

Health conditions before Columbus: paleopathology of native North Americans

Information about the health status of the earliest inhabitants of North America provides a chronology of health problems that spans more than a thousand years. Studies of disease in ancient times add an important dimension to our understanding of the life struggles of a largely unknown past. In this article, we provide a brief overview of health conditions and quality of life in North America before contact and colonization.

Data on health in ancient societies are inferred from the analysis of a wide range of archaeological materials, but human bones and teeth form by far the largest body of evidence. For several regions in the United States, there are health chronologies spanning hundreds of years. For example, Walker, using a multimethod approach involving the analysis of skeletal lesions and detailed reconstruction of the environment, demonstrated that Indians of southern California who lived in marginal island environments (about 800 BC to AD 1150) showed greater evidence of health problems than those who lived on the mainland, where food was more abundant and diverse.¹ He also showed increased rates of infectious diseases over time.

There has been a shift toward conducting population-level analyses that shed light on epidemiologic characteristics of the health of ancient societies by providing frequencies and patterning of disease within and between populations.² Much of the recent paleopathology literature emphasizes temporal and spatial variability in patterns of disease and the shift in many parts of North America at different times from an economy based on gathering and hunting to agriculture. Although not all groups in North America adopted full-blown maize agriculture, many did, and it has been the focus of intense debate.²

The study of North American archaeological remains has been under protest by native groups because historically they have had little say over the excavation and curatorship of their ancestors' remains.³ These protests led to legislation passed in 1990 entitled the Native American Graves Protection and Repatriation Act (US Public Law 101-601). This law ensures that Native Americans have the final say regarding the nature of studies that rely on ancestral and historic human remains. In many ways, this legislation has redefined the nature of archaeological research in the United States and has opened new venues of study as Native Americans and anthropologists have begun working together to reconstruct the past.⁴

Summary points

- Data on health in ancient societies come mainly from human bones and teeth
- Studies of skeletons suggest that iron deficiency anemia was widespread in native North Americans, probably due to their overreliance on maize, which is low in iron, in their diet
- The most frequent causes of infectious diseases in prehistory were common microorganisms such as staphylococcus and streptococcus
- Archaeologic remains show that native groups were not living in a pristine, disease-free environment before contact with Europeans
- Studies of ancestral menus and ancestral health trends may provide important clues to the health problems of today's Native Americans

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AN ANALYSIS OF DISEASE IN ANCIENT POPULATIONS

Because skeletal tissue typically responds in nonspecific ways to disease, the diagnosis of a specific cause is often difficult. Fortunately, what has the greatest explanatory power is not the specific agent but, rather, the severity, duration, and temporal course of generalized physiologic perturbations. These general stressors, as they may be read and deciphered from skeletal lesions, can provide a means for assessing the health status and degree of functional impairment that an individual experienced.

To elucidate this general health stress perspective, a model was developed to apply to studies of health in the past.⁵ With its focus on relationships between environment, culture, and biologic conditions, this model has proved useful in considering past adaptive struggles and

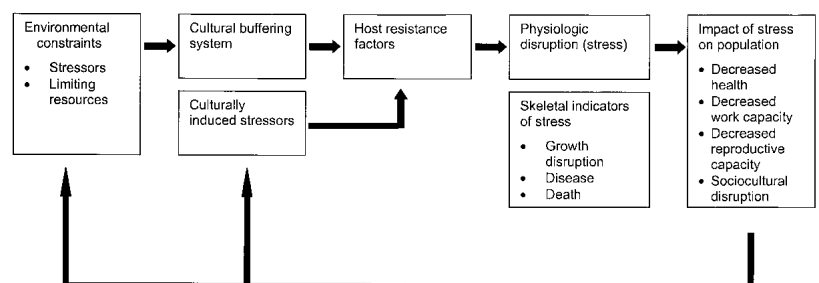


Figure 1 Model depicting variables necessary for delineating precontact group adaptation. The feedback loop can be used only when the archaeological context of the human remains is well documented.

the centrality of health (figure 1). Analysis of past health begins with understanding the environmental context within which people lived. The environment greatly influences how successful groups are at procuring food and what the constraints may be in providing food, clothing, and shelter. If groups are to thrive, they must adapt to climate, excess heat or cold, high altitude, parasites, and predators.

