 2011). This belief is supported by recent randomized controlled trials which show that a Paleolithic, hunter-gatherer style diet exerts beneficial effects on fat mass, abdominal obesity, triglyceride levels, blood pressure, and several other markers of health in patients with type-2 diabetes, impaired glucose tolerance, BMI >30, and/or ischaemic heart disease and may be superior to other healthy diets like the Mediterranean diet (Jonsson et al., 2009; Jonsson, Granfeldt, Erlanson-Albertsson, Ahren, & Lindeberg, 2010; Lindeberg et al., 2007; Mellberg et al., 2014).

The Agricultural Revolution

The domestication of plants and animals with the Agricultural Revolution approximately 12,000 YA set the stage for profound changes in the human diet. Dairy foods and cereal grains, which were rarely or never consumed by Paleolithic humans, were now increasingly incorporated as staple foods wherever Agriculture took root, something that changed both qualitative and quantitative aspects of human diets (Cordain et al., 2005; Lieberman, 2014). While most preagicultural humans hunted and gathered many different species of plants and animals, people who had fully made the transition to farming typically relied on just a few species of cereal grains as their main source of food (Cordain, 1999).

When compared to Paleolithic diets, post-agricultural diets tend to be markedly higher in starch, dairy fats, and milk sugars and lower in omega-3 fatty acids, most micronutrients, and protein (Cordain et al., 2005; Lindeberg, 2011). The incorporation of cereal grains, legumes, and dairy into the human diet also led to an increased consumption of gliadin and alkylresorcinols, certain lectins,
hormones, and bio-active peptides, and various other proteins and anitnutrients for which the human genetic makeup had virtually no evolutionary experience (Carrera-Bastos et al., 2011; Cordain, 1999).

The archaeological record shows that when hunter-gatherer societies made the transition to an agricultural pattern of subsistence there was a characteristic decrease in lifespan, a reduction in stature, and an increased incidence of dental crowding, malocclusion, infectious diseases, iron deficiency anemia, dental caries, enamel defects, and several bone mineral disorders (Cordain, 1999; Lieberman, 2014; Lindeberg, 2011; von Cramon-Taubadel, 2011). Many of these injurious changes can, at least partially, be attributed to the replacement of animal-based hunter-gatherer diets with less nutritious cereal-based diets (Cordain, 1999; Lieberman, 2014; Lindeberg, 2011; von Cramon-Taubadel, 2011).

**Traditional diets**

Some researchers have proposed that cereal grains and dairy foods are less than optimal foods for human consumption, and that there has been inadequate evolutionary time and selection pressure for the human genome to sufficiently adapt to these relatively novel foods (Carrera-Bastos et al., 2011; Cordain, 1999). These arguments are partly based on the data which show that the incorporation of these foods groups into the human diet with the Agricultural Revolution was accompanied by a nutrition-related health decline (Carrera-Bastos et al., 2011; Cordain, 1999). However, it’s important to note that several traditional societies, such as the Okinawans in Japan, which are among the most long-lived populations ever studied, and various Mediterranean populations, have seemingly maintained very good health on diets high in grains, legumes, and/or dairy (Price, 2008; Willcox et al., 2007).

Studies of various and diverse traditional, non-westernized societies across the globe show that the way food is produced, prepared, and processed in these cultures tend to be very different from how it’s done in more modernized societies (Price, 2008). This may be particularly relevant when it comes to the foods introduced during the Neolithic era some 12,000-4,000 YA, as these foods often require more elaborate processing than the foods regularly consumed by Paleolithic humans, and as previously mentioned, tend to contain some potentially problematic compounds. Grain-eating traditional societies often soak, sprout, and/or ferment grains in order to improve the digestibility and/or shelf life of the food, and many dairy-consuming cultures produce butter, GHEE, kefir, and other dairy foods from raw, full-fat, and grass-fed milk (Price, 2008).

Traditional processing techniques such as soaking, sprouting, and fermentation increase the bioavailability of many micronutrients and remove or decrease the levels of several potentially
proinflammatory antinutrients (Cordain, 1999; Price, 2008; Selhub, Logan, & Bested, 2014). Fermentation is still widely used to produce and preserve food, with estimates suggesting that fermented foods and beverages account for approximately one-third of the human diet globally (Selhub et al., 2014). However, the types of foods and cultures that are used, the length of the fermentation process, etc. often differ markedly between traditional, non-modernized cultures and industrialized societies, something that may have important implications for human health (Price, 2008; Selhub et al., 2014).

What is probably the most detailed and comprehensive study of isolated, non-westernized populations eating traditional diets was carried out by Dr. Weston A. Price, a dentist born in Newburgh, Ontario, Canada (Price, 2008). During the late 19th century and early 20th century, malocclusion, dental arch deformities, tooth decay, and other conditions associated with poor oral health and abnormal craniofacial development were rapidly increasing in prevalence in the U.S., where Dr. Price worked as a practicing dentist (Price, 2008). Unlike many of his contemporaries who tried to establish the causes and possible solutions to these problems by studying industrialized populations and the diseases themselves, Dr. Price set out to study healthy, traditional societies.

