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The biological consequences of inequality in prehistory

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Summary – *Inequalities have a long history and undoubtedly affected health in past societies. Yet, few paleoepidemiological studies have successfully linked health variations to inequalities. In general, the study of the biological consequences of socioeconomic inequalities in prehistory has been hampered by a lack of confidence in the ability to archaeologically detect inequality during life, as well as difficulties in the conceptualization of inequality processes in antiquity. Research thus far has most often attempted to link to health single, ethnographically supported status markers such as grave position and funerary remains. We review select studies of the biological consequences of status differentiation and inequality. The biological consequences of "class-inequality" are clear in some hierarchical societies such as Westerhus, Medieval Sweden, but less obvious at Monte Alban, Mexico, and Dickson Mounds, Illinois, U.S.A. Other studies have linked morbidity and mortality to the development of interregional variation in political power along the Nile River Valley, in Mississippian societies, and in the American Southwest. Such studies are beginning to give some sense of the operation of "fields of power" in antiquity and the biological consequences of inequalities in access to knowledge and power in past societies. Further studies of the processes linking inequality and biology in antiquity will require clearer conceptualization of fields of power, and means for analysis of the interrelationship between fields of power within families, communities, and regions.*

Keywords – *Stress, Inequality, Health, Paleoepidemiology.*

Introduction

Bioarchaeology, the study of human biological remains in archaeological contexts, has made tremendous advancements in the last quarter century. Taking leads from human adaptability and the "new" archaeology, it has developed from a descriptive science with a primary goal of charting the geographic and temporal distribution of disease, to one with an evolutionary and ecological framework that has concern for the process by which people in antiquity became ill. A more descriptive paleopathology might only be concerned that a pathology such as caries was present in Basketmaker II in the American Southwest or at any other time-place combination. In contrast, a more processual bioarchaeology calls for examining the changing pattern of occurrence of caries. Its goal is to explain why caries rates change in relationship to social and ecological contexts such as changes in diet, available foodstuffs, food preparation technologies, weaning practices, and oral hygiene. By testing among competing hypotheses to explain the distribution of disease, paleopathology became paleoepidemiology, a processual and populational science. And, by beginning to try to understand the

burden of disease in prehistory, bioarchaeologists became better equipped to understand the cause and consequence of disease and how it related to social formations and change in prehistory.

Despite the development of processual and epidemiological approach in bioarchaeology, the range of questions explored has remained limited. Bioarchaeology has been limited both materially and theoretically. Materially it has been held back by the nature of what preserves well. Theoretically it has been limited by the "ecological biases" of the parent disciplines of the new archaeology and human adaptability, a holdover from the 1960s. These limitations have specifically restricted study of the relationship between health and socioeconomic and political inequalities. Studies are infrequent of the distribution of disease and death within a group and in relationship to socioeconomic factors. As well, studies of between group health differences invariably focus on well documented differences in ecology and economics (food procurement strategies, settlement systems, etc.) to explain differences in health patterns. Few between group studies of health consider differences in governance or access to ideology and political power. Of course "ideology" and "power" do not leave unambiguous archaeological signatures. However, these regional and class-based power differentials are the major determinants of health today (Navarro, 1976; Waitzkin, 1983) and in recent history, and we see no reason why they would not have been key to health in antiquity.

The purpose of this paper is to provide some focus on the problem of measuring inequality in prehistory and relating patterns of inequality to patterns of health. The first section focuses on what might be referred to as classical inequality - variation in resource and power within a geographically defined group such as a village. Here we use for illustrative purposes work at Westerhus, Sweden and Dickson Mounds, Illinois, although these are not the only examples possible. The second section considers the case for inequalities based on geographic location within a prehistoric political system. Here we focus on research from the Nile River Valley and then revisit work at Dickson Mounds.

Health variation and within group inequalities

Analyses of variation in morbidity and mortality in relationship to within group inequality have usually equated inequality with social class or status. An excellent example of this work is that of Swärdstedt (1966) on the relationship between social class and linear enamel hypoplasia prevalences at Westerhus, a medieval Swedish population. Linear enamel hypoplasias are lines, bands or pits of decreased enamel thickness, due etiologically to a disturbance to normal enamel development (Sarnat and Schour, 1941; Goodman and Rose, 1990). The ameloblasts that make enamel fail to secrete sufficient enamel, thus the hypoplastic or underdeveloped area of the crown is seen to the naked eye as an area of reduced enamel thickness. These defects are useful for reconstructing health during the time of tooth formation, around birth to six years for the commonly studied permanent anterior teeth. They are indelible and not remodelled, so the record of stress is fixed and the location of the defects on tooth crowns provides a unique record of the pattern of stress over developmental age (Goodman and Rose, 1990).

