

CHAPTER SEVENTEEN

Health, Nutrition, and Demographic Change in Native California

Phillip L. Walker and Russell Thornton

ABSTRACT

Before the arrival of Europeans, California was inhabited by Native Americans with a diverse array of cultural adaptations that varied markedly through time and space. A few regional differences and weak temporal trends can be discerned in the health status of California's prehistoric inhabitants. However, the overall pattern suggested by the available bioarchaeological data is one in which health conditions greatly diverged through time within different geographical areas. Short-term declines in health status linked to fluctuations in local environmental productivity appear to have been common. Skeletal studies suggest a tendency during the prehistoric period toward declining health among the inhabitants of the densely populated Santa Barbara Channel and Sacramento Valley regions. In both areas, evidence of growth disruption and infectious disease increases significantly between the Early and Late Periods. Skeletal data and paleoenvironmental records suggested that in some areas, living conditions declined substantially around the end of the first millennium owing to climate-induced fluctuations in marine and terrestrial productivity. Although conditions improved significantly in some areas during the Late Period, the arrival of Europeans marked the beginning of a spectacular population decline. By the end of the nineteenth century, the combined effects of epidemics, genocide, and social disruption had reduced the once-thriving Californian Indian population to a few thousand individuals. During the last half of the twentieth century there has been a remarkable reversal of this trend toward population decline, owing to improved living conditions on reservations and the immigration of large numbers of Indians from other states to California's urban centers.

INTRODUCTION

The goal of this chapter is to provide a broad historical perspective on changes in the health, nutrition, and demography of California's population from the arrival of its earliest Paleo-Indian colonists until the present. Although some comparative data are available for nineteenth-century Euro-American skeletons, most of our bioarchaeological evidence derives from prehistoric Native American burials.

Owing to the widespread practice of cremation by California Indians, large skeletal collections are only available from a few areas. Consequently, our knowledge of spatial variations in health and nutrition is very incomplete. Skeletal collections large enough to allow a statistical analysis of temporal variation in health and nutrition are only available from the densely populated Santa Barbara Channel and Sacramento River Valley areas. Because high population densities contribute to the maintenance and spread of infectious disease, the health of Indians in these areas may differ from that of people who lived in more sparsely populated areas.

As will be clear from the data we present, health conditions varied markedly through time within the same geographical area. Although some trends can be discerned, short-term declines in health status linked to fluctuations in local environmental productivity appear to have been common. This spatial-temporal variation makes sweeping generalization about regional differences in health impossible. Since most of our data are from Santa Barbara Channel area sites, we will focus our discussion on the health and nutrition of the Indians who lived in this area of Southern California. When additional data are available, comparisons will be made with Euro-Americans and Native Californians from other areas of the state. Finally, data on the health status of the Native Californians in our sample will be compared with that of other populations included in the Health and Nutrition in the Western Hemisphere project.

For this overview, it is useful to divide the history of California into Paleo-Indian (pre-9000 BC), Early (9000-1000 BC), Middle (1000 BC-AD 1250), Late (AD 1250-AD 1782), and Historic Periods. These divisions of a continuous historical process are to some extent arbitrary, since the tempo of cultural change varied markedly in different areas of California. However, they do provide a useful framework for describing major socioeconomic changes that occurred throughout the state. Because some of the cemeteries we have studied were used for many generations, it is common for them to contain burials from more than one period. To accommodate these uncertainties, when necessary, we have grouped collections from different periods (Table 17.1). For example, many cemeteries were used throughout the Middle and Late Periods.

Table 17.1: Chronological Groupings and Numbers of Burials Examined

Period	Approximate dates	Native Americans		Euro-Americans
		Southern California	Northern California	
Historic Period	AD 1870-AD 1782	159		102
Late Period	AD 1782-AD 1250	1125	0	0
Late Middle Period	AD 1250-AD 500	417	233	0
Middle and Late	AD 1782-600 BC	354	217	0
Middle Period	AD 1250-600 BC	266	0	0
Early Period	1050 BC-5550 BC	491	0	0
Unknown	Prehistoric?	100	47	0

AN OVERVIEW OF CALIFORNIA PREHISTORY

Although a few researchers believe that people arrived in California more than 20,000 years ago (Orr 1968; Berger 1980), most archaeologists find the evidence of such an early occupation unconvincing (Glassow 1980:81; Moratto 1984). The earliest generally accepted evidence for the human occupation of California consists of a few sites containing large, fluted projectile points of a type that has been firmly dated elsewhere in North America to 10,000-9000 Bc. Additional evidence for the presence of humans in California at this time comes from radiocarbon dates on human bone (Johnson et al. 1999) and deeply stratified cultural deposits (Erlandson et al. 1996). Most of these early sites are located in areas containing many large, shallow lakes during Paleo-Indian times. These lakes undoubtedly attracted migratory waterfowl and large game animals. The early Californians who exploited these resources probably lived in small, highly mobile groups with an economy that emphasized big-game hunting and the gathering of plant foods (Moratto 1984:29-70). The health status of people during this period is unknown, owing to the almost complete lack of skeletal material. However, because of their low population densities and the abundance of food in a recently colonized environment, it seems likely that living conditions were quite good.

During the Early Period, California Indians underwent a fundamental adaptive shift. An economic emphasis on big-game hunting was gradually replaced by economies that were heavily dependent on seed collecting (Wallace 1978:25). This economic transformation was, in part, a response to the environmental changes associated with the end of the Pleistocene. The lakes of Southern California gradually dried up because of reduced rainfall, and there was a concomitant decrease in the availability of big-game animals. This, along with other environmental changes, forced California Indians to diversify their subsistence strategies. The result was an economic emphasis on exploiting a broad range of plant and animal resources.

At the beginning of the Early Period, most of the state's population was concentrated in Southern California. During the next 5,000 years California Indians gradually evolved a broad spectrum of economic strategies that allowed them to occupy all but the most inhospitable areas of the state. Important advances were made in seed-processing technology during the Early Period. Sites begin to contain large numbers of loaf-shaped manos and flat milling stones that, based on ethnographic accounts, appear to have been used to grind hard seeds from chaparral and grassland plants. Between 4,000 and 5,000 years ago, mortars and pestles begin to appear in sites throughout the state. Ethnographic data suggest that these tools were primarily for acorn processing.