The non-westernized populations included in his studies occupied different ecological niches and environments around the world, and their diets often differed markedly in terms of macronutrient ratio, food composition, etc. (Price, 2008). However, Dr. Price found that all of the diets of the traditional societies he visited had certain universal characteristics in common. Perhaps most importantly, they were all comprised primarily of minimally processed foods, contained little to no refined sugar, trans fats, and refined grains, and contained some particularly nutrient-dense foods such as organ meats (Price, 2008). Also, the animal source foods that were consumed by these traditional societies came from pasture-fed or wild animals, and plant foods and dairy products were often soaked, sprouted, and/or fermented to improve digestibility and/or storage life (Price, 2008).

Tooth decay, malocclusion, crowded teeth, and several other oral health-related problems were rare or absent in all of the non-westernized communities Dr. Price studied (Price, 2008). Moreover, the traditional people were lean, physically fit, and had very low incidence of most chronic, non-communicable diseases, including, but not limited to, cancer, cardiovascular disease, and type-2 diabetes (Price, 2008).

In the book Nutrition and Physical Degeneration, Dr. Price argues that the low prevalence of dental arch deformities, tooth decay, and chronic, non-communicable disease in these non-modernized populations can largely be attributed to their nutrient-dense, whole foods diets (Price, 2008). This statement is supported by his and others’ studies which show that traditional people who adopt a more westernized diet, higher in refined grains, sugar, highly processed food, and refined
vegetables oils, experience a rapid decline in health and develop many of the dental health problems Dr. Price encountered in his practice (Carrera-Bastos et al., 2011; Price, 2008; Spreadbury, 2012).

While some of the mechanisms proposed by Dr. Price in relation to the impact of diet on health and craniofacial development have either not been clinically tested or abandoned in favor of more scientifically sound theories, the main premise of his work is very much valid. By now it’s well established that a high intake of refined sugar sets the stage for tooth decay and that a lack of chewing/masticatory stress, particularly during the early years of life, can lead to underdeveloped dental arches, malocclusion, and crowded teeth (Lieberman, 2014; Touger-Decker & van Loveren, 2003; von Cramon-Taubadel, 2011).

As for the impact of traditional diets upon general health, a variety of population studies and controlled trials have linked adherence to traditional dietary practices, which are typically characterized by a high intake of minimally processed foods like vegetables, fruits, fish, seafood, and whole grains, with lowered risk of obesity, type-2 diabetes, cardiovascular disease, and many other chronic ills (Grosso et al., 2014; Jung et al., 2014; Lipski, 2010; Selhub et al., 2014). A bulk of the randomized controlled trials in this area have looked at the Mediterranean diet, which is a nutritional strategy inspired by the traditional dietary practices of Greece, Southern Italy, and Spain. A Mediterranean-style diet is high in olive oil, legumes, whole grains, fruits, fish, and vegetables, contains a moderate amount of dairy products (predominantly in the form of cheese and yogurt) and wine, and is low in red meat, sugar, refined grains, and refined vegetable oils. Several meta-analyses and systematic reviews have linked adherence to a Mediterranean diet with significant improvements in health status and support the use of a Mediterranean diet in the prevention of cardiovascular diseases, the metabolic syndrome, and several other chronic health problems (Esposito, Kastorini, Panagiotakos, & Giugliano, 2013; Grosso et al., 2014; Serra-Majem, Roman, & Estruch, 2006).

The Industrial Revolution and Modern Era

Over the last couple of centuries – and especially the most recent decades – there have been major changes in the human diet all over the world.

Refined grains

Prior to the Industrial Revolution some 200 years ago, the vast majority of cereal grains consumed worldwide were in the form of whole grains that contained all of the components of the grain, including the germ, bran, and endosperm (Cordain et al., 2005). However, this changed when stone milling tools started getting replaced by automated sifting devices and mechanized steel roller
mills, something that allowed for easier removal of the bran and germ and mass production of refined grains (Cordain et al., 2005). Today, most of the cereal grains consumed worldwide is of the refined type, something that is concerning as refined grains are markedly lower in fiber and micronutrients compared to whole grains (Jonnalagadda et al., 2011).

Besides the increasingly common practice of removing the outer layers of cereal grains before consumption, recent changes related to how cereal grains are grown and produced have altered certain nutritional characteristics of commonly consumed cereal grains like wheat, such as the content of various proteins and micronutrients (Cordain, 1999).

Since wheat, rice, and other grass seeds today are important staple foods in most countries, these changes in the production, processing, and transportation of cereal grains could potentially have a major impact on human health and well-being.

