An Examination of Dental Health in an Impoverished Population

M.A. Thesis Proposal

Catharina Berglund
Department of Anthropology
San Francisco State University
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I. Abstract:

The purpose of this study is to examine dental caries in the Hamann-Todd Osteological Collection. This historical population dates to the late nineteenth and early twentieth centuries. My hypotheses are: 1) There is a distinction in frequencies of carious lesions between the sexes in a population that lived under impoverished conditions; 2) Members of older age groups will have a higher incidence of dental caries than younger individuals. This research is relevant for several reasons, including informing us about the general health of past populations, giving insight into a modern disease by seeing how it developed and how it has evolved due to changing conditions, and possibly seeing how status and living conditions can affect the development of a specific disease.

In order to assess caries incidence I will perform a complete dental inventory for each individual, recording the number and size of carious lesions for each tooth, using a recording form based on previous work (Buikstra and Uberlaker 1994; Griffin 2004). I will then perform statistical analysis on the data, in order to test my hypotheses. My expected findings are that there is a significant difference in lesion frequency between the sexes, and that younger individuals have a lower incidence of caries than older individuals.

II. Introduction:

The purpose of this study is to examine dental disease in a historic population from the late nineteenth and early twentieth century Midwestern United States. This study will examine dental caries in the Hamann-Todd Collection, housed at the Cleveland Museum of Natural History. The study will also assess the prevalence of caries between the sexes, a range of age groups, and various ethnic groups. Because the majority of individuals in this collection are known to have been of low socioeconomic status, one of the goals of this study is to assess the possible correlation between incidences of dental caries and socioeconomic status (Balabuszko 2005; Cobb 1932). I will also investigate the documented availability of dental care to populations of low socioeconomic status and its potential effect on the formation of carious lesions.

Human remains are an integral aspect of learning about prehistoric and historic populations (White 2000; Buikstra and Uberlaker 1994). The skeleton can inform

researchers about the general health of peoples in the past, lifestyle, diet and nutrition, in terms of day to day life in the past and also how people were affected by certain diseases that they had to live with (Wright and Yoder 2003; Cohen 1989). “When a representative population sample is available, analysis of skeletal pathology can provide estimates of community health and thus facilitate investigations of disease patterning in comparative perspective” (Buikstra and Uberlaker 1994: 107). This type of study can also give insight into modern diseases by considering how a specific disease, dental caries in this case, has evolved over time in changing social, economic, dietary and climatic conditions. There is also a possibility of assessing how social status and living conditions can affect the emergence and development of a disease within a human population. This study is relevant to the discipline of anthropology in terms of adding to the literature on paleopathology. Only a few of the studies concerning individuals of low socioeconomic status specifically focus on dental health. In addition, there have been studies focusing either on impoverished populations or differences between males and females in prevalence of dental caries, but few studies have combined the two in order to look at the impact of socioeconomic status on dental health.

The specific hypotheses that I will test are: males and females have significantly differing frequencies of carious lesions in an impoverished population; younger individuals exhibit a lower incidence of dental caries than member of older age groups. In addition, I will consider the variation in lesion frequency between individuals of different ethnic backgrounds. In order to test my hypotheses, I will travel to the Cleveland Museum of Natural History and examine the dentitions of seven hundred individuals in the collection. I have already obtained permission from the museum, and a copy is

attached to this proposal. I will gather data on the number and size of carious lesions present, as well as the general presence and absence of teeth in the dentition. Using my data, I will then conduct a statistical analysis, using chi-square and t-tests, to assess significant differences in the data. These are common statistical tests employed for hypothesis testing, and have been used in previous research.

III. Background:

Paleopathology can be defined as "the study of diseases in ancient populations as revealed by skeletal remains and soft tissues" (White 2000: 381). This field examines the progression and evolution of diseases over long periods of time. Paleopathology is important for the archaeologist in terms of examining how people interacted with their environment and adapted to this environment over time. When studying disease in modern populations, researchers are only able to study the effects and progression of the disease over a short time span. In paleopathology, however, the progression of disease can be studied in terms of climate change or other environmental factors over hundreds or thousands of years. There are three main objectives to paleopathological research: the diagnosis of specific diseases in individual skeletal remains, the analysis of the impact of various diseases in human populations through time and space, and the clarification of evolutionary interactions between humans and disease (White 2000: 381).

