

CHAPTER 2

Theoretical Framework

Scholars have long been interested in the cultural and environmental determinants of human health (Lambert 1993). Researchers interested in the health consequences of dietary shifts have used skeletal indicators of stress to monitor changes in the health of prehistoric populations. These indicators include the growth rates of children, adult stature, mortality rates and the frequency of skeletal markers such as Harris lines, enamel hypoplasias, portotic hyperostosis and periosteal lesions (Bartelink 2006, Ivanhoe 1995, Lambert 1993, Smith et. al 1993,). This study focuses on stature and the consequences that a shift in diet may have had on stature over time.

ADD MORE

Research on the Genetics of Stature

Many researchers (Boas 1920, Johnston 1962,) agree that the ultimate stature of an individual is in part based on ones genetics as well as environmental effects playing on that individual as a child. In order to assess the affects of the environment and diet on stature it is important to determine the level at which the environment plays into ones eventual stature. Boas (1920) was one of the first to collect data on stature of children over time. For his paper in 1920 Boas collected observations on approximately 120 individuals ranging from 11 years old to adult. Because of the longevity of the study Boas was able to conclude that an individual who is short as a child will on average be

short as an adult and vice versa for tall individuals. Using further data taken from children in a range of environments, from very poor and impoverished to healthy and nourished he concluded that the ultimate stature of an individual is an effect of both hereditary and environmental causes. Boas (1920) also argues that each hereditary type can be considered as stable only in a stable environment, and that with a change of environment, many of the characteristic features of the body undergo changes. Boas' (1920) observations in this study confirm the conclusion that environmental conditions play an important part in the determination of the bodily form of the adult. It is obvious, therefore, that explanations that take into account only hereditary causes cannot satisfactorily account for the observed phenomena. This is particularly true of stature and weight, which appear extremely variable in the same lines of descent, according to the environmental conditions in which the individuals live.

MORE TO COME...

Research on Stature in Archaeological Populations

Research on stature in archaeological populations comes mostly from data derived from long bone measurements, which represent a simple measure of stature (Lambert 1993). Many studies have been done on the rate of long bone growth in prehistoric populations (Johnston 1962, Buikstra ?,) These studies, similar to those done on living children, often assume that the differences found among populations in terms of stature and rates of growth reflect the health status of those populations. Compiled below is a grouping of some of the different articles published over the years that have looked at

stature and long bone growth in past human populations. These articles provide insight as to the ways in which stature from past populations can be analyzed, and how long bone growth patterns can be interpreted in order to infer past health.

Johnston (1962) was one of the first researchers to look at long bone growth rates in an archaeological sample. In this study, Johnston (1962) looked at long bone measurements from 165 infants and young children from Indian Knoll, an approximately 5000-year-old site located in Kentucky where the inhabitants subsisted entirely on hunting and gathering. The majority of individuals included in the study died before the age of one, indicating a high level of infant mortality. Johnston (1962) hoped to determine the growth of the long bones associated with increasing age and the mean values at each age for each bone. He compared the sample means, standard deviations, and percentages of relative growth to Maresh's (1955) data on healthy white children from the United States. Johnston (1962) found that compared to the American white children, the Indian Knoll infants show slower growth rates and mean differences becoming statistically significant after 2 years old. Johnston (1962) therefore concluded that environmental factors are generally responsible for the depressed growth rate, however they probably act in conjunction with genetically entrenched tendencies toward population shortness as well.

ADD MORE

Environmental Effects on Prehistoric Native American Populations

INTRO SENTENCE

Jones et al. in 1999 aimed to prove that the environment should not be overlooked as a potential cause of prehistoric culture change. They suggest that between A.D. 800 and 1350 was a time of increased aridity, which coincided with a unique pattern of demographic stress and frequent economic crises across much of western North America, known as the Medieval Climatic Anomaly.

For their study the authors looked at how climatic change influenced the cultural development of different human populations living under different ecological conditions in four study regions across western North America: the Great Basin, California Central coast, Mojave Desert and the Sierra Foothills. Jones et al. (1999) set out to determine whether changes in prehistoric culture are consistent with predicted responses to environmental stress and resource shortages. To do this they used data on the late Holocene paleoenvironment and cultural sequences from the four regions of study. They found a striking correlation between drought and changes in subsistence, population, exchange, health and interpersonal violence during the Medieval Climatic Anomaly.

Overall their findings were consistent with their hypothesis. They found evidence of poor health, more interpersonal violence and population movement during the periods of drought during the Medieval Climatic Anomaly, in all four regions.

While the authors do a very good at illustrating how important it is to look at environment and shifting climates as a factor of culture change in the archeological record, they fall short in providing clear evidence of what precisely is limiting these populations (INCLUDE EXAMPLES).