**Domesticated fatty meats and refined vegetable oils**

The Industrial Revolution gave rise to various technological developments (e.g., steam engine, railroads) that allowed for more efficient transport of grain and cattle and increased grain harvest, something that made it possible and economically favorable to produce meat in feedlots (places where livestock are fed grains (primarily corn) and fattened up for market) (Cordain et al., 2005). The increasingly common practice of feeding beef cattle, sheep, and other forms of livestock grain-based diets led to a shift in the fatty acid composition of the meat (Cordain et al., 2005). Animals source foods from domesticated animals, particularly those that are fed a fattening diet of corn and given antibiotics and/or growth hormones, are higher in saturated fatty acids, omega-6, and total fat (domesticated animals are typically slaughtered at peak body fat percentages) and lower in omega-3 when compared to foods derived from wild animals (Davidson, Maciver, Lessard, & Connors, 2011; O'Keefe & Cordain, 2004). Other similar changes can be seen in the production of certain forms of seafood. E.g., the nutritional profile of farmed salmon is different from that of wild salmon, with one especially important characteristic being an elevated omega-6/omega-3 ratio in farmed varieties (Hamilton et al., 2005).

Most (>50%) of the fatty acids found in the fat cells of wild animals are of the saturated type, while polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) are the dominant fatty acids in the muscles and organs (Cordain et al., 2005). Since wild animals have depleted body fat stores during most of the year, saturated fat would not have been abundantly available year-round for Paleolithic humans (Cordain et al., 2005). Rather, MUFA and PUFA made up the majority of the total carcass fat of the wild animals our ancient ancestors preyed on (Konner & Eaton, 2010).
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The Neolithic practice of storing and eating concentrated sources of animal saturated fatty acids in the form of butter, cheese, etc. and a dramatic increase in the consumption of refined vegetable oils over the last century are two other key factors that have contributed to the profound changes in the fatty acid composition of human diets over the last 12,000 years (Carrera-Bastos et al., 2011).

Refined sugars

The first production of crystalline sucrose occurred approximately 500 BC, but it wasn’t until the Industrial Revolution that the production and use of refined sugar really started to gain foothold (Cordain et al., 2005). Over the last 200 years there has been a dramatic worldwide increase in sugar consumption, with a particular rise in the per capita consumption of refined sugars in Western nations such as England, the U.S., Norway, and Sweden (Cordain et al., 2005).

Honey was one of the few concentrated sources of sugar available to our ancestors prior to the first production of sucrose (Crittenden, 2011). The Hadza of Northern Tanzania, one of the last hunter-gatherer communities left on the planet, are known to favor honey over all other foods and will go to great lengths to acquire this calorie-dense food item (Marlowe et al., 2014). During certain periods of the year, honey is the primary source of calories for the Hadza (Marlowe et al., 2014). Similar behaviors and food preferences are seen in other non-modernized populations who live in areas of the world where honey is an available food resource (Crittenden, 2011; Marlowe et al., 2014). However, as opposed to the production and use of sucrose in modernized nations, honey is only seasonally available, something that restricts regular access.

The worldwide consumption of high-fructose corn syrup (HFCS), a sweetener made by processing corn syrup to increase the level of fructose, has increased dramatically since the late 1970s as a result of the advent of chromatographic fructose enrichment technology which made it economically feasible to produce large quantities of HFCS (Hanover & White, 1993). This sweetener, which comes in two main forms that are both composed of nearly equal amounts fructose and glucose, are today used in all sorts of sugary beverages and processed food items (Hanover & White, 1993). The fructose density of many of these modern food products far exceeds that of fruit, which was the densest source of fructose available to our ancestors.

It’s also important to note that the cultivated and conventionally-produced fruits and vegetables found at a typical grocery store today are different in several respects when compared with wild fruits and vegetables. Perhaps most importantly, when compared to wild varieties, cultivated fruits and vegetables tend to be higher in sugar, lower in fiber, and less nutrient-dense (Konner & Eaton, 2010; Lieberman, 2014).
Alcohol

Recent evidence suggests that a genetic mutation that arose approximately 10 MYA equipped our primate ancestors with a markedly enhanced ability to metabolize ethanol, which suggests that our ancestors may have ingested small amounts of alcohol in the form of fruits that had undergone natural fermentation long before human-directed fermentation began (Carrigan et al., 2015). As our hominin ancestors started transitioning from a lower quality plant-based diet rich in fruits to a higher quality diet richer in meat and cooked food, the consumption of ethanol declined, and the data suggest that alcohol would have made up an insignificant part of Paleolithic hominin diets (Lindeberg, 2011).

Some of the earliest evidence of wine and beer drinking comes from two different sites in Iran dating back to 7400-7100 years before present and the late fourth millennium BC, respectively (Cordain et al., 2005). Evidence suggests that the production and consumption of distilled alcoholic beverages came much later, perhaps not until approximately 700-1200 years before present among certain populations in the near East, Europe, and China (Cordain et al., 2005). The Industrial Revolution was important, as new innovations set the stage for cheaper and easier manufacture and transport of alcoholic beverages.