Paleopathology, as a focus of scientific research, goes back to the late nineteenth and early twentieth century. Early research was descriptive and classificatory, while the early twentieth century began an "analytical" period. The time span between 1930 and 1970 was characterized by specialization, while from 1970 to the present, the field has been moving into an interdisciplinary phase (Roberts and Manchester 1997: 3).

According to Ortner, current research addresses broader issues in the biomedical and anthropological sciences, as well as the concept of meaning (Ortner 1991).

Dental pathology is “the scientific study of the origin, nature and course of dental diseases” (Lukacs 1989: 261). Dental pathologies are commonly interrelated, but due to the limited scope of this analysis, dental diseases related to caries will not be discussed. However, it is mentionable that they include dental attrition and abscessing, as well as periodontal disease. Attrition and caries are especially interrelated, according to Goodman and coworkers (1982). Rates of attrition can be a factor in the rate of formation of carious lesions.

There are several important studies using populations similar to the one under consideration for this thesis. The first is a study on the Monroe Country Almshouse cemetery in Rochester, NY, which discusses the dental health of a nineteenth century population known to be of low socioeconomic status (Higgins et al. 2002). The skeletal remains date from 1826-1863. Primary documentary records are abundantly available for public paupers in the mid nineteenth century Northeast, as well as secondary historical analyses of the urban poor. These sources are used throughout this study to add to the data collected from the skeletal remains.

Almshouses were constructed as a segregation point for the public poor, and many included a public hospital, an insane asylum and a penitentiary in the same complex. There were two main goals of almshouses: to relieve poverty and to use the threat of having to enter an almshouse as a deterrent for public dependency. The population of the almshouse was largely foreign-born, with the greatest majority stemming from Ireland (Higgins et al. 2002: 166). All of the inmates were white. It was

also quite common to have female-headed, single-parent families and orphaned children. The authors believe it is important to understand the nature of the almshouse system in order to accurately interpret the results of the skeletal analysis, and thus this study is an example of using a biocultural approach.

The general conclusion that the authors make is that almshouses in the United States were dangerous and unhealthy in the mid-nineteenth century (Higgins et al. 2002: 169). Because the average stay at almshouses was only a few days or at most two weeks, it is argued that the poor health observed in these skeletons is the result of nutritional and disease stress experienced outside the almshouse (Higgins et al. 2002: 175). The sample size for this study is 296, consisting of 67 subadults and 229 adults. Among the adults, 72 are female and 103 are male (Higgins et al. 2002: 169). The average age at death for the whole group of adults is 40 years and 3 years for the subadults. The authors considered dental health among the diseases examined. They found that approximately 37% of the female skeletons exhibited dental caries, while 27% of the males showed signs of dental caries (Higgins et al. 2002: 172). In both sexes, mandibular molars had the greatest number of carious lesions. According to the authors, “The high frequency of caries in both sexes may be indicative of their depressed socioeconomic status” (Higgins et al. 2002: 177). Most likely, these individuals could not afford dental care. In addition, they were probably forced to rely on food sources high in carbohydrates, leading to a high incidence of caries. The higher rates of dental caries could be ascribed to reproductive stress (Higgins et al. 2002: 177).

A second important study by Balabuszko (2005) assesses the impact of sex and gender on the health status of individuals living under stressful conditions caused by low

socioeconomic status. The author uses a sample from the Hamann-Todd Osteological Collection, which is the same population that will be used in this thesis. This population is known to be of low socioeconomic status. The majority of individuals come from the county morgue, the city hospital, the Warrensville Farm, a poorhouse, and the state hospital (Balabuszko 2005: 54). The major hypothesis tested in this study is that males and females had a significant difference in health status. The author also examined race, age and year of death and their relationship with health status.

The sample size for this study was a total of 601 individuals, with 101 white females, 150 white males, 201 black females, and 149 black males. Presence or absence of periosteal lesions was recorded, in addition the location on the bones (63-66). The results of this study supported the original hypothesis that health status would be significantly different in males and females, with males having a lower health status. The author also found that blacks and whites had a similar health status. Another aspect of Balabuszko's study was to assess if health was improving over time. The results for the entire sample population were significant, but the author believes this could be a result of a lower mean age in the individuals selected from the later years.