Another study looking at the environmental and climatic effects on prehistoric populations comes from Weiss (2002). For this study, Weiss (2002) tested the hypothesis that drought negatively affects prehistoric populations, holding constant biology, culture and mode of subsistence. She looked at skeletal remains from two California cemeteries bracketing a severe drought that began around 1200 B.P. The remains were analyzed to determine drought-related quality of life changes in the Native Americans from these sites. Quality of life was assessed through femoral computerized tomography scan measures of cortical thickness, age at adult death, and pathology/trauma frequency. Evidence for the drought came from tree ring data, packrat middens, and fossils. Decreases in quality of life were documented by a reduction in site size and bead and other artifact manufacturing, and by increments in pathologies and traumas. Artifacts, beads and hunting implements were found that show cultural similarity and continuity of the two cemeteries.

After Weiss (2002) controlled for age and sex differences she found that changes from Cemetery 1 (the non-drought cemetery) to Cemetery 2 (the drought cemetery) showed decreases in cortical thickness and age at death and increases in pathology and trauma frequency. Cemetery 1 had greater cortical thickness, older ages at death, and fewer pathologies and traumas than Cemetery 2. In the end Weiss (2002) concluded that these droughts had a negative affect on prehistoric Californian Native Americans.

Research on Indicators of Health in Prehistoric Populations
Research on Stature as a Reliable Indicator of Health

Research on Shifts in Diet Affecting Health in Prehistoric Populations

INTRO SENTENCE NEEDED

One of the main studies to look at the effects of a change in diet on the health of a population came from Lambert's (1993) study. In this study Lambert looked at skeletal health through time on the Santa Barbara Channel Islands. Lambert (1993) used skeletal material from eight archaeological sites from Santa Cruz Island and Santa Rosa Island, the two largest islands in the Northern Channel Island archipelago. A total of 327 individuals were examined for evidence of periostitis, of those, the adults whose sex could be determined and contained intact femora were measured for stature estimations.

Lambert (1993) found that a significant decline in stature and higher rates of periostitis over time were health related trends resulting from a shift in diet. Some causes presented by Lambert to explain these declines were; population density, sedentism, and more interactions with outsiders. Population density during that time would have restricted mobility and access to diverse resources. Lambert (1993) concluded from this evidence that the health on the Channel Islands declined with a shift in a diet to a more fish-based economy. Paleopathological evidence indicates a similar decline in health when hunter-gatherers adopted agriculture, moved to larger permanent villages and began to consume more of a low-protein diet of cultigens (Lambert 1993).

Other studies that looked at changes in diet affecting the health and stature of prehistoric populations include Bartelink's dissertation from 2006. In his dissertation

Bartelink (2006) explores questions related to prehistoric health in regard to spatial and temporal differences. He used bioarchaeological data derived from skeletal material to evaluate subsistence change in mid-to-late Holocene central California (circa 4950-200 B.P.) populations. For this study, Bartelink (2006) looked at a total of 511 human skeletons from ten archaeological sites in the Sacramento Valley and San Francisco Bay area. He uses a variety different of methods for testing his hypothesis, including, stable isotope analysis, dental pathologies, periosteal reactions, stature, and enamel hypoplasia. While using a variety of different methods doesn't necessarily provide for more accurate data or conclusions, it does give a better overall understanding of the population in question. He then used this data to investigate temporal and spatial variability in diet and health in prehistoric California.

Bartelink (2006) tested the hypothesis that health status, as measured by childhood stress and disease indicators, declined during the late Holocene in central California. He tested for health in the prehistoric populations by using carbon and nitrogen stable isotope ratios. He found that the paleopathological data provided support for late Holocene resource intensification models for the Sacramento valley, but not for the Bay Area.

While Bartelink's (2006) dissertation is very useful for looking at health changes through time in California, he fails to take into account the genetic relationship of the populations being examined, assuming that all of the populations were genetically the same, even spanning thousands of years.

One study showing that a shift in ones genetic make-up may be the result of a change in stature seen over time comes from Smith et al. (1992). Testing the theory that marked dietary changes took place about 2000 years ago in southwestern Cape South Africa, Smith et al. (1992) examined a diachronic series of human remains, spanning the past 4000 years. They were looking to determine if dietary changes were reflected in the human skeleton. They examined bone mass and long bone morphometry from 53 adult skeletons with no gross skeletal pathologies. The results found a trend towards increased bone mass and stature in the post-2000 BP specimens. Their results were not consistent with evidence of dietary stress but rather suggest a change in the genetic composition of southwestern Cape populations.

According to the authors, and based on the archaeological record and isotope values for the southwestern Cape, there appears to be general agreement that a change in food staples utilized occurred post 2000 BP. This dietary shift has been associated with increased stress due to population pressure, resulting in competition over land and resources. As a consequence less desirable foodstuffs were exploited.