Studies of the frequency of different types of pathological conditions show that, in most respects, the health of people who lived during the Early Period was better than that of later populations. However, skeletal evidence does suggest that periods of seasonal starvation may have been more common than they were during the Late Period (McHenry 1968; Dickel et al. 1984).

By the beginning of the Middle Period, about 3,000 years ago, opportunities for continued population growth through territorial expansion had greatly diminished.

Instead, California Indians began to modify Early Period economic systems to allow more people to be supported within the areas they already occupied. New subsistence techniques were introduced and existing technologies refined. New forms of social organization that facilitated the exchange of food, manufactured goods, and raw materials were adopted. Instead of moving seasonally to exploit locally abundant resources, people increasingly began to focus their lives around permanent villages.

The way in which this economic intensification was accomplished varied according to the resources available in each area. For example, the Indians of the Santa Barbara Channel area became heavily dependent on marine resources, and people living in Central California intensified their use of acorns.

Settlement-pattern data show that California Indians became more sedentary during the Middle Period. As local population densities increased, the feasibility of moving over large areas on a seasonal round decreased. Gradually, people began to focus their activities around large, permanently occupied villages. This increased sedentism was made possible in part by the development of trade networks that facilitated the exchange of manufactured goods and locally abundant natural resources (Ericson 1977; C. King 1981). The diverse array of California Indian cultures described by early European explorers represented a continuation of these Middle Period trends toward increased economic specialization and trade.

The arrival of Europeans marked the beginning of a new phase of California Indian history. The process of cultural differentiation we have described was abruptly terminated by the death and cultural disruption of the contact period. These cataclysmic events posed a new set of adaptive challenges. What is now the State of California had a large, dense aboriginal native population. Although scholarly estimates vary widely, a contact population of 310,000 to 705,000 seems the best acceptable estimate we have today (Thornton 1980; Ubelaker 1988). Whatever the precise figure, demographers do agree that the California Indian population suffered a catastrophic decline following the arrival of Europeans and Euro-Americans (Figure 17.1). This demographic collapse occurred somewhat later in California than in most other regions of the United States, and the complex set of reasons for the population decline is unique. The primary causes of the decline of California's Native American population were: 1) the introduction of such epidemic diseases from Europe and Africa as smallpox, measles, malaria, cholera, typhus, and, syphilis; 2) the effects of the mission system; and 3) the Euro-American destruction of traditional patterns of subsistence, which not only produced starvation but was accompanied by warfare, raids, and outright genocide. These disruptive influences increased mortality rates and lowered fertility, and the population declined accordingly. The result was also a virtual collapse of Indian societies and cultures, a collapse preventing virtually any demographic recovery of California Indians until well into the twentieth century.

The decline in the California Indian population differs from that in most areas of the present-day United States for some basic reasons. First, the decline in California occurred relatively later, probably primarily during the nineteenth century; this was a result of the relative isolation of the area until the late 1700s and early

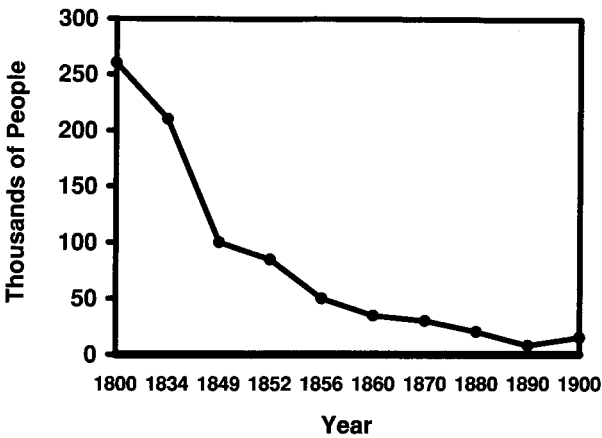


Figure 17.1. Decline of the American Indian population of California, between 1800-1900. *Sources:* Powers (1877: 416); Merriam (1905: 60); U.S. Bureau of the Census (1915: 10, 112); Mooney (1928: 19); Cook (1976: 69-71, 1978: 91); Stanley and Thomas (1978: 114); Thornton (1987: 109); Ubelaker (1988).

1800s. Second, epidemic diseases derived from Europe and Africa, while extremely important in California, were perhaps relatively less important than in many other regions of the United States; however, venereal diseases, especially syphilis, were probably relatively more important in California than elsewhere. Third, the mission system, introduced to control, colonize, and (theoretically) convert the inhabitants of an area, produced significant population decline (often in interaction with diseases, venereal and otherwise). Fourth, starvation among California Indians was most likely more widespread than in most areas of the United States, as traditional subsistence patterns were quickly destroyed. Fifth, vigilante raids and blatant genocide were surely more important in reducing native populations in California than elsewhere in North America. And, finally, sixth, the aftermath of population destruction was somewhat atypical, in that most California Indians were simply left "on their own" after their demographic, social, and cultural destruction. One result was that many became integrated as "wage laborers" at the very lowest rung of the of late-nineteenth-century California economic structure.