Salt

Prior to the Neolithic period there was no systematic mining, production, or transportation of salt (Cordain et al., 2005). While Paleolithic hunter-gatherer tribes living in coastal areas may have regularly consumed small amount of salt in the form of food dipped in seawater or dried seawater used for various purposes, recent studies suggest that salt intake is minimal even among inland hunter-gatherers (Cordain et al., 2005). As for other traditional, non-westernized societies, the intake of salt would have varied depending on geographic locale, climate, and food resources, among other things, but would have never reached the high levels consumed in Western societies today (=10 g/d) (Cordain et al., 2005; Price, 2008). Approximately ¾ of the salt consumed in Western populations comes from salt that has been added to processed foods (James, Ralph, & Sanchez-Castillo, 1987).

Rapid and powerful changes

Dairy foods, cereals, refined sugars, refined vegetable oils, and alcohol are relatively novel additions to the human diet from an evolutionary perspective in the sense that they contributed little or none of the calories in the diets of preagricultural humans (Carrera-Bastos et al., 2011; Konner & Eaton, 2010; Lindeberg, 2011). Today, these types of foods make up approximately 70% of the total
daily calories consumed in the U.S., and other westernized nations are not far behind (Cordain et al., 2005).

Also, as previously mentioned, the way we grow, manufacture, process, and prepare our food in industrialized countries is often very different from how it was done in hunter-gatherer communities and traditional societies, something that has further contributed to the rapid and powerful changes in the human diet over the last 12,000 years. Some of these innovations and changes have been beneficial in the sense that they have allowed us to store food for a longer time, access food from all over the world, etc. However, they have also in several instances unfavorably altered the nutritional characteristics of meat, fruits, vegetables, nuts, dairy, cereal grains, and all of the other foods typically consumed by humans (Carrera-Bastos et al., 2011; Cordain et al., 2005; Lindeberg, 2011).

The incorporation of dairy foods, cereals, refined sugar, refined vegetable oils, alcohol, salt, and fatty domesticated meat into the human diet during the Neolithic, Industrial, and Modern eras has fundamentally altered several key nutritional characteristics of ancestral hominin diets, something that has had far-reaching effects on human health and well-being (Carrera-Bastos et al., 2011; Cordain et al., 2005; Lieberman, 2014; Lindeberg, 2011). The dietary indicators affected include, but are not limited to, glycemic load, fatty acid composition, macronutrient composition, antinutrient content, micronutrient density, acid-base balance, sodium-potassium ratio, and fiber content (Carrera-Bastos et al., 2011; Cordain et al., 2005).

The Western Diet

In many nations, expert committees are appointed with the job of developing dietary guidelines for the public. While these public dietary guidelines differ between countries, there are certain recommendations that can be found across the board. In the U.S., Nordic countries, and many other industrialized nations, people are recommended to limit their intake of saturated fat and sugar, eat several servings of whole grains and fruits and vegetables each day, choose lean meat and dairy products over fatty red meat and high-fat dairy, consume seafood on a regular basis, and limit their intake of highly processed foods, among other things (Ministers, 2014; Schneeman, 2003; USDA & DHHS, 2010). The dietary pattern that emerges from these recommendations has several similarities with traditional diets such as the Mediterranean diet (Lipski, 2010; Serra-Majem et al., 2006).

There’s a big discrepancy between the nutritional template outlined by official dietary guidelines and the way a lot of people choose to eat (Carrera-Bastos et al., 2011). This is even truer if we compare modern, industrial diets to the diets that were consumed by hunter-gatherers and
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traditional, isolated populations (Carrera-Bastos et al., 2011). Today, a lot of people in developed nations, and increasingly also in developing countries, eat diets that line up with a so-called western dietary pattern, which is characterized by high intakes of red and processed meat, high-fat dairy products, refined sugar, refined grains, salt, and “fast food” and low intakes of fruits and vegetables, whole grains, and seafood (Carrera-Bastos et al., 2011; Ruiz-Nunez et al., 2013). Many of the nutritional characteristics of this diet, including a high intake of saturated fat, net-base yielding foods, fructose, sucrose, and omega-6, the low intake of fiber, phytochemicals, and omega-3, a high sodium-potassium ratio and glycemic load, and the low micronutrient density, have been linked with adverse health effects (Carrera-Bastos et al., 2011; Cordain et al., 2005; Lindeberg, 2011; Ruiz-Nunez et al., 2013; Spreadbury, 2012). Extensive evidence shows that the consumption of a Western style-diet increases the risk of cancer, heart disease, obesity, type-2 diabetes, and several other non-communicable chronic health conditions (Heidemann et al., 2008; Lindeberg, 2011; Myles, 2014; O'Keefe & Cordain, 2004; Ruiz-Nunez et al., 2013).