Sledzik and Moore-Jansen (1991) authored another study significant for this project. This study does not specifically consider individuals of low socioeconomic status, but instead focuses on military skeletal samples. Because many historic documents are available for the United States military at different points of the nineteenth century, it is possible to glean a large amount of information about dental disease in this era from a military skeletal population. The samples in this study consist of recruits and volunteers

from the War of 1812, the Civil War and the Indian Wars (Sledzik and Moore-Jansen 1991: 215).

The authors used the Snake Hill archaeological site for their War of 1812 group. The sample from this site consists of 28 individuals, with an age range of 18-26 years (Sledzik and Moore-Jansen 1991: 215). The authors chose skeletal remains from the National Museum of Health and Medicine, Armed Forces Institute of Pathology for the Civil War group. This sample consists of 49 crania and 10 associated mandibles. The age range for this group is 18-45 (Sledzik and Moore-Jansen 1991: 216). Skeletal materials for the Indian Wars group also come from the National Museum of Health and Medicine. This group has 14 crania with 8 associated mandibles. Age of the individuals ranges from 20-44 years (Sledzik and Moore-Jansen 1991: 216).

The Civil War sample was found to have the overall highest caries experience. The authors compared frequency of carious lesions by site and tooth type, as well as age group. Diet in the United States underwent rapid changes throughout the 19th century. Public attitudes towards dental care also changed a great deal throughout the century. In the early 19th century, personal and dental hygiene was left to the discretion of each soldier, often resulting in infrequent washing and oral care. The authors found a presence of fillings, indicating that soldiers received some dental care (Sledzik and Moore-Jansen 1991: 221). By the late 19th century, the military had increased its use of dentistry in treatment of dental disease. This is reflected in the high antemortem loss figures and lower caries rates (Sledzik and Moore-Jansen 1991: 221-222). The Indian Wars sample also had a high rate of abscess, possibly as a result of 19th century dentistry practices.

A third study conducted by Ted Rathbun (1987) discusses the health and disease of a skeletal population from a slave cemetery in South Carolina. The sample size, which dates from 1840 to 1870, consists of 36 individuals, specifically 8 subadults, 13 adult males and 15 adult females.

Dental pathological conditions in this population included carious lesions, alveolar resorption and abscesses, and linear enamel hypoplasias. Dental disease was determined to be a significant problem for individuals at the 38CH778 site. According to the results of the study, the number of teeth lost antemortem varied by gender and was age progressive (Rathbun 1987: 244). It was not infrequent in this sample for all molar teeth to be absent by the age of 30 in both sexes. Females had a higher rate of tooth loss (mean=11.57 for females and 6.50 for males), which was partially attributed to their living longer (Rathbun 1987: 244). The number of crown carious lesions also varied by gender. Females did have a higher frequency of carious teeth, but it was not statistically significant. In addition, the authors found that females had more missing teeth and of those that remained, more were carious teeth and more crown surfaces were affected than in males (Rathbun 1987: 244). Males exhibited more alveolar and periapical abscesses, as well as more teeth with linear hypoplasias. Based on these results, researchers determined that half of the females and 92% of the males experienced significant periods of metabolic stress (Rathbun 1987: 244).

Based on the skeletal evidence from this site, the authors state that strenuous physical labor was a significant part of life in the nineteenth century (Rathbun 1987: 251). The average age at death for this population sample was comparable to the national life expectancy estimates for slaves in this time period. However, it is noted that females

seem to have lived longer and this is possibly related to the social structure of the slave group and/or the plantation as a whole. Based on the results of the dental pathology survey, it is suggested that these individuals ate a diet fairly high in carbohydrates and plant foods (Rathbun 1987: 251).

Saunders and others (1997) conduct a comprehensive survey of dental caries and antemortem tooth loss rates in their study in nineteenth century Upper Canada. They also examine the effects of age and sex on dental pathology and compare the results to British and American studies. The authors wish to examine historical documentation about socioeconomic factors, diet, dental care and environmental conditions that may have affected the observed rates of dental pathology, again using a biocultural approach. Marked increases in dental caries in Canada occurred in the latter half of the nineteenth century. These have mainly been linked to the increase in consumption of sugar and refined carbohydrates. Increases in the rate of caries also occurred in the United States.