In terms of ancient health, understanding the cultural patterns helps us to understand which cultural customs buffered against poor health and which customs may have promoted disease. For example, enclosed rock shelters in Colorado offered protection from the elements and predators, but they also facilitated the exchange of communicable diseases.⁶ The development of agriculture in North America allowed greater production of calories relative to human expenditure⁷ and, thus, would seem to have provided a buffer against undernutrition. However, the resulting increased population density, along with other ecologic and demographic changes associated with intensified farming, had a profound influence on health, with statistically significant increases in infectious diseases and iron deficiency anemia.

The response to disease stress is often a stereotypic physiologic change that results from the effort to adjust and overcome the stress, and this is frequently manifest in relatively permanent osteologic indicators. Although paleopathologists may be limited by the amount of information that can be gleaned from archaeological remains, a multidisciplinary approach has allowed the integration of forensic, medical, and epidemiologic methods to reconstruct health conditions.

PREVALENT HEALTH PROBLEMS IN PRE-COLUMBIAN TIMES

Iron deficiency anemia

Porotic hyperostosis is a descriptive term for lesions primarily found on the parietal and orbital bones of the cranium, produced by bone marrow proliferation diagnostic of anemia. The lesion generally takes the form of a raised, porous area that develops when the trabecular portion of the cranial bone (diploë) expands and the outer table of bone becomes thinner, exposing the inner diploë. Anemias can potentially affect any bone of the skeleton that is involved in the production of red blood cells, but the most frequently affected bones are those of the cranium (figure 2).

Porotic hyperostosis is a skeletal indicator of nutritional stress that has been extensively studied in archaeological populations.⁸ Nearly all cases in North America seem to be due to iron deficiency, and the presence of low iron stores is likely to occur concomitantly with other health problems and nutritional deficiencies. Although these le-

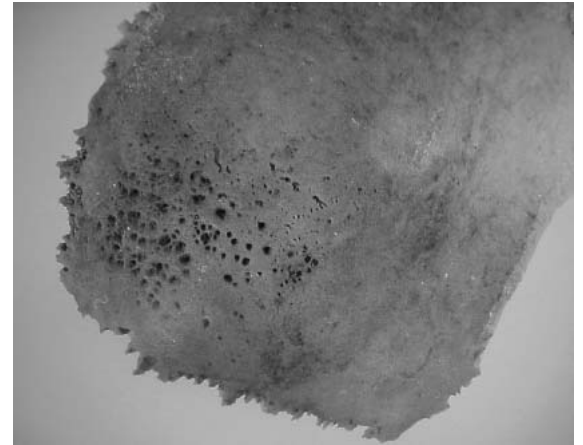


Figure 2 Porotic hyperostosis is a condition that is generally seen on the cranial bones and is indicative of iron deficiency anemia

sions can also be caused by hereditary hemolytic anemia and other disorders, iron deficiency is accepted as the primary cause of porotic hyperostosis for the vast majority of documented prehistoric cases.⁹

Iron deficiency anemia appears to have been widespread and ubiquitous in most ancient populations in the New World.⁸ The general distribution of the lesion corresponds with increasing reliance on agricultural products such as maize, which are low in bioavailable iron. For example, Lallo and co-workers evaluated changes in rates of porotic hyperostosis for ancient Mississippians in Illinois living in the 12th century and found that its prevalence increased dramatically in the transition from hunting and gathering to agriculture.¹⁰ They suggested that this was due to an overreliance on maize in the diet and that the lesions were most pronounced in younger children because of diarrheal disease during weaning, combined with poor diet.