Depending on what one selects as the baseline population, the Indian population of California was still somewhat intact by the beginning of the nineteenth century, primarily because of its relative isolation. Dating from the first few decades of the nineteenth century, however, and extending to the latter decades of the century, the Indian population underwent a rapid decline. As also shown in Figure 17.1, the California Indian population reached its nadir around 1900: the Indian population totaled only slightly more than 15,000 at that time (with the non-Indian population of California being some 1.47 million). Since the beginning of the twentieth century, some population recovery has occurred (Figure 17.2): the 1980 U.S. census enumerated almost 200,000 American Indians in California (out of a total population of some 23.67 million). Perhaps only about one-fifth of this population, however, and surely no more than one-half of it, are the descendants of indigenous

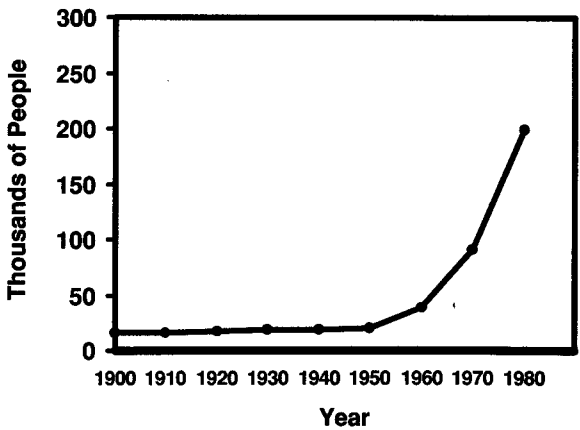


Figure 17.2. Recovery of the American Indian population of California, 1900 to 1980. The increase after 1960 in part reflects the migration of significant numbers of Indians to California. *Sources:* see Figure 17.1.

California Indians; the majority are Indians who migrated into the state from other areas, or their descendants.

California thus has a large, unique, and highly diverse American Indian population, the largest of any state. It is composed of both American Indians indigenous to the state and American Indians who have migrated there. A large proportion of this population are urban American Indians, but a significant proportion are rural and/or reservation and "rancheria" American Indians. A virtual one-third of all the tribes recognized by the U.S. government are located in California. This is remarkable in light of the tremendous demographic, social, and cultural destruction experienced by California Indians during the history of the state.

VARIATION IN HEALTH AND NUTRITION

Although systematic attempts to analyze spatial and temporal variation in health and nutrition based on California skeletal collections are in their infancy, a few patterns seem clear. We will first discuss the data we have on the population history of the Channel Island area, which is the source of our largest skeletal series. The Channel Island population will then be compared with contemporaneous Native Americans living in Northern California. Finally, the health and nutrition of Native Californians will be compared with that of the nineteenth-century Euro-American colonists who displaced them.

Body Size

In the Channel Islands area, there is a gradual decrease in body size during the Middle Period, with especially small statures during the Late Middle Period (Figure 17.3). There is little evidence of large-scale movement of people into the Santa Barbara

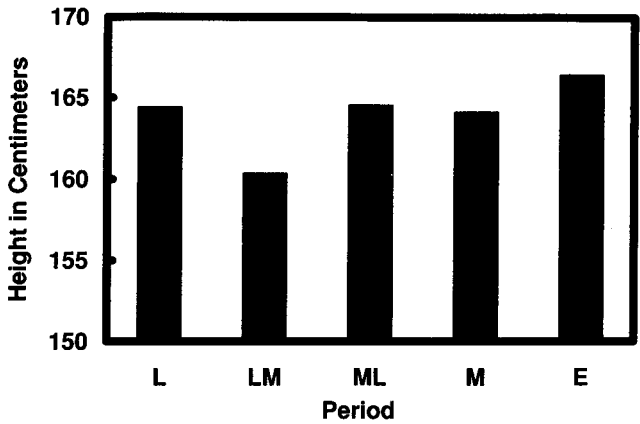


Figure 17.3. Temporal variation in height estimated from long bone lengths. Period abbreviations: L = Late Period, LM = Late Middle Period, ML = Middle and Late Period, M = Middle Period, E = Early Period. Chronological information on each period is provided in Table 17.1.

Channel area after its initial colonization. This temporal variation in stature, therefore, appears to be a result of in situ responses to the local environment instead of external influences. The Late Middle Period was a time of unstable environmental conditions and high levels of warfare and violence. It seems likely that the small stature of people during this period reflects stunting owing to these unfavorable environmental conditions (Walker and Lambert 1989). During the late prehistoric period, statures increase significantly, perhaps owing to improved living conditions. Although historic period collections are too small and poorly preserved to provide reliable stature estimates, comparisons of long bone diameters and tooth dimensions indicate that body size decreased significantly after the establishment of the mission system. Although a size reduction relative to precontact times is seen in collections from historic cemeteries (Walker et al. 1996), the largest size reduction appears to have occurred after the local Indians moved to the missions (Walker et al. 1989b).

These changes in body size are in some respects paralleled by changes in sexual dimorphism. Sex differences in stature decrease markedly during the Late Middle Period and then increase again during the Late Period (Figure 17.4). Data from the mission-period cemetery at Malibu suggest that sexual dimorphism in tooth size and some long bone dimensions decreased again when the local Indians began to interact more intensively with European colonists (Walker et al. 1996b).

Diet and Dental Health

Paleopathological and isotopic data suggest that the diets of California Indians varied regionally through time. For example, in the Santa Barbara Channel area, the shift from hunting and gathering to an economy based on intensive marine-resource exploitation is accompanied by a decrease in dental caries (Figure 17.5,

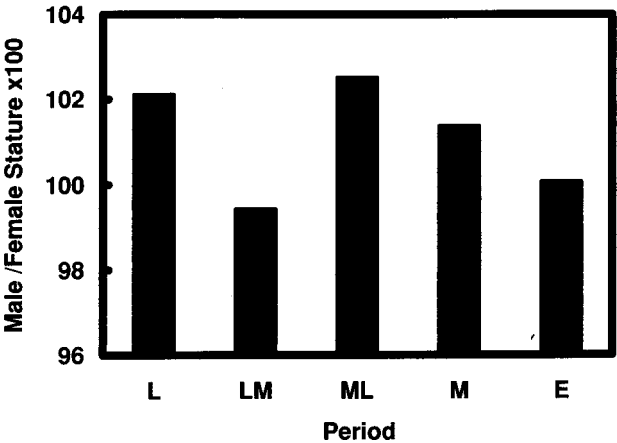


Figure 17.4. Temporal variation in sexual dimorphism. Stature estimates are based on long bone lengths. Period abbreviations: L = Late Period, LM = Late Middle Period, ML = Middle and Late Period, M = Middle Period, E = Early Period. Chronological information on each period is provided in Table 17.1.

