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Realigning Our 21st Century Diet and Lifestyle With Our Hunter-gatherer Genetic Identity

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Humans evolved during the Paleolithic period, from approximately 2.6 million to 10,000 years ago. Although the human genome has remained largely unchanged,[1] our diet and lifestyle have become progressively more divergent from those of our ancient ancestors. These maladaptive changes began with the advent of the agricultural revolution approximately 10,000 years ago and have been accelerating in recent decades. Socially, we are a people of the 21st century, but genetically we remain citizens of the Paleolithic era.

The evolutionary collision of our ancient genome with the nutritional quality of recently introduced processed and synthetic foods underlies virtually all of the chronic diseases of Western civilization.[2,3] Today, most of us dwell in mechanized urban settings, leading largely sedentary lives and eating a diet of highly processed synthetic foods. **As a result, two-thirds of Americans are overweight or obese.**[4] **The lifetime incidence of hypertension is an astounding 90%, and insulin resistance/metabolic syndrome is present in up to 40% of middle-aged American adults (Figure 1).**[6] **The average total cholesterol level in adult Americans is approximately twice the physiologically normal level (Figure 1).**[7]

Cardiovascular disease remains the number one cause of death, accounting for 41% of all fatalities, and the prevalence of heart disease in the United States is projected to double during the next 50 years.[8] Despite remarkable pharmacological and technological advances, the pandemic of cardiovascular disease continues. At least for today, the genes we are born with are those that we will live and die with. Thus, the most practical solution for reducing the incidence of chronic degenerative diseases, such as atherosclerosis, is to realign our current maladaptive diet and lifestyle to simulate the milieu for which we are genetically designed.

Living organisms thrive best in the milieu and on the diet to which they were evolutionarily adapted; this is a fundamental axiom of biology. *(continued on page 3)*

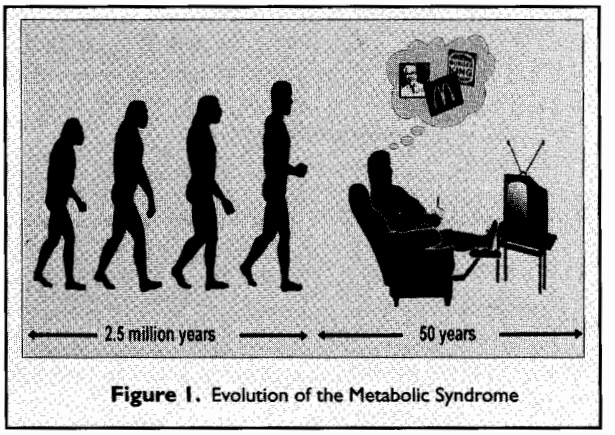

Figure 1. Evolution of the Metabolic Syndrome

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All of the food consumed daily by our ancient ancestors had to be foraged or hunted from wild plants and animals in their natural world. In many respects, that Paleolithic world is gone forever, but insights gained from a wide array of disciplines are providing a clear picture of the ideal diet and lifestyle for humans.

The hunter-gatherer mode of life became extinct in its purely non-Westernized form in the 20th century.[9] At the beginning of the 21st century, we are the first generation to have the genetic and scientific understanding to allow us to reconstruct the essence of that lifestyle and the means to afford it.

Historical and archaeological evidence shows hunter-gatherers generally to have been lean, fit, and largely free of signs and symptoms of chronic diseases, even in those individuals who managed to avoid premature death from infection, starvation, trauma, etc, and live into old age.[10,11] When hunter-gatherer societies transitioned to an agricultural grain-based diet, their general health deteriorated.[12,13] The average adult height was substantially shorter for both men and women who consumed cereals and starches compared with their hunter-gatherer ancestors, who consumed lean meats, fruits, and vegetables.[14,15] Furthermore, studies of bones and teeth reveal that populations that changed to a grain-based diet had shorter life spans, higher childhood mortality, and a higher incidence of osteoporosis, rickets, and various other mineral- and vitamin-deficiency diseases.[12,13]

This review outlines the essence of the hunter-gatherer lifestyle and diet and suggests practical steps to realign our modern milieu with our ancient genome in an effort to improve cardiovascular health, vigor, and longevity.