Infectious diseases

Infectious diseases are among the most significant selective forces in human evolution¹¹ and, combined with undernutrition, continue to be the largest contributor to morbidity and mortality worldwide. Although most infectious diseases leave no diagnostic markers, it is fortunate for paleopathologists that some affect the skeleton, changing the structure of bone tissue. The most frequent causes of infectious diseases in prehistory have been estimated to be common microorganisms such as staphylococcus and streptococcus, with conditions such as tuberculosis and venereal and nonvenereal syphilis relatively rare and more controversial to diagnose.¹² The chronic (typically nonlethal) conditions are important to track at the community level because these illnesses perhaps shed the most light on everyday occurrences of poor diet, transmissible diseases, and the state of waste disposal and hygiene.

Osteomyelitis results from the introduction of pyogenic infection, and the skeletal response involves the periosteum, cortex, and medullary cavity. Osteitis is another form of this phenomenon, but the reaction is primarily localized within the cortical bone. Periostitis occurs when the reaction is restricted to the outer shaft, or periosteum. It can occur as a direct response to a skin infection, through trauma, through systemic bacterial invasions, or from other soft tissue infections. Diagnosis and identification of the cause of the infection are difficult, and paleopathologists have now advocated using general descriptive categories for classifying the skeletal changes observed.¹³ Referred to as nonspecific infectious lesions, the skeletal manifestations are categorized as periosteal reactions because most of the infectious conditions seen on prehistoric bones tend to fall in this category (figure 3). Specific diagnoses are attempted by paleopathologists when there are lesions that seem to fit the pattern reported for treponemal or tubercular infections, although the number of these in pre-Columbian individuals is relatively rare.

Lallo and colleagues noted that the severity of periosteal reactions among Mississippian burials increased nearly fourfold during the period spanning the hunter-gatherer phase through intensive agriculture.¹⁰ The increase in infectious diseases in the intensive agriculturalists was thought to be related to increased population density and sedentary behavior, coupled with low dietary quality and overreliance on maize. Other trends in infectious diseases demonstrated that adult women had higher rates than did men and that individuals with infections died at an earlier age. Individuals had a high rate of co-occurrence of porotic hyperostosis and infections, suggesting that iron deficiency may have predisposed children to infectious diseases by lowering resistance.

Osteoarthritis

Osteoarthritis is among the oldest and most commonly known diseases that affect humans. Measuring the amount of arthritic involvement with skeletal remains is sometimes difficult because of the potentially large number of areas to be assessed (each vertebra and all joint systems) and the range of variation in bony response among individuals. Although many factors may contribute to the breakdown of skeletal tissue, the primary cause of osteoarthritis is related to biomechanical wear and tear and functional stress.¹⁴ Biomechanical stress is most apparent at the articular surfaces of long bone joint systems and is referred to as degenerative joint disease. There may be a relationship between such disease and other health problems. For example, a study correlating the incidence of degenerative joint disease and infection was undertaken for a Mississippian population from Illinois (AD 1000-1200). Individuals with multiple joint involvement dem-