Swärdstedt (1966) was able to show clear differences in enamel defects among social groups buried at Westerhus (Fig. 1). As seen in Figure 1, individuals in social group I are landowners and individuals of high status, group II are

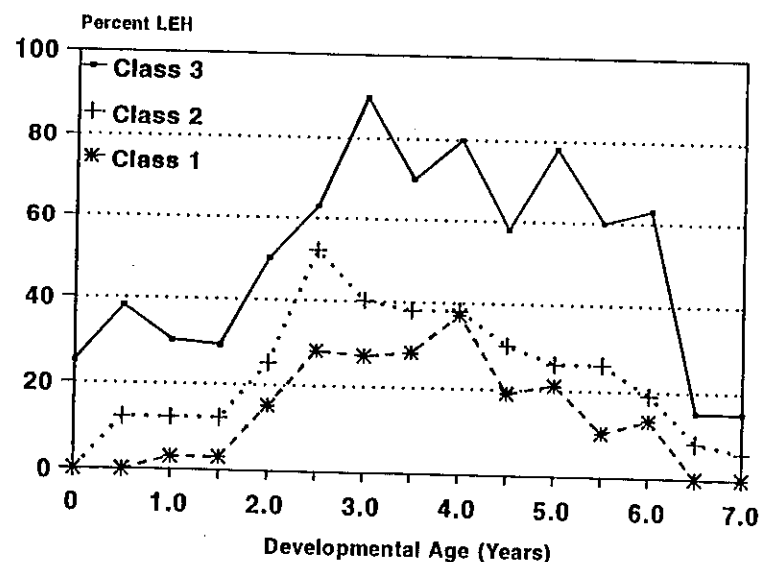


Fig. 1 - The frequency of linear enamel hypoplasias (LEH) by half-year developmental periods for social groups from Westerhus, Medieval Sweden. Class 1 individuals are defined as higher class landowners; Class 2 individuals are peasants and Class 3 individuals are slaves with little freedom and control of the means of production (redrawn from Swärdstedt, 1966).

peasants who own their own land but are clearly below group I in status and wealth, and individuals in group III are indentured slaves of a sort. They neither own their own land nor control their means of production. They are at the bottom of this caste-like society.

The frequency of enamel defects is greatest in all half-year developmental periods in the slave group. Conversely, LEH is lowest, e. g., less stress, in the landowners and intermediate in the peasant group. In general terms, the data fit extremely well the expected pattern -- the landowners with greater wealth were less stressed. They most likely were better fed, live in less crowded conditions, and were likely to have been metabolically less challenged. The slaves, with little control over their life appear to be very highly stressed. That the greatest difference is between the peasants and the slaves may have been less expected, and might suggest some rethinking of the life conditions of these two groups. Two possibilities are suggested. First, because stressed peasants have less cultural and biological resistance, they are more likely to die from the period of stress. Thus, the stressed peasants are more frequently eliminated from the sample of adults and the analysis of hypoplasias. Second, the stressors in the environment were such that they could not be avoided much more effectively by the sons and daughters of wealthy landowners as they could be by the siblings of peasants.

Why did this analysis "work well" in the sense that hypoplasias and stress closely follow social status? Partly we think because this is a "clean" study. Enamel hypoplasias, a relatively reliable and valid measure of health, was used and perhaps even more critically, clearly demarcated and real differences among

social groups were studied. Here, status and wealth differences are archaeologically intelligible; there is historical documentation of this and differences are noted by place of burial relative to the church. There is little guess work in reconstructing meaningful social groupings in life. Unfortunately, this is not typical of other efforts to reconstruct status in life from archaeological remains.