The Western Diet and gene expression

Many of the adverse health effects of a nutritionally poor diet can be traced back to the impact of food on gene expression (Carrera-Bastos et al., 2011; Myles, 2014; Ruiz-Nunez et al., 2013). The human genome is constantly interacting with the environment, with genes being upregulated or downregulated in response to environmental stimuli (Shenderov & Midtvedt, 2014). There’s solid evidence showing that consumption of a Western diet leads to a suboptimal gene expression pattern, with an upregulation of genes involved in proinflammatory processes (Bouchard-Mercier et al., 2013; Carrera-Bastos et al., 2011; Myles, 2014; Ruiz-Nunez et al., 2013).

A 2013 cross-sectional study looking at associations between dietary patterns and gene expression profiles of healthy men and women found that gene expression profiles differed between individuals adhering to a prudent dietary pattern characterized by high intakes of vegetables, fruits, and whole grain products and those adhering to a Western dietary pattern characterized by high intakes of refined grain products, desserts, sweets, and processed meats (Bouchard-Mercier et al., 2013). The genes that were differentially expressed were present in networks related to the immune and/or inflammatory response, cancer, and cardiovascular diseases, which led the researchers to conclude that the differences in gene expression profiles probably modulate the risk of chronic diseases (Bouchard-Mercier et al., 2013).

These results are consistent with other data showing that many of the characteristic elements of the Western diet, such as the high omega-6/omega-3 ratio and high content of refined sugars, are linked to unfavorable gene expression profiles (Myles, 2014; Ruiz-Nunez et al., 2013; Simopoulos, 2006). Moreover, recent research within the field of epigenetics, the study of cellular
and physiological trait variations that are not caused by changes in the DNA sequence, suggests that diet-related changes in gene expression cause alterations in the transcriptional potential of a cell that may be heritable (Alegria-Torres, Baccarelli, & Bollati, 2011; Hardy & Tollefsbol, 2011; Myles, 2014). In other words, the environment (e.g., diet) of mum and dad may be partly passed on to offspring through epigenetic tags left on the genome (Alegria-Torres et al., 2011; Hardy & Tollefsbol, 2011; Myles, 2014).

**The Western Diet, the immune system, and chronic low-grade inflammation**

Many of the adverse health effects elicited by Westernized diets can be traced back to the impact of diet on the immune system (Myles, 2014). It has been suggested that systemic chronic low-grade inflammation, a condition characterized by elevated levels of several proinflammatory compounds (e.g., interleukin 6) in systemic circulation, is a common denominator of most, if not all, typically Western chronic illnesses (Ruiz-Nunez et al., 2013). Several pro-inflammatory factors in the current Western diet, including, but not limited to, the high intake of saturated and trans fatty acids, a high omega-6/omega-3 ratio, a low status of vitamin D and certain other micronutrients, the low intake of dietary fiber, fruits, and vegetables, and the consumption of carbohydrates with a high glycemic index, collectively cause a state of systemic chronic inflammation (Galland, 2010; Myles, 2014; Ruiz-Nunez et al., 2013). This chronic activation of the immune system sets the stage for impaired glucose tolerance, insulin resistance, and eventually, chronic non-communicable diseases - in particular those centered around the metabolic syndrome (Carrera-Bastos et al., 2011; Ruiz-Nunez et al., 2013).

**The Western Diet and the human gut microbiota**

Over the last decade it has become clear that the trillions of microorganisms that inhabit the human body, collectively called the human microbiota, are far more important to our health than previously realised. Recent studies have revealed that the human microbiome, the collective genomes of all the microorganisms found in and on the human body, encodes at least 150-fold more genes than are present in the human genome, essentially making us 99% microbe from a genetic perspective (Qin et al., 2010).

Most of the microorganisms associated with the human body reside in the gastrointestinal tract, with the densest communities found in the large intestine (Qin et al., 2010). These gut microbes play an important role in the regulation of our immune system and metabolism and have even been shown to affect brain function, mood, and behavior (Fujimura, Slusher, Cabana, & Lynch, 2010; Guinane & Cotter, 2013). Microbial imbalances in the gut, often referred to as gut dysbiosis,
have been linked to a myriad of diseases, including major public health hazards such as obesity, type-2 diabetes, and cardiovascular disease (Fujimura et al., 2010; Guinane & Cotter, 2013).