The Ideal Human Diet

Perhaps no scientific topic has generated more controversy and confusion in recent times than the question of the ideal human diet. This confusing issue is epitomized by the Atkins[16] versus Ornish[17] debate. The Atkins diet is high in protein, high in saturated fat, and avoids nearly all carbohydrates. In contrast, the Ornish diet consists of 80% carbohydrates and minimized consumption of all animal protein and fats. Proponents of each diet insist that theirs is the answer to the American epidemics of obesity and cardiovascular disease; however, the advice of these diets is mutually exclusive and diametrically opposed (Table 1).

In truth, the ideal diet is neither of these extremes nor what many medical professionals now promote. In

Table I
COMPARISON OF DIETS

	Traditional		Low-Carb	Low-fat
Nutrient	**Mediterranean**	**Hunter-gatherer**	**Atkins Diet**	**Ornish Diet**
Protein	Moderate (16-23%)	High (19-35%)	Moderate (18-23%)	Low (< 15%)
Carbohydrates	Moderate (50%)	Moderate (22-40%)	Low (4-26%)	High (80%)
Total fat	Moderate (30%)	Moderate (28-47%)	High (51-78%)	Low (< 10%)
Saturated fat	Low	Moderate	High	Low
Monounsaturated fat	High	High	Moderate	Low
Polyunsaturated fat	Moderate	Moderate	Moderate	Low
Omega-3 fat	High	High	Low	Low
Total fiber	High	High	Low	High
Fruits and vegetables	High	High	Low	High
Nuts and seeds	Moderate	Moderate	Low	Low
Salt	Moderate	Low	High	Low
Refined sugars	Low	Low	Low	Low
Glycemic load	Low	Low	Low	High

a recently published review of approximately 150 studies of the link between diet and cardiovascular health,[18] the authors concluded that 3 major dietary approaches have emerged as the most effective in preventing cardiovascular events:

1. Replacing saturated and trans-fats with monounsaturated and polyunsaturated fats;
2. Increasing consumption of omega-3 fats from either fish or plant sources, such as nuts; and
3. Eating a diet containing large amounts of various fruits, vegetables, nuts, and whole grains while avoiding foods with a high glycemic load (a large amount of quickly digestible carbohydrates).

Despite common misperceptions, this report found no strong evidence for a link between the risk for cardiovascular disease and the intake of meat, cholesterol, or total fat.

These broad characteristics are consistent with the diet with which Paleolithic humans evolved. This is the diet that our hunter-gatherer ancestors thrived on until the advent of the agricultural revolution. Through the millennia, our genome and physiology became adapted to this diet. The average human lifespan has almost doubled over the past century; however this has been largely the result of the use of antibiotics; the availability of a clean public water supply; reduced infant and maternal mortality; and less trauma, starvation, and other causes of premature death. In contrast, the prevalence of chronic diseases of civilization has increased over the past century, in part because of this marked decrease in premature death.

Real Food, Not Synthetic Food

Our remote ancestors consumed only natural and unprocessed food foraged and hunted from their environment. This subsistence strategy resulted in a diet based on lean protein that was also high in fiber, vitamins, minerals, antioxidants, and other beneficial phytochemicals (Table 2).[19] Compared with the average modern American diet, the typical Paleolithic diet contained 2 to 3 times more fiber, 1.5 to 2.0 times more polyunsaturated and monounsaturated fats, 4 times more omega-3 fats, and 30% to 40% less saturated fat. The protein intake was 2 to 3 times higher, and the potassium intake was 3 to 4 times higher; however, the sodium intake was 4 to 5 times lower.[20] Finally, the Paleolithic diet contained no refined

Table 2
FUNDAMENTALS OF THE HUNTER-GATHERER DIET AND LIFESTYLE

- Eat whole, natural, fresh foods; avoid highly processed and high–glycemic-load foods.
- Consume a diet high in fruits, vegetables, nuts, and berries and low in refined grains and sugars. Nutrient-dense, low–glycemic-load fruits and vegetables such as berries, plums, citrus fruits, apples, cantaloupe, spinach, tomatoes, broccoli, cauliflower, and avocados are best.
- Increase consumption of omega-3 fatty acids from fish, fish oil, and plant sources.
- Avoid trans-fats entirely and limit intake of saturated fats. This means eliminating fried foods, hard margarine, commercially baked goods, and most packaged and processed snack foods. Substitute monounsaturated and polyunsaturated fats for saturated fats.
- Increase consumption of lean protein, such as skinless poultry, fish, and game meats and lean cuts of red meat. Cuts with the words *"round"* or *"loin"* in the name usually are lean. Avoid high-fat dairy and fatty, salty processed meats such as bacon, sausage, and deli meats.
- Incorporate olive oil and/or non–trans-fatty acid canola oil into the diet.
- Drink plenty of water.
- Participate in daily exercise based on various types of activities (incorporating aerobic and strength training and stretching exercises). Outdoor activities are ideal.

grains and sugars (except for seasonally available honey).