Walker and Erlandson 1986) and tooth wear rates (Walker 1978). These changes are paralleled by a shift in the stable isotope concentrations in bone that suggest increasing dependence on protein derived from marine animals. On the Northern Channel Islands, these dietary changes appear to have affected men and women differently. Dental pathological and isotopic studies suggest that during the Early Period, the diets of women were more terrestrially oriented and less variable than those of men (Walker and DeNiro 1986; Walker et al. 1989a).

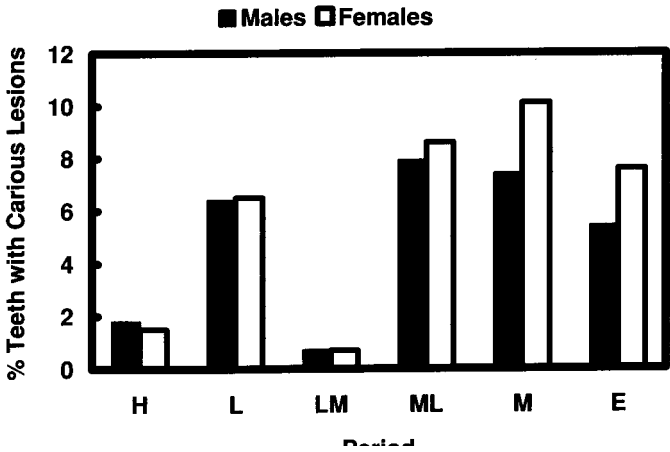


Figure 17.5. Temporal variation in dental caries rates in the Santa Barbara Channel area sites. Period abbreviations: H = Historic Period, L = Late Period, LM = Late Middle Period, ML = Middle and Late Period, M = Middle Period, E = Early Period.

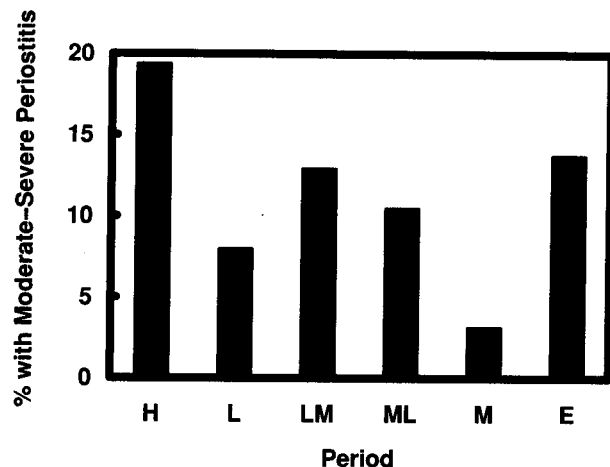


Figure 17.6. The percent of individuals with tibias affected by moderate to severe osteoperiostitis in Santa Barbara Channel area sites. Period abbreviations: H = Historic Period, L = Late Period, LM = Late Middle Period, ML = Middle and Late Period, M = Middle Period, E = Early Period.

Infectious Disease

Paleopathological studies show that bone lesions like those we now associate with streptococcal or staphylococcal infections were fairly common in some California Indian populations (cf. Roney 1959, 1966; Suchey et al. 1972). There is also evidence that tuberculosis, coccidioidomycosis, and treponematoses were present in prehistoric California (Roney 1959; Cybulski 1980; Hoffman 1987). Based on skeletal evidence for anemia, it seems likely that blood loss through gastrointestinal infections and water contamination were a health concern for some populations (Walker 1986). The prevalence of such problems is perhaps also suggested by elaboration of traditional medical practices for treating digestive system disorders (Walker and Hudson 1993).

In skeletal collections from the Channel Islands area, the frequency of individuals with periosteal lesions indicative of bone infections varies markedly through time (Figure 17.6). Although burials with skeletal lesions whose histological appearance is suggestive of endemic syphilis occur as early as 4600 BP (Walker and Lambert, 1998), such cases appear to increase in frequency during times of resource stress, warfare, and population aggregation (Walker and Lambert 1989). On Santa Cruz Island, periostitis increased significantly between the Early and Middle Periods and then became somewhat less prevalent during the Late Period (Lambert 1989; Lambert and Walker 1991). The pattern of periosteal involvement seen in Historic Period skeletons from Malibu appears to differ somewhat from that seen before the arrival of Europeans (Walker et al. 1996). This perhaps reflects the introduction of a new treponemal disease, such as venereal syphilis.

Warfare and Violence

Skeletal studies of the frequency of wounds inflicted by clubs, spears, and arrows clearly show that patterns of warfare and violence varied both regionally and through

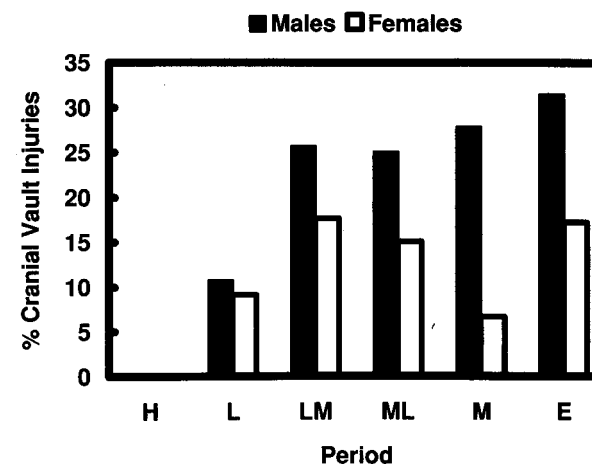


Figure 17.7. Percent of Santa Barbara Channel area crania with nonlethal depressed fractures of the cranial vault. Period abbreviations: H = Historic Period, L = Late Period, LM = Late Middle Period, ML = Middle and Late Period, M = Middle Period, E = Early Period.

time in prehistoric California. This is consistent with ethnographic evidence of marked intertribal variation in the prevalence of warfare and violence (Kroeber 1925; McCorkle 1978). Significant differences can be seen even within the territory of a single group. For example, in the Santa Barbara Channel area, nonlethal cranial injuries possibly associated with a local form of nonlethal dispute resolution are much more common than they are among members of the same tribe who lived on the mainland coast (Walker 1989, 1996).

