REVIEW

Paleolithic diets: a sceptical view

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Summary

Some anthropologists have suggested that humans are genetically determined to eat diets quite different from those of today. Very little human evolution has occurred in the past 15,000 years. However, diets have changed dramatically and in parallel with a shift in disease patterns from infectious diseases and diseases associated with nutrient deficiencies, to chronic degenerative diseases associated with excessive and unbalanced intake of energy and nutrients. This review examines some of the archaeological evidence relating to the diets of early man and other primates, and current hunter-gatherer societies. Knowledge of the relative proportions of animal and plant foods in the diets of early humans is circumstantial, incomplete, and debatable and there are insufficient data to identify the composition of a genetically-determined optimal diet. The evidence related to Paleolithic diets is best interpreted as supporting the idea that diets based largely on plant foods promote health and longevity, at least under conditions of food abundance and physical activity.

Keywords: diet, homonid, hunter-gatherer, paleolithic, prehistoric, primates

Introduction

In 1985, the American anthropologists Eaton and Konner reviewed the evidence related to the diets of our Paleolithic ancestors by evaluating the nutrient content of 69 game and plant foods they were likely to have eaten. Eaton and Konner made the intriguing suggestion that prehistoric diets must have contained far more protein – and therefore far more meat – than is currently consumed or recommended. They also proposed that humans *evolved* to consume in a Paleolithic dietary pattern and therefore we are genetically determined to eat diets quite different from those of today. Humans have not evolved much in the past 15 000 years or so, but our diets have changed dramatically and have done so in parallel with a shift in disease patterns. Whereas the leading causes of death used to be infections, and diseases associated with nutrient deficiencies, they now comprise chronic degenerative diseases associated with excessive and unbalanced intake of energy and nutrients (McGinnis & Foege 1993). In 1997, Eaton & Konner expanded their food survey to include 321 plants and animals. Their more recent suggestion is that the Paleolithic diet must have included 37% of energy from protein, 41% from carbohydrate, and 22% from fat, along with amounts of vitamins, minerals, and fibre that seem unimaginably high and unachievable through modern-day diets. As shown in Table 1, the Paleolithic amounts are decidedly different from those

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Table 1 Comparison of Paleolithic diet with US and UK dietary recommendations*

	Paleolithic Diet	US Dietary Recommendations	UK Dietary reference values
Protein, % energy	37	12	
Carbohydrate, % energy	41	58	50
Fat, % energy	22	30	35
Cholesterol, mg/d	480	300	
Fibre, g/d	104	20–35	20–24
Vitamin C, mg/d	604	60	40
Vitamin E, mg/d	32.8	8–10	
Iron, mg/d	87.4	10–15	8.7–14.8
Energy, kJ (kcal)/d	12558 (3000)	9209–12139 (2200–2900)	8100–10600 (1940–2550)

* Adapted from references 3 and 6.
Note; for illustrative purposes only. US and UK recommendations cannot be directly compared because different methodologies were used to derive values.

currently recommended by health authorities in the United States and in many other countries (Cannon 1992).

What are we to make of this proposition? Throughout the course of human history, societies have developed widely varying dietary patterns that take advantage of food plants and animals available as a result of geography, climate, trade, or economic status (Diamond 1997). Our very existence indicates that ancestral diets must have provided sufficient energy and nutrients to support growth and reproduction. Whether they optimally promoted adult health is more difficult to determine but seems unlikely, given the sharp increase in human life expectancy observed during this century. Also at issue is the precise composition of prehistoric diets, their relative proportion of animal and plant foods, and the quality and credibility of the evidence in support of their evolutionary derivation.

Lines of evidence

Current dietary patterns in the industrialised world developed from changes in food production that began with the industrial revolution some 200 years ago. Human nutritional requirements, however, date from the Paleolithic era. Eaton & Konner proposed that from the appearance of *Homo sapiens* some 45 000 years ago until the beginnings of agriculture 10 000–15 000 years ago (Table 2), lean meat supplied a large proportion of dietary energy. This assertion raises issues germane to current dietary recommendations but also to methods of dietary assessment; it is difficult to determine what groups of people ate yesterday, let alone thousands of years ago (Lee & Nieman 1996) especially when they left no written records. To estimate ancient diets, we must rely on archaeological analyses of the diets of

Table 2 Stages of evolution of human diets*

Period	Years Ago
Pleistocene: stone age	1.6 million
Homo sapiens, archaic	400 000
H. sapiens, Neanderthal	80 000
H. sapiens, modern	45 000
Holocene: agriculture	10 000
Industrial Revolution	200
Global food economy	50

* Adapted from reference 1.

hominoid primates and early hominids, and observations of indigenous populations who still hunt and gather for subsistence. Interpreting such evidence requires careful consideration of underlying assumptions that are not easily tested.