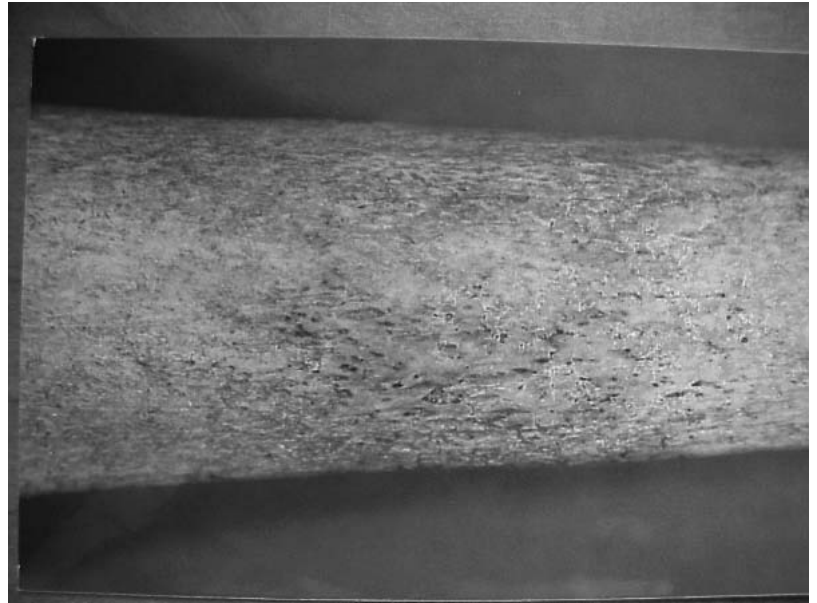


Figure 3 Periosteal reactions can be seen clearly on this long bone and are indicative of some type of nonspecific infectious condition

onstrated a statistically higher percentage of periosteal reactions. The prevalence of both infectious lesions and degenerative joint disease increased with age, and women demonstrated greater frequencies of disease in the shoulder and elbows than did age-matched men.

In general, early Native Americans appeared to sustain osteoarthritis at rates comparable with individuals today, although the earlier rate of onset and decreased life span of early Native Americans may have served to compress the observable cases into a shorter time frame within the life span. Much work in the area of osteologic correlates of occupational stress and weapon use suggest strong associations between lifestyle and patterns of osteoarthritic and other bone changes.¹⁵

DEMOGRAPHY AND DISEASE AT CONTACT

There is wide agreement about the effects of diseases and epidemics associated with European contact.^{16,17} The first well-documented, widespread epidemic in what was to become New Mexico was smallpox in 1636. Shortly thereafter, measles entered the area, and many Pueblos lost as many as a quarter of their inhabitants.¹⁸ After the founding of Spanish settlements and missions, there was substantially more contact, and throughout the 17th century, epidemic disease was repeatedly imported.

Osteologic data demonstrate that native groups were most definitely not living in a pristine, disease-free environment before contact. Although New World indigenous disease was mostly of the chronic and episodic kind, Old World diseases were largely acute and epidemic. Different populations were affected at different times and suffered varying rates of mortality.¹⁹ Diseases such as

treponemiasis and tuberculosis were already present in the New World, along with diseases such as tularemia, giardia, rabies, amebic dysentery, hepatitis, herpes, pertussis, and poliomyelitis, although the prevalence of almost all of these was probably low in any given group.¹⁴ Old World diseases that were not present in the Americas until contact include bubonic plague, measles, smallpox, mumps, chickenpox, influenza, cholera, diphtheria, typhus, malaria, leprosy, and yellow fever.¹⁹ Indians in the Americas had no acquired immunity to these infectious diseases, and these diseases caused what Crosby referred to as “virgin soil epidemics,” in which all members of a population would be infected simultaneously.²⁰

It is important to look not only at the effects of specific events like epidemic outbreaks but also at longer-term processes that influence the age and mortality structure of populations. Kunitz and Euler stated that “one does not need to invoke large-scale dramatic epidemics; prosaic entities like malnutrition and infectious diarrhea are more than sufficient to do the job.”⁶ Neel likewise cautioned that, to understand the influence of introduced diseases on indigenous peoples, we must first know the longer history and “epidemiologic profile” of the populations.²¹ This points to the value of incorporating the information on precontact health as a precursor to understanding the effects of contact.

CONCLUSIONS: LESSONS FROM THE PAST

The importance of understanding health within a broad historical framework is illustrated by the following example, which draws on recent collaborative investigations into endemic health problems of the indigenous groups who call themselves the Pima and Tohono O’odham in southern Arizona. High rates of diabetes, hypertension, and obesity have plagued members of these groups since the 1940s. Recent multidisciplinary efforts to understand the etiology of these patterns have combined oral history and anthropologic, archaeologic, and epidemiologic information on diet and health to better understand the progression of these health problems over time.²² Some Pima Indians have begun to incorporate traditional foods such as lima beans, tepary beans, mesquite pods, and maize into their diet, with positive health results.²³ Research such as this examines the larger interacting sphere of culture, environment, and life processes, and such studies of ancestral

menus and ancestral health trends may continue to provide important clues to today’s health problems.

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