Temporal variation in patterns of violence is also apparent. In the Santa Barbara Channel area, the frequency of nonlethal cranial injuries appears to decrease through time (Figure 17.7). This change in skeletal evidence for violence appears to be associated with the introduction of the bow and arrow. Beginning around AD 500, the bow and arrow started to be adopted by Native Californians, and it rapidly replaced clubs and spear throwers in warfare (Moratto 1984). This change in weapons technology coincided with the beginning of a period of fluctuating climatic conditions and increased violence (Moratto 1984:213-214; Walker et al. 1989b; Walker and Lambert 1989; Lambert 1994). In the Santa Barbara Channel area, the Late Middle Period was an especially violent time. For example, at the Calleguas Creek site, which dates from this time, more than 10 percent of the adult population shows evidence of arrow wounds (Walker and Lambert 1989).

Regional Comparisons

Although most of our skeletal data are from the Channel Islands area, information is also available on several Late Middle Period skeletal collections from the Sacramento Delta area of Northern California. Comparisons of these collections with roughly contemporaneous Late Middle Period collections from the Channel Islands area provide evidence for significant regional differences in health and nutrition.

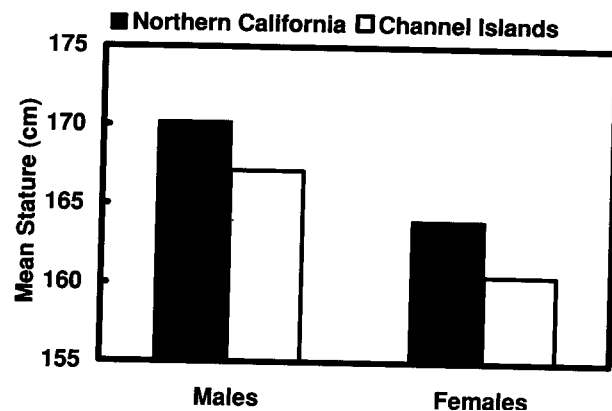


Figure 17.8. Comparison of stature estimates based on long bone lengths for Native Californians living during the Late Middle Period in northern California and the Channel Islands area of Southern California.

Long bone dimensions show that the stature of the Northern California population was significantly greater than that of their Southern California contemporaries (Figure 17.8). It seems unlikely that this regional variation in stature is entirely a product of environmental factors, such as diet or disease. Penutian-speaking people, who entered California later than the Hokan-speaking people of the Santa Barbara Channel area, occupied the Sacramento Delta. These stature differences may, therefore, reflect genetic as well as environmental differences between the two populations.

This interpretation is reinforced by an analysis of health indexes, such as the frequency of teeth with hypoplastic lesions (Figure 17.9). Based on these data, it

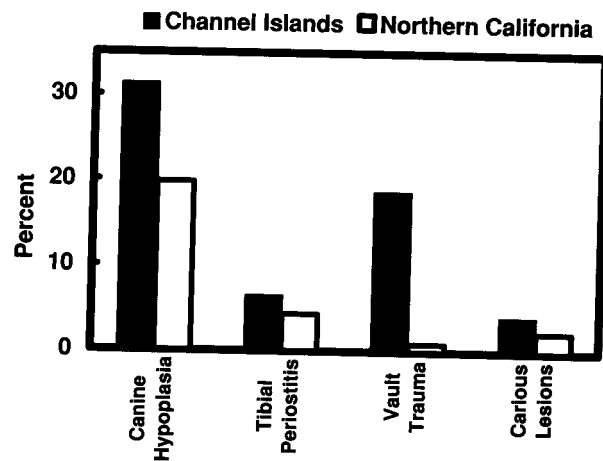


Figure 17.9. Comparison of health indexes for Native Californians living during the Late Middle Period in Northern California and the Channel Islands area of Southern California. Values for carious lesions are the percent of teeth with carious lesions. All other values are the percent of individuals affected. The values for tibia] periostitis are for individuals with moderate to severe lesions.

appears that the health status of people living in Northern California was somewhat better than that of people living in Southern California during the Late Middle Period. This is the opposite of what would be predicted if the regional differences in stature were environmental in origin.

There is a striking difference between the Channel Island and Northern California collections in the frequency of healed cranial injuries (Figure 17.9). Such injuries are rare in the Northern Californians and exceptionally common among the Channel Islanders. The magnitude of this difference suggests that patterns of interpersonal violence sometimes varied markedly in contemporaneous California Indian groups.

Comparisons of Native Californians and Euro-Americans

Euro-Americans began moving into California in large numbers beginning in the mid-nineteenth century. Although our data on these immigrants is limited to observations of about 100 skeletons from mid-nineteenth-century cemeteries (Table 17.1), some striking differences between them and the Native Californians they displaced are nevertheless apparent.

First, the Euro-Americans who moved to California were much taller than Native Americans they encountered there (Figure 17.10). The average stature of male colonists was more than 174cm, which is nearly 8 centimeters greater than the male average for our California Indian sample. These heights are large in comparison to those of other nineteenth-century Euro-Americans (Steckel 1995). This suggests the possibility that the nineteenth-century Americans who moved to California were either unrepresentative of the American population as a whole or that the children of these immigrants experienced environmental conditions favorable to their growth and development.

Although the large body size of the colonists might be taken as an indication of good health, other indexes suggest that their health was poorer than that of

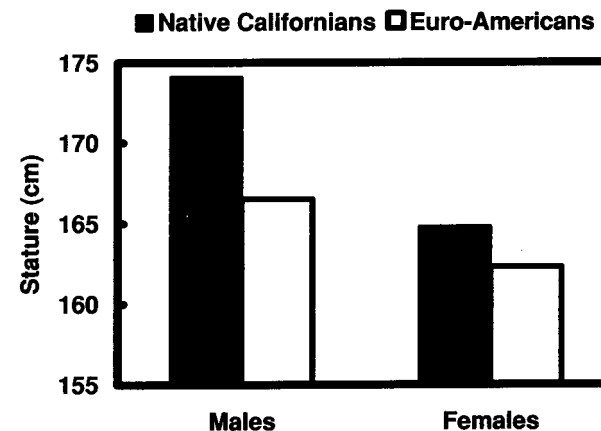


Figure 17.10. Comparison of stature estimates based on long bone lengths for Native Californians and nineteenth-century Euro-American immigrants to California.