How generalizable is this sort of analysis? Following Swärdstedt's lead, Goodman and co-workers (1984) have looked for similar social class differences in health at Dickson Mounds, Illinois, U. S. A. Dickson Mounds is located near the confluence of the Spoon and Illinois Rivers, close to the town of Lewiston, Illinois. The skeletal sample studied spans from the Late Woodland, a hunting and gathering occupation (ca 900 - 1000 A. D.) and assumed to be highly egalitarian, to Middle Mississippian (ca 1150 - 1300 A. D.), assumed to be more highly stratified. The Middle Mississippian at Dickson represents the culmination of changes from (1) hunting and gathering to maize based agriculture, (2) small seasonal camp sites to settled village occupations, and (3) from little trade to nearly continent wide trade in symbolic and utilitarian items (Goodman et al., 1984; Goodman and Armelagos, 1985).

Rothschild (1979) had previously worked on markers of social status at Dickson. She concluded that Dickson might be less stratified than assumed for an agricultural chiefdom and the best measure of social status might be grave offerings. Therefore, in analysis of the relationship between health and social status we divided individuals into those: (1) without any grave offering, assumed to signify lowest status in life, (2) individuals buried with only utilitarian items,

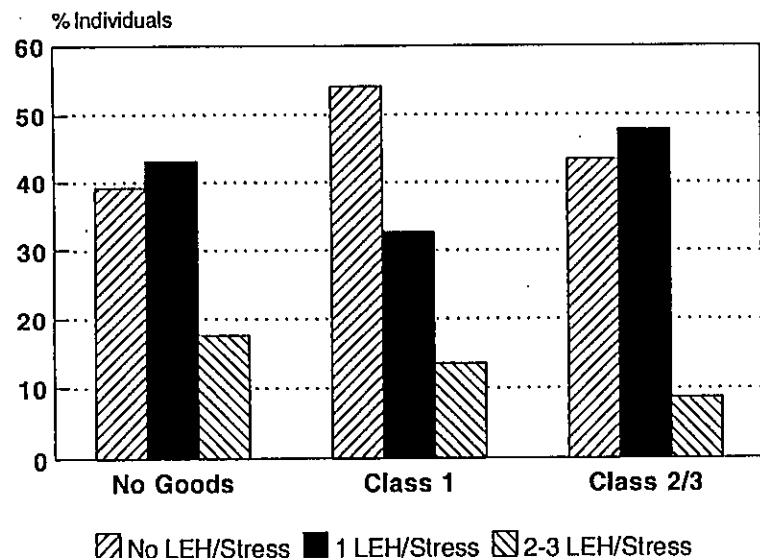


Fig. 2 - Relationship between type of grave offerings and number of LEHs-stress periods at Dickson Mounds. Stress periods are between ca 3.5 and 7.0 developmental years. Class 1 grave goods are utilitarian items. Class 2/3 grave goods are items of symbolic worth and exotica.

called Class 1 offerings, assumed to be intermediate social status, and (3) individuals with exotica, called Class 2/3 offerings, assumed to be individuals of highest social status. As in the Swärdstedt study of Westerhus, the measure of health is linear enamel hypoplasia.

A crosstabulation of individuals by category of enamel defects or stress (none, one episode and two or more stress episodes) with grave goods/social status is not statistically significant. However, a trend is evident in which individuals with no grave goods are more likely to have multiple stress episodes (17.6%) compared to those with utilitarian items (13.5%) or exotica (8.7%) (Fig. 2). In fact they have over a two fold risk of having an enamel defect compared to individuals buried with non local goods.

Although there is a clear trend linking social status and health, the relationship is not statistically significant. Why is the relationship between social status and health not stronger? One hypothesis is that status, while affecting health, does so in more subtle ways in this past population. Perhaps as Rothschild suggests, this is a more egalitarian society than assumed and the results are less dramatic because the status differences are less striking. Alternatively, it could be that status is more complexly patterned, and that it cannot be sufficiently captured by any single measure such as grave offerings at time of death. In short, grave offerings provide an imperfect measure of status in life. We assume both hypotheses are partly true. But, if status is not well measured, or "different" from our ethnographic notions of it, then how can it be better evaluated? This is a question we will return to in the discussion.

Sociopolitical power, health and regional systems

Just as inequality is found within and between groups today, so too it was surely manifest in the past. An excellent illustration of differential power and access to health can be seen in the work of Van Gerven, Armelagos and colleagues in the Nile River Valley (Armelagos, 1969; Martin et al., 1984; Van Gerven et al., 1981). The Nile River Valley is unique in that it is a very narrow strip of fertile land bordered by a very unproductive desert. Because the land outside of the valley is largely uninhabitable, those living along the valley have few adaptive options. They must adjust to the ecology and presumably the sways of power.