The development of the human microbiota begins with the inoculation of microbes from mum during pregnancy, birth, breastfeeding, and other forms of early contact and continues throughout life in response to various environmental stimuli (Graf et al., 2015; Voreades, Kozil, & Weir, 2014). While the human genome has changed relatively little over the last several millennia, the human microbiome – the collective genomes of all the microorganisms associated with the human body – changes rapidly in response to shifts in diet and lifestyle, which has led some researchers to suggest that incompatibilities between the two can quickly arise (Sonnenburg & Sonnenburg, 2014). This idea is supported by recent studies which show that hunter-gatherers and traditional people harbor gut microbiotas that differ markedly from those found in people living in more industrialized societies (Martinez et al., 2015; Obregon-Tito et al., 2015; Schnorr et al., 2014). Perhaps most importantly, all of the studies that have been performed to date have found that the so-called westernized microbiota is characterized by decreased biodiversity (Martinez et al., 2015; Obregon-Tito et al., 2015; Schnorr et al., 2014). This is concerning, as biodiversity can be used as a marker of the stability, resilience, and health of an ecosystem and because the loss of some microbial “old friends” that have co-evolved with humans for millions of years may be an important underlying cause of many modern illnesses associated with poor immunoregulation (Blaser, 2015; Rook, 2010, 2013; Rook & Brunet, 2005).

Several elements of current modern lifestyles perturb the human microbiome and compromise the diversity of the gut microbiota (Blaser, 2015; Hold, 2014; Rook, 2010, 2013). These elements include, but are not limited to, the use of broad-spectrum antibiotics, bottle-feeding in infancy, caesarean sections, excessive hygiene, consumption of highly processed foods, and decreased exposure to biodiversity from the natural environment (Blaser, 2015; Hold, 2014; Rook, 2010; Rook & Brunet, 2005; Salminen, Gibson, McCartney, & Isolauri, 2004).

While it’s long been known that the Western pattern diet adversely affects human health by influencing the expression of genes found in our eukaryotic, human cells, it’s now becoming increasingly clear that the effects also extend to the human microbiome, and that the gut microbiota plays a key role in mediating some of the adverse health effects of a poor diet (Hold, 2014; Voreades et al., 2014). Recent studies both in animals and humans show that a Western-style diet induces gut dysbiosis, impairment of intestinal barrier function, and increased intestinal permeability of bacterial endotoxins (Brown, DeCoffe, Molcan, & Gibson, 2012; Martinez-Medina et al., 2014). The high intake of saturated fat and refined sugar in the Western diet is especially concerning, as these nutrients seem to promote the growth of proinflammatory microorganisms in the small intestine when
consumed in large quantities (Hold, 2014; Pendyala, Walker, & Holt, 2012; Spreadbury, 2012). Also, the low intake of dietary fiber unfavorably impacts colonic health by starving beneficial bacteria, compromising microbial diversity, and leading to a low production of short-chain fatty acids, which are essential for maintaining a healthy pH and properly functioning intestinal barrier (Sonnenburg & Sonnenburg, 2014). Last, but not least, the consumption of preserved, highly processed, and “clean” industrially produced food, as opposed to the minimally processed and cleaned foods (e.g., roots and tubers) regularly consumed by hunter-gatherers and some non-westernized populations, reduces the intake of various food-associated microbes, some of which may be beneficial to human health (Alcock, Maley, & Aktipis, 2014; Leff & Fierer, 2013; Rook, 2010).

The Western pattern diet differs markedly from the diets our ancestors consumed for millions of years, and hence, it selects for a gut microbiota that is very different from the microbiota the human body evolved to harbor. This is concerning for a number of reasons, one of which is that the gut dysbiosis associated with the consumption of a Western-style diet causes impaired development of the immune system and chronic inflammation and seems to be an underlying cause of many chronic, non-communicable diseases (Brown et al., 2012; Fujimura et al., 2010; Hold, 2014; Pendyala et al., 2012; Sonnenburg & Sonnenburg, 2014). Also, recent studies show that the gut microbiota impacts our dietary preferences and appetite, and that the consumption of a highly processed, modern diet may initiate a vicious circle where certain foods and food ingredients promote the growth of a specific set of microbes, which then in turn increases our desire for these foods (Alcock et al., 2014; Norris, Molina, & Gewirtz, 2013).
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Results

As shown in the summary of major findings in table 1, the Agricultural Revolution starting about 12,000 years ago and the Industrial Revolution some 250 years ago set the stage for profound changes in the human diet, something that has had far-reaching effects on human health.

Table 1. Major changes in the human diet triggered by the Agricultural and Industrial Revolution, and the broad implications of these changes to human health