The data presented in this article show that the dietary changes documented for the post 2000 BP period in the southwestern Cape were associated with a significant increase in size as well as in cortical bone thickness in the human populations. The question postulated by the authors from these finding was to what extent these skeletal changes can be attributed to dietary change alone, or are indicative of some change in the genetic make-up of the post 2000 BP populations sampled in this study.

The morphometric data presented do not fit the generally accepted model of decreased bone mass in populations undergoing transition from hunting/gathering to either agriculture or pastoralism. They instead show an inverse trend to that expected for people living in a stressed and impoverished environment as suggested by the archaeological data. It is the opinion of the authors that genetic change provides the most feasible explanation of the changes found in stature and bone mass, and is the result of population replacement and or admixture.

Research Showing a Shift in Diet in Prehistoric California Populations

In order to prove the hypothesis that a shift in diet affected prehistoric California populations, it must first be shown that a change in diet actually occurred. Schulz's (1981) dissertation discusses Heizer's 1949 suggestion that acorns were not a major part of the local subsistence adaptation prior to the middle period for Native Americans in California. Other hypothesis he tests are that meat formed the most important component of the diet in Early times (Heizer 1949), that salmon were a major resource in the lower valley in the Late prehistoric period (Baumhoff 1963) and that the valley floor was depopulated during Phase 1 of the Late Period (Moratto et al. 1978).

In testing these hypotheses, Schulz (1981) looked at the native distribution of major plant communities on the lower Central Valley floor. This was discussed in order to provide a basis for the comparative evaluation of the importance of the acorn crop. Schulz (1981) goes into great detail about the various flora and fauna found in each major

plant community of the Central Valley. He also provides some explanation as to why each plant community were important and what aspects of the flora and fauna found in these areas would be important to the Native populations. With this discussion he was able to illustrate the wide variety of foods available to the inhabitants of the lower Central Valley.

In looking at the archaeological evidence for acorn subsistence in Windmiller sites, Schulz (1981) discusses the faunal remains, midden characteristics and the frequency of mortars and pestles found in the Central Valley. In his discussion he make an interesting point regarding the use of the mortar and pestle, a point which is often overlooked by others. He suggests that the mortar and pestle were used for many other resources besides just acorns, some of which include; pea vines, clover, eulophus bulbs, wild sunflower roots, mazanita berries and many more.

Assuming that the adoption of an acorn economy provided an increase in food supply and thus permitted denser populations, Schulz (1981) looked at paleopathological evidence to test this assumption. He looked at seasonal mortality, age distribution, Harris lines, enamel hypoplasia, dental caries and tooth loss and used previous work in Central California.

In the end, Schulz (1981) concluded that Heizer (1949) was correct in believing that acorns were not a dominant element of the Windmiller economy, but wrong in assuming that hunting was: that Baumhoff (1963) overestimated the dietary importance of salmon in the late prehistoric adaptation of the lover Central Valley; and that Moratto et al.

(1978) insightfully emphasized the potential impact of climate change on prehistoric adaptation but are wrong in hypothesizing a Late prehistoric depopulation of the valley floor. Schulz (1981) is also careful to note that many of his interpretations were based on limited evidence and could therefore be proven wrong.

Basgall's (1987) study addresses the intensive reliance on acorns by Native Americans, known as balanophagy and the ramifications of such subsistence intensifications. Looking at food refuse from archaeological sites, milling tool components and human skeletal populations he argues that acorn reliance did increase over time and that health also improved over time with a greater reliance on acorns. He bases these conclusions on fewer transverse lines found in the skeletal populations **(INCLUDE WHICH POPULATIONS HE LOOKED AT)**. Basgall (1987) also found an increase in hypoplasitic defects in the Late Period, which he relates to an effect of increased sedentism and higher population density during the Late Period.

Basgall (1987) also notes that archaeological data is consistent with the notion that balanophagy brought with it increased dietary reliability (manifested in the decreased transverse lines and increased subadult life expectancy) but not a qualitatively better diet, as witnessed by increased mortality rates and a higher incidence of hypoplasitic defects. He concludes that there was an increase in health in the Middle period, which then drops off again in the Early period, possibly the result of a shift to a more sedentary lifestyle.

Basgall (1987) believes that acorns are not seen in the early record as much because the Native Americans didn't know how to process them yet. He also argues that milling

tools seen during the Late period are probably more likely associated with ochre or seed processing. This conclusion is based on the higher incidence of such artifacts being recovered with burials.

Basgall's (1987) article is important to help understand the role acorn reliance played on the Native Americans of the Central Valley and how a shift to a more heavily reliant acorn rich diet could socially affect these populations.

Optimal Foraging Theory

CHAPTER 7

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