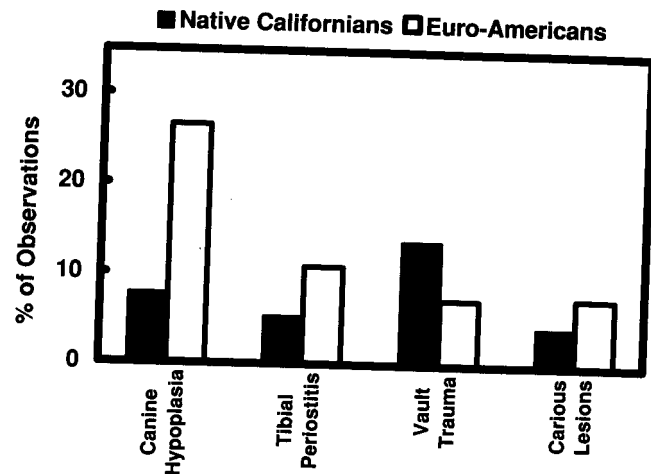


Figure 17.11. Comparison of health indexes for Native Californians and nineteenth-century Euro-American immigrants to California. Values for carious lesions are the percent of teeth with carious lesions. All other values are the percent of individuals affected. The values for tibial periostitis are for individuals with moderate to severe lesions.

Native Californians they displaced (Figure 17.11). The higher caries rate of the colonists undoubtedly reflects the access the settlers had to sugar and other refined carbohydrates. They also had more hypoplastic teeth and a higher frequency of moderate and severe periosteal lesions.

Western Hemisphere Comparisons

The Health and Nutrition in the Western Hemisphere database provides an unprecedented opportunity to compare the health status of ancient Native Californians with that of Native Americans living elsewhere in the New World. Such comparisons are of special interest because through hunting, gathering, and fishing, Native Californians were able to maintain population densities comparable to those of agriculturalists living elsewhere in the New World. Many bioarchaeological studies have shown a decline in health associated with the shift from hunting and gathering to agriculture. This is typically explained in terms of a decrease in the quality of the diet, owing to heavy dependence on a small number of cultigens and demographic changes that facilitated the spread of infectious disease, such as increases in sedentism, village size, population density, and level of intervillage interaction. Many of these same demographic changes occurred in the absence of agriculture in such areas of California as the Santa Barbara Channel region. Our California data, therefore, have the potential to give insights into the relative significance of dietary and demography variables as causes of the decline in health seen with the shift from hunting and gathering to a more sedentary village life.

The comparative value of the data from Native Californians is illustrated by the light they shed on skeletal evidence of iron-deficiency anemia (porotic hyperostosis

and cribra orbitalia). An increased prevalence of anemia in American Indian populations with the shift from hunting and gathering to agriculture is often attributed to the nutritional deficiencies of a low-iron, low-protein, corn-based diet (Walker 1985). The health status of the agricultural populations sampled in the Health and Nutrition in the Western Hemisphere database lend credence to this hypothesis; the anemia index shows that those groups that depended heavily on maize as a dietary staple experienced more anemia than hunter-gatherers or people who practiced mixed agriculture. However, our comparative data from the Santa Barbara Channel area shows that heavy maize dependence per se is not a sufficient explanation of the variation in the prevalence of anemia seen in Native American populations. Skeletal evidence of anemia is just as common among some of the Indians of the Northern Channel Islands whose diet was composed mainly of fish and other iron-rich marine resources as it is among maize-dependent agriculturalists. This contrasts with the rarity of lesions associated with anemia among the Indians of the mainland, whose diet contained a larger proportion of iron-deficient plant foods (Walker 1985). These data suggest that the etiology of iron-deficiency anemia is complicated and that its prevalence depends upon multiple factors, with iron availability in the diet being only one. For example, the Northern Channel Island data suggest that iron loss associated with diarrheal disease and other infections may be just as important in the etiology of the condition as an iron-deficient diet.

Judging from the average summary health index score of 76.9 for the Native Californians in our sample, their health status was somewhat better than that of Native Americans who practiced intensive maize agriculture (average index = 68.9), but worse than that of other hunter-gatherers (average index = 82.1). This is not surprising in view of the unusual nature of the hunter-gatherer adaptations in the populations studied (intensive exploitation of acorns and riverine resources in Northern California, and intensive use of marine resources in the Santa Barbara Channel area). These subsistence strategies allowed for the maintenance of large, semisedentary village populations. Although village life produces many social and economic advantages that are unavailable to smaller groups, our data clearly show that it also has its health costs.

CONCLUSIONS

Skeletal studies show that overall, the health of people living in the densely populated Santa Barbara Channel and Sacramento Valley areas declined during the prehistoric period (Schulz 1981; Dickel et al. 1984; Walker 1986, 1989, 1990; Walker et al. 1989b; Lambert 1989). In both areas, evidence of growth disruption and infectious disease increases significantly between the Early and Late Periods. This decline in health appears to be largely a result of increased exposure to pathogens. As population densities and sedentism increased, so did the opportunities for the maintenance and spread of infectious disease. Concentrating people in one place not only creates sanitation problems, but it also provides an environment favorable to the spread of parasites and other pathogens.

In both areas, the socioeconomic changes of the Middle Period had significant health consequences. In Central California, there is evidence that the frequency of episodes of acute growth disruption decreased during the Middle Period (McHenry and Schulz 1978; Schulz 1981; Dickel et al. 1984). This has been interpreted as evidence that greater year-round economic security was one of the results of the heavy emphasis on acorn exploitation that evolved in this area during the Middle Period. In the Santa Barbara Channel area, the shift to more intensive use of marine resources may also have resulted in greater economic security. However, age-controlled studies of arthritis suggest that this was accomplished through an increase in workload, especially that of the men (Walker and Hollimon 1989).