Clearly, the ongoing epidemic of cardiovascular disease is at least in part due to these striking discrepancies between the diet we are designed to eat and what we eat today. In growing season, abundant fruits, berries, and vegetables were consumed. **The one variable on which nearly all nutrition experts can agree is the need for an increased intake of fruits and vegetables in our modern diet.** Also, the hunter-gatherer diet is high in beneficial phytochemicals and antioxidants, which renders multivitamin and mineral supplements superfluous.[20]

Caloric Intake:

Throughout most of human history, *food consumption* (energy intake) was obligatorily linked to *food acquisition* (energy output). Accordingly, our ancient ancestors expended more energy finding and obtaining food calories than do typical sedentary, westernized citizens for whom there is virtually no connection between energy intake and energy expenditure.

Our craving for calorie-dense foods—such as fats, sweets, and starches—is the legacy of our Paleolithic ancestors, who sought these foods because they conferred positive survival value in an environment in which these food types were scarce. These cravings betray us in our modern world, where calorie-dense foods are abundant and inexpensive and most people die of caloric excess manifested as obesity, the metabolic syndrome, hypertension, and cardiovascular disease. Compounding the issue is the fact that our genome became adapted to an environment in which caloric intake was often sporadic and sometimes inadequate. This promoted efficient energy use and storage, commonly referred to as the thrifty gene hypothesis. **Although this genetic adaptation (which results in storage of excess calories as intra-abdominal fat) provides a survival advantage in an environment of scarcity, it becomes a liability in the setting of long-term excessive caloric intake.**

Although the key to weight loss is simply the daily consumption of fewer calories than are expended, it is easier to moderate caloric intake in a diet that has adequate quantities of protein and fat because of superior satiety compared with a high-carbohydrate, low-fat diet.[18,21,22] **A growing consensus indicates that a diet containing moderate amounts of beneficial types of fat and protein in addition to carbohydrates with a low glycemic load (non-starchy vegetables and fruits) in conjunction with daily exercise is the most effective way to achieve and maintain ideal body weight and prevent cardiovascular disease.**[18,21–23] This approach was the eating pattern and lifestyle of prehistoric humans.

Omega-3 Fats:

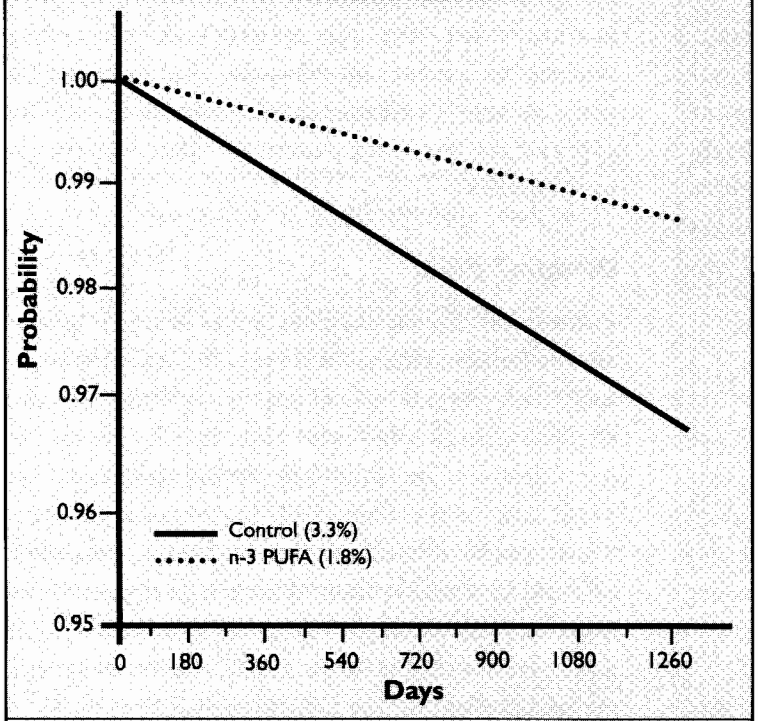
Polyunsaturated fats are classified as omega-6 (generally proinflammatory) or omega-3 (anti-inflammatory with several other inherent cardioprotective effects). Omega-3 fats were abundant in the diet of our Paleolithic ancestors.[24] In the natural world, the broad base of the food chain is composed of algae, which are ubiquitous in the sea, and grasses and leaves on land. The small amount of fat in algae, grasses, and leaves is rich in omega-3 fatty acids, which become more concentrated in larger animals up through both the land and marine food chains, especially in fish and larger grazing animals. **Today, meat from domesticated animals is low in omega-3 fats, because these animals are generally fed grain or corn, rather than grass.**[25] This and other issues have resulted in a much lower intake of omega-3 fats today compared with that of our remote ancestors.[24,25]