Through the ages different political groups have ascended to power, but most often the seat of power was to the north of the Wadi Halfa and Kulubnarti regions, where Van Gerven and Armelagos's bioarchaeological programs have taken place. Van Gerven and colleagues (1981) find that health of local groups varies in direct relationship to the florescence of Kingdoms. Health suffers when kingdoms are powerful, and when kingdoms lose power health gets better in these peripheral groups. Van Gerven et al. (1981) suggest that during economically expansive times kingdoms exert greater control and doubtlessly extract surplus labor and tribute from locals. However, during time of collapse locals are left to govern themselves, and with greater local political control comes greater access to resources and improved health. Specifically, when either the Kingdom of Meroe to the south or the Christian Kingdom to the north expands during periods of great power, Nubians lose political autonomy and their health suffers. Conversely, when the kingdoms decline in power they are less able to control areas as far away as Kulubnarti, and health in the political periphery improves. Infants and children appear to be particularly affected by these regional

processes (Martin et al., 1984). In summary, health in Nubia is highly related to one's position in relationship to sociopolitical systems. Here, being just over the border of a system of control allows for better health, something we also see in less accessible parts of the American Southwest, such as on the top of Black Mesa (Martin et al., 1991). Conversely, being on the periphery of a system (rather than outside of a system) can be extremely stressful as this is a place where control over power is minimal.

Does this sort of regional analysis work elsewhere? Returning to Dickson Mounds, Goodman et al. (1984) have previously shown that health declines rapidly from the Late Woodland to the Middle Mississippian period (Tab. 1). Between the Late Woodland and the Middle Mississippian one finds a three to four fold increase in the prevalence of long bone infection and signs of anemia (porotic hyperostosis), a decrease in growth of long bones and an increase in linear enamel hypoplasias and enamel histological defects, an increase in osteoarthritis and long bone fractures, and an increase in infant mortality.

Why did health decline at Dickson? Traditional arguments have centered on changes in cultural ecology, specifically changes in subsistence and settlement. With the advent of agriculture the diet could have become less diverse and less stable. With village formation could have come greater opportunity for the spread and maintenance of infectious diseases. However, at Dickson it is also clear that a process of involvement in a larger and more powerful social system has taken place, similar to what is seen at Nubia. Dickson came into a Middle Mississippian sphere of influence. The exotica previously mentioned comes through Cahokia, a major seat of power in Middle Mississippian about 120 miles to the south of Dickson.

Thus, Goodman and Armelagos (1985, 1989) argued that the decline in health is even more consistent with its political marginalization in a Cahokian/Mississippian social formation than with its change in cultural ecology. Indeed, in order to fully explain health changes at Dickson it may be necessary to understand how political and social influences, those things that leave few material traces, relate to real ecological changes that are the direct, proximate determinants of health.

Tab. 1 - Summary of select skeletal indicators of health at Dickson

	Late Woodland	MALW ^a	Middle Mississippian
Mean Tibial Length ^b (mm)	228.6	229.2	209.0
Mean Tibial Circumference ^b (mm)	33.3	32.8	25.2
% of Enamel Hypoplasias - Adults	45.0	60.0	80.0
% Porotic Hyperostosis - subadults	13.6	31.2	52.0
% Tibial Infectious Lesions		26.0 ^c	84.0
% Traumatic Lesions - Males	17.9	16.4	38.0
% Traumatic Lesions - Females	23.5	16.4	31.1
% Degenerative Lesions - Males	38.5	42.6	76.0
% Degenerative Lesions - Females	41.2	41.0	67.4
Life Expectancy at Birth (years) ^d	22-26		20-22

^a MALW = Mississippian Acculturated Late Woodland.

^b Based on 5-10 year age group.

^c Combined MALW and Late Woodland.

^d Calculations based on notions of moderate population growth (Johansson and Horowitz, 1986)

Discussion

Just as it would be short sighted to consider changing patterns of health in the present without reference to differences in access to resources and power, so also we must build into our analysis of health in the past a greater appreciation for patterns of access to and wielding of resources and power. In order to do this type of analysis we need to look, first and foremost, at political-economic processes. If one does not look for variation in power, then one can not evaluate its consequence for health and well being. In commenting on intragroup differences in health in *Health and the Rise of Civilizations*, Cohen (1989) responds that it is just noise. For Cohen the dynamic of significance is only the changing patterns of subsistence. We suggest that this approach mistakes for noise an even more fundamental processes, one that has an even more ubiquitous consequence for health. Not only is what Cohen characterizes as noise an important and interesting signal, one can not look at processes such as health changes with agricultural intensification without at least thinking about how one's position of power will change with agriculture. It is too simplistic and undoubtedly wrong to think that agriculture means the same thing for everyone's health. Rather, it certainly appears that agriculture may differentially benefit those who are closest to seat of power and have less benefit for those peasants who will become part of larger sociopolitical systems.