Hominoid Primates

It seems intuitively obvious that the diets of closely related primates might give some indication of the evolutionary basis of human diets. Thus, anthropologists have studied the dietary habits of gorillas, orangutans, chimpanzees, and other hominoids in the wild through patient observations as well as examinations of teeth, stomach contents, and faeces. These investigations suggest that gorillas are almost exclusively herbivorous, but other species use animals as food in amounts up to 15% of the diet by weight. Although the structure of the primate digestive tract suggests that the predominant foods should be plants, evidence also indicates that these animals eat whatever is readily at hand (Harris & Ross 1987) – plants, but also insects, eggs, crustaceans, and carrion. Overall, nearly 70% of primate species eat

Dietary information is available for only a few of these groups, and much of it lacks precision (Harris & Ross 1987), perhaps because the investigating anthropologists were more concerned about gender roles than dietary intake; hence, *Man the Hunter* (Lee & DeVore 1968) as opposed to *Woman the Gatherer* (Dahlberg 1981). Studies of the San and !Kung peoples of the Kalahari showed that they relied heavily on gathering, a practice that did not take much time or effort in an environment of abundant plant resources. The groups consumed more than 150 plant and 100 animal species, but derived most of their energy from just 23 plant species. These plants provided a dependable food source, whereas game was scare, difficult to find, and hard to kill; snakes, lizards, and insects were not eaten. Thus, about 80% of the diet by weight consisted of foods from plant sources (Lee & DeVore 1976).

Eaton & Konner estimated the proportion of plant foods in the diets of hunter-gatherer groups as 50–80% by weight in inland, semitropical habitats, 50–90% in coastal areas, but less than 10% in the northernmost Arctic (Eaton *et al.* 1997). Despite recent suggestions that animal foods comprised 45–65% of energy intake (Cordain *et al.* 2000) the preponderance of evidence supports the idea that plant foods predominated in the diets of hunter-gatherer groups living in areas where plants could be grown (Mitton, 2000).

The Arctic exception

The one exception occurs among the indigenous people of Arctic North America, the extreme of human (and plant) habitation. In the 1920s, Arctic Inuit were reported to rely completely on hunting for their food, but to do little or no gathering, particularly at latitudes above 49 degrees (Lee & DeVore 1968). Instead, the population depended on marine and land mammals and fish for 80–100% of intake and therefore on a diet based almost entirely on animal protein and animal fat (Harris & Ross 1987).

If these observations are correct, the population must have been able to survive to reproductive age on a diet containing only minimal amounts of the nutrients for which plants are the primary sources. Because vitamin C is found almost exclusively in plant foods, a source of this vitamin must have been available to prevent scurvy and ensure survival. Analyses of the nutrient content of raw game meats and offal indicate that raw bison, caribou and moose contain 5–15 mg vitamin C/100 g portions (US Department of Agriculture 1989) an amount that should be sufficient to prevent scurvy in most people. Whale skin, organ meats, and the stomach contents of animals also would be expected to contain the vitamin. Comparative information on life expectancies, infant mortality rates, and other health indices of precontact indigenous peoples, however, is largely lacking. Despite the short growing season, investigators have identified more than 1000 edible plant species in Arctic areas, and found evidence for consumption of at least 550 of them – seaweeds, lichens, fungi, ferns, conifers, and flowering plants. Their observations of present-day indigenous populations reveal considerable gathering, processing, and preservation of edible plants (Kuhnlein & Turner 1991). Thus, it seems likely that precontact indigenous people consumed enough plant foods to provide needed nutrients, and gathered and stored plant foods for use during winter seasons.

Implications

As should be apparent from this brief overview, the evidence for the relative proportions of animal and plant foods in the diets of early humans is circumstantial, incomplete, and debatable. The available data are insufficient to identify the composition of a genetically determined optimal diet, if such exists, let alone draw compelling inferences. Despite our current consumption of non-Paleolithic diets, the lifespans of adults in most industrialised countries are lengthening, and populations are remaining relatively healthy into ripe old age. The evidence related to Paleolithic diets can best be interpreted as supporting the idea that diets based largely on plant foods promote health and longevity, at least under conditions of food abundance. Substantial and compelling evidence supports recommendations that people in industrialised and industrialising economies could reduce risks for chronic disease if they increased their intake of fruits, vegetables, and grains in proportion to animal foods, and kept as active as our hunter-gatherer ancestors.