The correction of this omega-3 deficiency in the modern diet is a key step in improving cardiovascular health in our population.[26] **Prospective studies indicate that an increased intake of fat composed of omega-3 fatty acids from fish oils (eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]) will reduce cardiovascular risk by as much as 32% to 50% (Figure 2).**[25–30] Recently, for the first time, the American Heart Association recommended that a nutrient—the omega-3 fatty acids—be consumed as a supplement.[31]

The phospholipid layer of neuronal membranes of the brain are rich in omega-3 fats (~20%), especially DHA. This omega-3 fatty acid makes the cell membrane more elastic and is essential for optimal brain function. If a person is deficient in DHA, the mem-

Figure 2

THE GRUPPO ITALIANO PER LO STUDIO DELLA SOPRAVVIVENZA NELL'INFARTO MIOCARICO PREVENZIONE STUDY[26]



The study[26] showed a 45% reduction in sudden cardiac death (SCD) among patients receiving a concentrated fish oil supplement containing approximately 850 mg of omega-3 fats.

brane replaces it with an omega-6 fatty acid called docosapentaenoic acid (DPA),[32] which is almost identical to DHA, except for a tiny difference in molecular structure at n-6 that makes it vastly less flexible. This imparts subtle but critically important differences in neuronal membrane activity. Omega-3 deficiency has been associated with an increased risk for bipolar disorder, depression, stroke, dementia, and schizophrenia.[33]

Monounsaturated Fats:

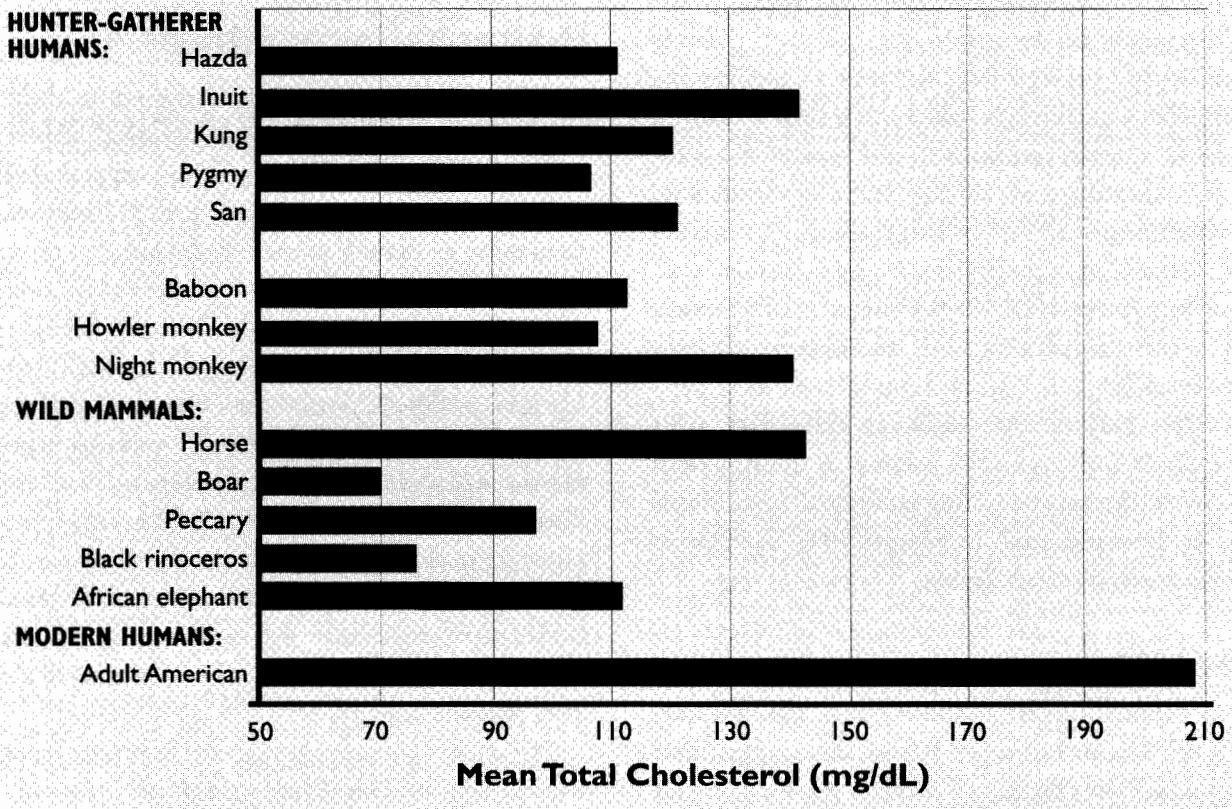
Monounsaturated fats made up approximately half of the total fat in the diets of most hunter-gatherers.[34] **Monounsaturated fats reduce cardiovascular risk, especially when they replace more easily digestible starches and sugars.**[35] Nuts comprise a valuable source of monounsaturated fats and have been shown to be cardioprotective in at least 6 epidemiological studies.[20,22,36] Our hunter-gatherer ancestors relied on nuts as an easily accessible, calorie-dense, highly nutritious food that was often available in non-summer months. Typically, 80% of the calories in nuts are from fat, but mostly in the form of healthy monounsaturated and polyunsaturated fats. **Epidemiological studies show that frequent nut consumption (≥ 5 times per week) is associated with up to a 50% reduction in risk for myocardial infarction compared with the risk in people who rarely or never eat nuts.**[36] **In other studies, nut consumption has been shown to reduce the risk of developing type 2 diabetes,**[37] **to lower the atherogenic low-density lipoprotein (LDL) cholesterol level without lowering the high-density lipoprotein (HDL) level,**[38] **and to provide plant-based protein and other potentially cardioprotective nutrients, such as vitamin E, folate, magnesium, copper, zinc, and selenium.** Because of their high levels of fiber, protein, and fat, nuts also provide better and longer-lasting satiety compared with the high glycemic-load snack foods that are typically consumed today. Oleic acid is the major monounsaturated fat in our diets and is found in meats, nuts, avocados, dark chocolate, and olive oil.

The Problem With Vegetarianism

All evidence points to the fact that hunter-gatherers were omnivorous.[39] **Strictly vegetarian diets are difficult to follow and are not necessarily associated with better health.** Many current vegetarians would be more appropriately labeled "breaditarians." Modern vegetarian diets often rely heavily on processed carbohydrates, such as white rice, potatoes, and white flour and sugars. In Westernized societies, sugar intake has increased substantially over the past 2 centuries.[40] **In a recent study, investigators found that a high–glycemic-load diet is the most important (albeit inversely related) dietary predictor of HDL level.**[41] A high–glycemic-load diet predisposes a person

Figure 3

TOTAL CHOLESTEROL LEVELS FOR HUNTER-GATHERERS, WILD PRIMATES, AND WILD MAMMALS



Total cholesterol levels generally range from about 70 to 140 mg/dL (corresponding to low-density lipoprotein levels of about 35 to 70 mg/dL). The mean cholesterol levels of modern Westernized humans are almost twice these normal values.[5]

to the metabolic syndrome and cardiovascular disease and is one of the most atherogenic features of our modern eating pattern.[41-44]

Can Meat Be Cardioprotective?