<table>
<thead>
<tr>
<th>Time period</th>
<th>Diet</th>
<th>Nutritional characteristics</th>
<th>Diet-related health conditions and diseases</th>
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<tr>
<td><strong>The Paleolithic era (2.6 MYA-10,000 YA)</strong></td>
<td>- Varied due to differences in geography, ecological niche, etc. (Cordain et al., 2005; Konner &amp; Eaton, 2010).&lt;br&gt; - Composed of wild plants and animals (Carreras-Bastos et al., 2011; Cordain et al., 2005).&lt;br&gt; - Main foods consumed: Meat, seafood, eggs, fruits, vegetables, nuts and seeds (Carreras-Bastos et al., 2011; Lieberman, 2014).</td>
<td><strong>General characteristics of Paleolithic diets:</strong> (Carreras-Bastos et al., 2011; Cordain et al., 2005; Konner &amp; Eaton, 2010; Lindeberg, 2011)&lt;br&gt; - Low caloric density&lt;br&gt; - Macronutrient distribution: Approximately 19-35% protein, 28-58% fat, and 22-40% carbohydrate&lt;br&gt; - Low glycemic load&lt;br&gt; - High antioxidant capacity&lt;br&gt; - High micronutrient density&lt;br&gt; - Roughly equal intake of omega-6 and omega-3&lt;br&gt; - Sodium/potassium ratio: &lt;1</td>
<td>- Hunter-gatherers, both contemporary and ancient, generally have strong bones, broad dental arches, good dental health, and low incidence of non-communicable diseases (Carreras-Bastos et al., 2011; Lieberman, 2014; Lindeberg, 2011; Spreadbury, 2012).&lt;br&gt; - Randomized controlled trials show that a Paleolithic diet exerts beneficial effects on a wide range of health markers and may be superior to other healthy diets like the Mediterranean diet (Jonsson et al., 2009; Jonsson et al., 2010; Lindeberg et al., 2007; Mellberg et al., 2014).</td>
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<tr>
<td><strong>The Agricultural Revolution (Starting about 12,000 YA)</strong></td>
<td>- Increased reliance on domesticated foods.&lt;br&gt; - Grains, dairy products, and/or legumes were incorporated as staple foods wherever agriculture took root (Cordain et al., 2005).</td>
<td><strong>Post-agricultural diets as compared to Paleolithic diets (general characteristics):</strong> (Carreras-Bastos et al., 2011; Cordain et al., 2005; Konner &amp; Eaton, 2010; Lindeberg, 2011)&lt;br&gt; - Higher in carbohydrate (particularly starch), dairy fats, antinutrients, and milk sugars&lt;br&gt; - Lower in omega-3, phytochemicals, most micronutrients, and protein&lt;br&gt; - Higher glycemic load&lt;br&gt; - Higher sodium/potassium ratio</td>
<td>- The transition to an agricultural pattern of subsistence led to a decrease in lifespan, a reduction in stature, and an increased incidence of dental health problems, iron deficiency anemia, and several bone mineral disorders (Cordain, 1999; Lieberman, 2014; Lindeberg, 2011; von Cramon-Taubadel, 2012).&lt;br&gt; - A variety of population studies and controlled trials have linked adherence to non-Paleolithic, traditional diets (e.g., the Mediterranean diet) with lowered risk of many chronic ills (Grosso et al., 2014; Jung et al., 2014; Lipski, 2010; Price, 2008; Selhub et al., 2014).</td>
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<tr>
<td><strong>The Industrial Revolution (Starting some 250 YA) and Modern Era (The last quarter of the 20th century-present)</strong></td>
<td>- Increased reliance on industrially produced foods.&lt;br&gt; - Increased consumption of refined grains, fatty domesticated meats, refined vegetable oils, alcohol, and salt in countries undergoing industrialization (Carreras-Bastos et al., 2011; Cordain et al., 2005).&lt;br&gt; - Widespread consumption of highly processed “fast food” in both developed and developing nations over the most recent decades.</td>
<td><strong>Post-industrial diets as compared to Paleolithic diets (general characteristics):</strong> (Carreras-Bastos et al., 2011; Cordain et al., 2005; Konner &amp; Eaton, 2010)&lt;br&gt; - Higher in carbohydrate, saturated fat, trans-fats, salt, refined sugars, and omega-6&lt;br&gt; - Lower in fiber phytochemicals, protein, and omega-3&lt;br&gt; - Higher glycemic load&lt;br&gt; - Lower micronutrient density&lt;br&gt; - Higher sodium/potassium ratio</td>
<td>- The introduction of novel foods with the Industrial Revolution altered several nutritional characteristics of human diets, something that has had far-reaching adverse effects on human health (Carreras-Bastos et al., 2011; Cordain et al., 2005; Myles, 2014; Ruiz-Nunez et al., 2013).&lt;br&gt; - Extensive evidence shows that consumption of a Western pattern diet adversely affects gene expression, immunity, and the gut microbiota and increases the risk of cancer, heart disease, obesity, type-2 diabetes, and several other non-communicable chronic health conditions (Bouchard-Mercier et al., 2013; Carreras-Bastos et al., 2011; Cordain et al., 2005; Hold, 2014; Myles, 2014; Ruiz-Nunez et al., 2013; Sonnenburg &amp; Sonnenburg, 2014).</td>
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Discussion

Within the field of nutrition there is a lot of controversy and debate as to how we should eat to achieve good health. The opinions of various diet researchers, scientists, and public health figures differ markedly, and for the public, it can often be difficult to make sense of all the conflicting news stories and information. This controversy largely stems from the fact that humans don’t have a narrow and distinct species specific diet, but rather have evolved to be able to consume a wide variety of different foods and diets. Also, the fact that there’s so much seemingly conflicting scientific data on the relationship between diet and health has contributed to a lot of disagreement among experts within the field.