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some animal foods (Harding & Teleki 1981) but we cannot assume from such observations that primate diets establish a *genetic* basis for an optimal human diet (Harris & Ross 1987).

Early hominids

On the basis of wear-and-tear patterns on fossilised jaws and teeth, early hominids must have eaten fleshy fruits and leaves from heavily wooded habitats, although later hominids who lived in savanna environments were likely to have been omnivorous. Because the ratio of stable isotopes (e.g. $^{13}C/^{12}C$ or $^{18}O/^{16}O$) reflects what vertebrates have eaten (Kohn 1999) researchers can now provide direct isotopic evidence for some aspects of the dietary patterns of early hominids. Their studies reveal that progenitors of *homo sapiens* must have eaten fruits and leaves but also large amounts of foods enriched in ^{13}C such as savanna grasses, or the animals that ate such grasses (Sponheimer & Lee-Thorp 1999). This finding is especially interesting because it suggests that early hominids were eating animals before they could make tools. It also suggests that because meat-eating occurred long before the human brain increased to its present size, this dietary practice cannot be responsible for the development of larger brains (Vogel 1999). One additional piece of evidence comes from findings at a European cave where investigators observed similar cut and fracture marks on the bones of deer and hominids, suggesting that Neanderthal hominids not only ate meat but also each other (Defleur *et al.* 1999).

An alternative dietary hypothesis to explain this transition is that consumption of tuberous vegetables ('underground storage organs') could have raised energy intakes and promoted longer lifespans (O'Connell *et al.* 1999) especially when the tubers were cooked and made more digestible (Pennisi 1999). This tuber hypothesis has elicited much debate about whether *any* foods could have been cooked two million years ago, as most evidence for the use of fire for cooking purposes suggests a much more recent date – 250 000 years ago (Pennisi 1999). Clearly, early hominids ate meat as well as plant foods, but in relative proportions as yet undetermined.

Paleolithic Humans

Anthropologists draw dietary inferences from examinations of fossilised bones and teeth, shell mounds, artefacts used for food acquisition and preparation, and the topography of archaeological sites, as well as from chemical analyses of bones, teeth, and plant remains. The gold standards for dietary intake, however, are faecal food remains and stomach contents; such samples are rare but constitute the only unequivocal proof of actual ingestion (Harding & Teleki 1981). Together, such studies provide considerable evidence for meat consumption by early humans. Fossil animal bones at archaeological sites display cut and hammer marks, teeth marks, and breaks that are consistent with meat consumption, and stone artefacts found at such sites also are consistent with meat-eating. Certain pathological changes in fossil human skeletons appear similar to those found in the skeletons of people who suffer from vitamin A toxicity, a condition that could only have occurred if early humans ate animal liver.

Findings of ancient human and animal bones occur only rarely, and such sites are scattered, poorly preserved, and incompletely recovered. All such samples are necessarily biased (Cohen 1989). Because bones are better preserved than vegetable matter, they give the impression that hunted animals must have been the primary food sources. Thus, archaeological techniques tend to underestimate plant consumption but overestimate animal consumption (Hastorf 1988). Moreover, finding animal bones or fossilised seeds at a site does not prove that they were used as food. For these reasons, experts continue to argue that early humans ate little but meat, while others view the archaeological evidence simply as consistent with meat-eating although too ambiguous to draw dietary inferences. Whatever the proportion of plant to animal foods, the life expectancy of Paleolithic humans has been estimated as about 25 years (Cohen 1989), suggesting that the diet, along with other conditions of life, must have been less than ideal. Even this point is debated, however, as foraging for tubers and other plants by 'grandmothers' could well have promoted infant survival and adult longevity equivalent to levels seen today (O'Connell *et al.* 1999).

Surviving hunter-gatherers

It is convenient to assume that existing hunter-gatherers are survivors of prehistoric ways of life. The few such societies that survived into the twentieth century were largely confined to marginalised regions not well-suited to agriculture, however, and they displayed life expectancies at birth of 25–30 years and infant mortality rates of 40–50% (Cohen 1989). By the 1970s, anthropologists believed these societies to be so radically changed that it was difficult to reconstruct practices of just 25–50 years earlier with any degree of rigour (Lee & DeVore 1976).

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