Analysis of roughly contemporaneous Late Middle Period collections indicate that living conditions may have been somewhat better in the Sacramento Delta than in the Channel Islands area at this time. Without better temporal control, however, drawing firm conclusions about regional differences in health is impossible. This is because short-term environmental fluctuations can cause living conditions to vary markedly through time.

Our skeletal data show that living conditions declined strikingly at the end of the Middle Period in the Channel Island area. This appears to have been a time of increased warfare and violence throughout California (Moratto 1984:213-214; Walker and Lambert 1989). This increase in violence may in part be explained by drought-induced increases in competition over resources after AD 400 (Walker and Lambert 1989). There is considerable evidence for population movement and cultural disruption at the end of the Middle Period. Many parts of the Central Valley and Sierran foothills were abandoned at this time, and there was also a cessation of trans-Valley trade (Moratto 1984:564).

Although conditions improved significantly in some areas during the Late Period, the arrival of Europeans starting in 1542 marked the beginning of the demographic collapse of the California Indian population. During the last half of the eighteenth century, European colonization of California began in earnest, and this had catastrophic consequences for Native Californians. By the end of the nineteenth century, the combined effects of epidemics, genocide, and social collapse had reduced the once-thriving Californian Indian population to a few thousand individuals.

During the last half of the twentieth century, California's Indian population has experienced a remarkable demographic rebound (Figure 17.2). Although this can to some extent be attributed to improvements in the living conditions and health care available to Native Californians living in rural areas (Walker and Hudson 1993), most of the increase is a result of Indians from other states migrating into California's urban centers.

REFERENCES

- Berger, Rainer. 1980. Early Man on Santa Rosa Island. In *The California Islands: Proceedings of a Multi-disciplinary Symposium*, ed. D. Power. Santa Barbara Museum of Natural History, Santa Barbara, Calif.
- Cook, Sherburne F. 1976. *The Population of the California Indians, 1969-1970*. Berkeley: University of California Press.
1978. Historical Demography. In Robert F. Heizer, ed., *California*, vol. 8 of *Handbook of North American Indians*, pp. 91-98. Washington, D.C.: Smithsonian Institution.
- Cybulski, J. S. 1980. Possible Pre-Columbian Treponematoses on Santa Rosa Island, California. *Canadian Review of Phys. Anthropol.* 2:19-25.
- Dickel, David N., Peter D. Schulz, and Henry M. McHenry. 1984. Central California: Prehistoric Subsistence Changes and Health. In *Paleopathology at the Origins of Agriculture*, ed. M. N. Cohen and G. J. Armelagos, pp. 439-461. New York: Academic Press.
- Ericson, J. E. 1977. Egalitarian exchange systems in California: A preliminary view. In T. K. Earle and J. E. Ericson, eds., *Exchange Systems in Prehistory*, pp. 109-126. New York: Academic Press.
- Erlandson, Jon M., Douglas Kennett, B. Lynn Ingram, Daniel Guthrie, Don Morris, Mark Tveskov, G. James West, and Philip . Walker. 1996. An archaeological and paleontological chronology for Daisy Cave (CA-SMI-261), San Miguel Island. *California Radiocarbon* 38(2):355-373.
- Glassow, Michael A. 1980. Early Man on Santa Rosa Island. In *The California Islands: Proceedings of a Multi-disciplinary Symposium*, ed. D. Power. Santa Barbara Museum of Natural History, Santa Barbara, Calif.
- Hoffman, J. M. 1987. The Descriptive Physical Anthropology of the Cardinal Site, CA-SJO-154: A Late Middle Horizon-Early Phase I Site from Stockton, California. Colorado Springs, *Colorado College Publications in Anthropology*, No. 12.
- King, Chester. 1981. "The Evolution of Chumash Society: A Comparative Study of Artifacts Used in Social System Maintenance in the Santa Barbara Channel Region before AD 1804." Ph.D. diss., University of California, Davis.
- Kroeber, Alfred. 1925. *Handbook of the Indians of California*. Bureau of American Ethnology of the Smithsonian Institution, Bulletin 78, Washington, D.C.
- Kroeber, Theodora. 1961. *Ishi in Two Worlds*. Berkeley: University of California Press.
- Lambert, Patricia. 1989. "Temporal Variation in the Health Status of the Prehistoric Population of Santa Cruz Island." M.A. thesis, Department of Anthropology, University of California, Santa Barbara.
1994. "War and Peace on the Western Front: A Study of Violent Conflict and its Correlates in Prehistoric Hunter-Gatherer Societies of Coastal Southern California." Unpublished Ph.D. diss., University of California, Santa Barbara.
- Lambert, Patricia, and Phillip L. Walker. 1991. Physical Anthropological Evidence for the Evolution of Social Complexity in Coastal Southern California. *Antiquity* 65(249): 963-973.
- McCorkle, Thomas. 1978. Intergroup Conflict. In Robert F. Heizer, ed., *Handbook of North American Indians*, vol. 8, *California*, pp. 694-700. Washington, D.C.: Smithsonian Institution.
- McHenry, Henry. 1968. Transverse Lines in Long Bones of Prehistoric California Indians. *American Journal of Physical Anthropology* 29:1-18.
- McHenry, Henry, and Peter Schulz. 1978. Harris Lines, Enamel Hypoplasia, and Subsistence Change in Prehistoric Central California. In D. R. Touhy, ed., *Selected Papers from the 14th Great Basin Anthropological Conference*, Ballena Press, Socorro Publications in Archaeology, Ethnology and History, No. 11, Menlo Park, Calif.
- Merriam, C. Hart. 1905. The Indian Population of California. *American Anthropologist* 7: 594-606.
- Mooney, James. 1928. The Aboriginal Population of America North of Mexico. In John R. Swanton, ed., *Smithsonian Miscellaneous Collections*, vol. 80, pp. 1-40. Washington, D.C.: U.S. Government Printing Office.