In 1973, the evolutionary biologist and Russian Orthodox Christian Theodosius Dobzhansky published an essay titled "Nothing in Biology Makes Sense Except in the Light of Evolution". This title phrase has gone on to become well-known and frequently quoted within the field of evolutionary medicine and biology and is used to highlight the fact that evolution explains the interrelatedness of the various facts of biology, and hence, makes biology make sense. The findings of this paper show that rapid and powerful changes in the human diet over the past millennia are an important underlying cause of many, if not most, of the chronic health problems that afflict contemporary humans, something that clearly highlights the importance of applying a similar evolutionary perspective to the field of nutrition. It could be argued that evolution is the missing piece in many of the discussions about food and diets and that the aforementioned phrase could just as easily have said: "Nothing in Nutrition Makes Sense Except in the Light of Evolution".

One of the current challenges within the growing field of evolutionary medicine is to adequately test hypothesis rooted in the evolutionary model in controlled clinical trials. As for nutrition, an evolutionary outlook gives us many hints as to how we should eat in the 21st century to achieve good health, but it doesn’t necessarily provide firm, causal conclusions. As an example; researchers and scientists advocating a Paleolithic diet tend to argue that humans are inadequately adapted to eat Neolithic and Industrial foods and that individuals looking to achieve optimal health should adhere to a Paleolithic, hunter-gatherer style diet. However, to date, there have only been a handful of randomized controlled trials testing a Paleolithic diet against other “healthy” diets.

The picture is further complicated by the fact that good data about the diet and physical fitness of our ancient ancestors are often limited. Moreover, studies showing that some traditional populations have maintained good health on diets containing grains, dairy, and/or legumes, and DNA analyses revealing recent genetic adaptations related to diet, question the idea that humans are best off avoiding all non-Paleo foods.
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The best way forward may be to carry out more randomized controlled trials in which Paleo diets, traditional diets, diets based upon official dietary guidelines, and other “prudent” diets are tested against each other. While this has certainly been done before, more research effort within this area is desirable, particularly in respect to the potential health effects of ancestral human diets. For the moment, it’s safe to say that an evolutionary outlook can help guide our food choices and that a diet based on nutrient-dense, minimally processed foods is far superior to a Western-style diet composed of industrial and highly processed foods.

So, while applying an evolutionary perspective to nutrition doesn’t necessarily provide firm, causal conclusions related to diet and health, it does allow us to look past current dogma and establish certain ground rules that serve as a guiding template for nutritional science and dietary advice in the 21st century.

Conclusions

The human diet has changed dramatically over the last 10,000 years. In today’s industrialized world, food comes nicely wrapped in plastic containers, calorie-dense and highly palatable products made up of a combination of ingredients that were unknown to our ancient ancestors are easily accessible at the local grocery store, and most of us never see how our food is grown and produced. While this situation is now the norm in many parts of the world, it’s without a doubt an abnormal situation from an evolutionary perspective. For 99.5% of the evolutionary history of our genus, Homo, a hunter-gatherer lifestyle was the norm, and while this way of life is now largely gone, the genetic imprint of our past is still very much with us.

Many of the changes in the human diet over the last several millennia set the stage for increased reproductive success, population growth, and/or economic and technological progress, but they also frequently came with a set of adverse effects, particularly related to human health. While some contemporary non-westernized populations still eat nutrient-dense, whole foods diets that resemble the diets consumed by Paleo lithic humans or traditional societies, a large part of the world’s population have now transitioned over to more westernized dietary habits. These dietary habits conflict with human dietary needs that were shaped over millions of years of evolution. Through natural selection, the process in nature by which the organisms best adapted to their environment tend to survive and transmit their genetic characters in increasing numbers to succeeding generations while those less adapted tend to be eliminated, our ancestors evolved for millions of years to eat diets that are profoundly different from modern, highly processed Western diets. There have been virtually no evolutionary time for the human genome to adjust to many of the recent, rapid, and powerful changes in the human diet, and hence, an evolutionary discordance
between the human genome and contemporary Western-style diets has occurred. This discordance manifests itself as chronic, non-communicable health conditions such as obesity, type-2 diabetes, and cardiovascular disease; conditions which are all rooted in the suboptimal gene expression pattern, low-grade chronic inflammation, and altered gut microbiota that result from eating a nutritionally poor diet.

Getting back to healthful diet in the 21st century requires combining modern science with an evolutionary perspective on nutrition and adjusting our contemporary diet so it more closely resembles that of our ancient forebears. Further research within the field, particularly in respect to the different impact of various “prudent” dietary patterns on human health, is warranted; as it can help illuminate what to aim for in terms of the more specific elements of a healthy diet.
References


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