Secondly, we need to better think about and conceptualize the working of power. It is surely problematic to think of power as operating on only one level and along a single dimension. Power tends to vary within regions, within communities and within households. As well, power may not operate in a clear, linear way. In another context Roseberry (1992) has referred to the notion of fields of power and this concept might provide a good way to think about how power is manifest in many prehistoric context. To follow Roseberry, power may reside in multiple overlapping fields. These fields of power may move actions and beliefs in conflicting directions, and the contour of such fields may shift through one's lifetime and over historical time.

In summary, an implicit assumption of those in complex, contemporary societies is that inequality was of a less degree in "simple" and prehistoric societies. Clearly it is a bit more difficult to get a handle on inequality in past societies, but the assumption that inequality is less important is one that has not been properly evaluated. What we look forward to are creative ways of measuring inequality and status differentials at the level of the household and community. While we are aware of the difficulties of evaluating status, and the problem of assuming that status is directly related to burial position, care in burial, grave offerings and such, the question is too important to give up on. It is hoped that we can also look forward to more studies of gender and ethnic differences in access to political power, status, and health.

Following the Westerhus example (Swärdstedt, 1966), a productive area of research may involve studies of populations with historical documentation of social position and status. An obvious example of this is work on African American biohistory (see articles cited in Rose and Rathbun, 1987). Finally, it is hoped that more bioarchaeologists will undertake regional analyses of variation in health in relationship to both ecology and power. Central Mexico is one of the places that this work has started.

What most excites us is the potential for merging ecological perspectives with a more resolutely political-economic perspective in bioarchaeology. In this way we might be able to open up a political ecology of bioarchaeology, a bioarchaeology

in which health is conceptualized and studied as it relates to the interaction between local, ecological determinants and the more distant formulations of fields of power. It is our hope that this paper has suggested that the interface of ecology and power is a fruitful area of research for understanding health in past societies. Challenges remain to better operationalize this broadening of horizons.

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ABSTRACT

Le conseguenze biologiche della disuguaglianza sociale nella preistoria

Riassunto - La disuguaglianza sociale ha una lunga storia e senza dubbio ha influenzato la salute nelle società del passato. Nonostante ciò, pochi studi paleoepidemiologici hanno correlato con successo tali disuguaglianze con lo stato di salute. In generale, lo studio delle conseguenze biologiche della stratificazione socioeconomica nella preistoria è stato ostacolato da una ridotta capacità di registrare da un punto di vista archeologico le disuguaglianze durante la vita, così come le difficoltà nel concettualizzare i processi di disuguaglianza nell'antichità. Finora le ricerche condotte hanno cercato di collegare allo stato di salute singole evidenze di stato supportate etnograficamente, come per esempio la posizione della tomba e i resti funerari.

Nel presente lavoro vengono revisionati studi selettivi delle conseguenze biologiche della differenziazione ed stratificazione sociale. Le conseguenze biologiche della "ineguaglianza di classe" sono chiare in alcune società gerarchiche come Westerhus, nella Svezia Medievale, ma sono meno ovvie a Monte Alban, Messico e Dickson Mounds, Illinois, USA. Altri studi hanno collegato la malattia e la mortalità allo sviluppo di variazioni interregionali nel potere politico lungo la Valle del Fiume Nilo, nelle società Mississippiane e nel Sudovest americano. Tali studi stanno cominciando a dare un certo senso all'operazione dei "campi di potere" nell'antichità e le conseguenze biologiche dell'ineguaglianza nell'accesso alla conoscenza e al potere nelle società del passato. Studi futuri sui processi che collegano la stratificazione sociale e la biologia nell'antichità richiederanno una più chiara concettualizzazione dei "campi di potere" e mezzi per l'analisi dell'interrelazione tra questi all'interno di famiglie, comunità e regioni.

Parole chiave - Stress, Ineguaglianza, Salute, Paleoepidemiologia.

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