- Moratto, Michael J. 1984. *California Archaeology*. Orlando, Fla.: Academic Press.
- Orr, Phil. 1968. *Prehistory of Santa Rosa Island*. Santa Barbara Museum of Natural History, Santa Barbara, Calif.
- Powers, Stephen. 1877. Tribes of California. *Contributions to North American Ethnology*, vol. 3. Reprint, Washington, D.C.: U.S. Government Printing Office.
- Roney, J. G., Jr. 1959. Palaeopathology of a California Archaeological Site. *Bulletin of the History of Medicine* 33(2): 97-109.
1966. Paleoepidemiology: An Example from California. In *Human Paleopathology*, ed. S. Jarcho. New Haven, Conn.: Yale University Press.
- Schulz, Peter. 1981. "Osteoarchaeology and Subsistence Change in Prehistoric Central California." Ph.D. diss., University of California, Davis.
- Stanley, Sam, and Robert K. Thomas. 1978. Current Demographic and Social Trends among North American Indians. *Annals of the American Academy of Political and Social Science* 436:111-120.
- Steckel, Richard. 1995. Stature and the Standard of Living. *Journal of Economic Literature* 33:1903-1940.
- Suchey, J. M., W. J. Wood, and S. Shermis. 1972. Analysis of Human Skeletal Material from Malibu, California (LAN-264). *Report: Archaeological Survey, Department of Anthropology*, University of California, Los Angeles.
- Thornton, Russell. 1980. Recent Estimates of the Prehistoric California Indian Population. *Current Anthropology* 21:702-704.
1987. *American Indian Holocaust and Survival: A Population History since 1492*. Normal: University of Oklahoma Press.
- Ubelaker, Douglas H. 1988. North American Indian Population Size, AD 1500 to 1985. *American Journal of Physical Anthropology* 77:289-94.
- U.S. Bureau of the Census. 1915. *Indian Population of the United States and Alaska, 1910*. Washington, D.C.: U.S. Government Printing Office.
- Walker, Phillip L. 1978. A Quantitative Analysis of Dental Attrition Rates in the Santa Barbara Channel Area. *American Journal of Physical Anthropology* 48:101-106.
1986. Porotic Hyperostosis in a Marine Dependent California Indian Population. *American Journal of Physical Anthropology* 69:345-354.
1989. Cranial Injuries as Evidence of Violence in Prehistoric Southern California. *American Journal of Physical Anthropology* 80(3):313-323.
1996. Wife Beating, Boxing, and Broken Noses: Skeletal Evidence for the Cultural Patterning of Interpersonal Violence. In D. Martin and D. Frayer, eds., *Troubled Times: Osteological and Archaeological Evidence of Violence*, pp. 145-175. London: Gordon and Breach.
- Walker, Phillip L., and M. J. DeNiro. 1986. Stable Nitrogen and Carbon Isotope Ratios in Bone Collagen as Indices of Prehistoric Dietary Dependence on Marine and Terrestrial Resources in Southern California. *American Journal of Physical Anthropology* 71(1):51-61.
- Walker, Phillip L., Francine Drayer, and Susan Siefkin. 1996. *A Comparative Analysis of Skeletal Collections from Malibu (LAN-264)*. Report prepared for the California Department of Parks and Recreation, Sacramento, Calif.
- Walker, Phillip L., and Jon Erlandson. 1986. Dental Evidence for Prehistoric Dietary Change on the Northern Channel Islands. *American Antiquity* 51(2):375-383.
- Walker, Phillip L., Carol Goldberg, and Michael DeNiro. 1989a. Stable Isotopic Evidence of Prehistoric Diet and Culture Change in Southern California. *American Journal of Physical Anthropology* 78(2):229.

- Walker, Phillip L., and Sandra Hollimon. 1989. Changes in Osteoarthritis Associated with the Development of a Maritime Economy Among Southern California Indians. *International Journal of Anthropology* 4(1):171-183.
- Walker, Phillip L., and Travis D. Hudson. 1993. *Chumash Healing: Changing Health and Medical Practices in an American Indian Society*. Banning, Calif.: Malki Museum Press.
- Walker, Phillip L., and Patricia Lambert. 1989. Skeletal Evidence for Stress during a Period of Cultural Change in Prehistoric California. In Luigi Capasso, ed., *Advances in Paleopathology, Journal of Paleopathology: Monographic Publication No. 1*, pp. 207-212. Chieti, Italy: Marino Solfanelli.
1998. Prehistoric Treponematoses in the Western United States. *American Journal of Physical Anthropology, Supp.* 26:224.
- Walker, Phillip L., P. Lambert, and M. DeNiro. 1989b. The Effects of European Contact on the Health of California Indians. In David H. Thomas, ed., *Columbian Consequences, vol. I: Archaeological and Historical Perspective on the Spanish Borderlands West* pp. 349-364. Washington, D.C.: Smithsonian Institution Press.
- Wallace, William. 1978. Post-Pleistocene Archaeology, 9000 to 2000 B.C. In Robert F. Heizer, ed., *Handbook of North American Indians, vol. 8, California*, pp. 25-36. Washington, D.C.: Smithsonian Institution.

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarc6n 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

<http://www.cambridge.org>

© Cambridge University Press 2002

This book is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2002

Printed in the United Kingdom at the University Press, Cambridge

Typeface Minion 10.25/12 pt. *System* B1'EX2E [TB]

A catalog record for this book is available from the British Library.

Library of Congress Cataloging in Publication Data

Steckel, Richard H. (Richard Hall), 1944-

The backbone of history : health and nutrition in the Western Hemisphere / Richard H.
Steckel, Jerome C. Rose.

p. cm.

Revised papers from a second conference sponsored by the National Science
Foundation (SBR-9423435) and held March 7-10, 1996 at Ohio State University, Columbus.

Includes bibliographical references and index.

ISBN 0-521-80167-2 (hardback)

1. Indians - Food - History - Congresses. 2. Indians - Health and
hygiene - History - Congresses. 3. European Americans - Health and hygiene -
History- Congresses. 4. African Americans -Health and hygiene - History- Congresses.
5. Human remains (Archaeology) - America - Congresses.
6. America - Antiquities - Congresses. I. Rose, Jerome Carl. II. Title.

E59163 S74 2002

614.4'27 - dc21

2001037965

ISBN 0 521 80167 2 hardback