In comprehensive studies of diverse hunter-gatherer populations, investigators have found that these people typically derived 45% to 60% of their calories from animal foods.[34,39] Although increased meat consumption in Western diets has been associated with increased cardiovascular risk, the hunter-gatherers were relatively free of the signs and symptoms of cardiovascular disease.[10]

It is not the amount of meat eaten, but rather the composition of the meat and the cooking methods used that determine the health effects of this food. Accumulating scientific evidence indicates that **meat consumption is not a risk for cardiovascular disease, but that this risk is secondary to the high levels of saturated fats that are typically found in the meat of most modern domesticated animals.**[40,45] Diets high in lean protein can improve lipid profiles and overall health, especially if care is taken to trim any visible fat from the meats before cooking and to allow the fat to drain from the meat when cooking.[46-51] However, **cooking red meats at high temperatures produces high levels of heterocyclic amines, which have been implicated in the risk for many cancers.**[52] **Highly salted and preserved meats may also contain carcinogens.**

Trans-fatty Acids:

Trans-fatty acids are found in small quantities in the fatty tissue of all ruminant animals. However, in recent decades, the intake of trans-fatty acids has

increased markedly because of their ubiquitous presence in commercially prepared foods. These "trans-fats" (also referred to as hydrogenated or partially hydrogenated vegetable oils) are synthesized by the hydrogenation of the edible oils, which is typically done in the prepared food industry to prolong the shelf-life of commercially baked goods such as cookies, crackers, donuts, croissants, and processed snack foods. Trans-fatty acids are also found in shortenings, most margarines, and deep-fried foods, and recently in many brands of commercially available canola oils.[53] **Trans-fats lower HDL levels, increase LDL levels, and increase the risk for both cardiovascular disease and cancer.**[22,35]

Studies indicate that replacing trans-fatty acids (typically 2% of total daily calories in the American diet) **with the same amount of natural unsaturated fatty acids would result in a large (50%) decrease in risk for coronary heart disease.**[35]

Beverages:

Our Paleolithic ancestors drank water almost exclusively of all other beverages. **Recent data suggest that a generous water intake—5 or more glasses daily—is associated with a lower risk for coronary heart disease.**[54] Water, when consumed frequently, displaces calorie-dense beverages such as sugared sodas from the diet. It also provides adequate hydration and reduces blood viscosity better than other commonly ingested drinks. Hyperviscosity has been shown to impair capillary blood flow, which results in neurological manifestations and an increased risk for bleeding. Thrombotic complications can also occur in both arteries and veins and manifest as a stroke, myocardial infarction, deep vein thrombosis, or pulmonary embolism.[55] Sugared sodas are the predominant types of beverages consumed in America today. These are calorie-dense, nutritionally barren drinks that have contributed to the rise in obesity and insulin resistance. Tea (Camellia sinensis) has been brewed for thousands of years as a favorite drink in several parts of the world. **This beverage has been shown to be high in natural antioxidant phytochemicals (polyphenolic compounds). Drinking tea has been shown to reverse endothelial vasomotor dysfunction in people with coronary artery disease.**[56]

Hunter-gatherer Fitness

Our Paleolithic ancestors exerted themselves daily to secure their food and water and to protect themselves and their clans.[57,58] Although modern technology has made physical exertion optional, **it is still important to exercise as though our survival depended on it**—and in a different way, it still does. We are genetically adapted to an extremely physically active lifestyle. **A sedentary existence predisposes us to obesity, hypertension, metabolic syndrome, diabetes, and most types of cardiovascular disease,**[59,60] **whereas regular exercise decreases the risk of developing all of these diseases.**[61,62] Even in times of caloric excess, hunter-gatherers avoided weight gain in part because they were extremely physically active. **Studies of obesity consistently show that the best way to maintain weight loss (regardless of the type of diet used) is by daily physical exercise.**[63]

Our remote ancestors participated in various types of physical activity daily. They walked and ran 5 to 10 miles daily as they foraged and hunted for their food sources.[57,58] They also lifted, carried, climbed, stretched, leaped, and did whatever else was necessary to secure their food, water, and protection while living in the wild. Days of heavy exertion were followed by days of recovery. In modern terms, these people cross-trained with aerobic, resistance, and flexibility exercises. According to recent data on physical activity, **fitness programs that use various exercises are the most effective in preventing cardiovascular disease.**[64]

Summary

The hunter-gatherer diet and lifestyle are the milieu for which we remain genetically adapted. Although it is neither practical nor even possible to replicate all prehistoric living conditions today, these general characteristics should serve as a template to design and test effective interventions to reduce the incidence of degenerative cardiovascular diseases.

There are no CME questions for this special report.

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