The sample size for this population was 276 individuals, with a total of 4605 teeth observed. The teeth were examined for presence, postmortem absence, antemortem absence, congenital absence, partial eruption and no eruption. Of the 6635 sockets observed, 290 teeth were lost postmortem, which amounts to 4.4% (Saunders et al. 1997: 75). Antemortem tooth loss equaled 5-53%, with the highest values for molars and premolars. Females had the highest rates of carious teeth. For the entire population, the number of carious teeth ranged from 5-70%, with molars again having the highest values (Saunders et al. 1997: 76). According to the historical documents examined by the authors, there was one practicing dentist at this site, but care was completely dependent on cost and the patients' ability to pay. 18 adults examined for this study were observed

to have tooth restorations, made up of either mixed silver amalgam or gold (Saunders et al. 1997: 80).

In contrast to studies mentioned above, a research paper discussing the results of an excavation of the Weir family cemetery in Manassas, VA considers the dental health of individuals of a high socioeconomic status. The sample size was twenty-four, with fifteen individuals coming from marked graves and nine from unmarked. The individuals from marked graves included two children three years of age or younger, six individuals between twenty and thirty-nine years, four individuals between forty and fifty-nine years, and three individuals older than seventy years (Little et al 1992: 398).

The members of the family showed relatively little dental attrition (Little et al. 1992: 404). Twenty individuals had at least one permanent tooth present and twelve of them had at least one carious lesion. Of the 197 teeth recorded, 35 had carious lesions, equal to a 17.8 percentage. In addition, 19 of the total 35 cavities had been filled with gold and amalgam. This is equal to 54.3 percent. According to the authors, the presence of gold fillings is indicative of individuals of high socioeconomic status.

Little and coworkers (1992) also focused on Burial 23, which was known to contain Walter Weir. In an autopsy of this individual, the authors found that the left maxillary M1 had a gold filling and there was an unfilled carious lesion on the left mandibular M2 (Little et al. 1992: 406).

This article serves as an example of dental health and level of dental treatment in a family known to have a high socioeconomic status. Investigators found, in general, low levels of dental attrition and caries percentages consistent with the range of other data

from the nineteenth century. They also found many gold and amalgam fillings, indicating availability of and access to dental care.

The studies mentioned above are very important for my research. The article by Higgins and others (2002) uses a population similar to my research population, and thus has been an influence in establishing my expected findings. Similarly, the thesis by Balabuszko (2005) uses the same research population, and thus it will be extremely useful in terms of information on the history of the collection and the living conditions in Cleveland during that time period. Although Balabuszko examines the general health status using the tibia, the results of my study are expected to be similar to the results of Balabuszko's study. This can be expected because dental and general health is similarly affected by living conditions and diet. The other studies serve not only as guides for what I can expect my results to be, but also as informants as to the extent and scope of dental care during this time period. I wish to build upon this previous research, using a population that has known characteristics, including being of low socioeconomic status. Having this information, in addition to documentation on each individual's sex, age and ethnic background, will allow me to conduct a study similar to those discussed above, but with a more specific focus.

IV. Methods:

One of the earlier attempts at standardizing methods for recording dental caries was suggested by Corbett and Moore (1976). Many other approaches have been based on this original suggestion, including the methods put forth by Buikstra and Uberlaker (1994) and Hillson (2001). In their study, Corbett and Moore classified the crania into age groups on the basis of dental attrition (1976: 404). There were a total of four groups

for this study. Using the data collected, the authors calculated the caries rate separately for each skull as a percentage of the numbers of each tooth type present. The authors also estimated the frequency of caries at each location on the tooth by calculating the numbers of cavities at each location as a percentage of the total number of surfaces at risk for caries (Corbett and Moore 1976: 404). Buikstra and Uberlaker modified the Corbett and Moore approach in their standardization of skeletal recording techniques. Buikstra and Uberlaker stressed a differentiation of teeth without caries from missing teeth or teeth that could not be observed. They designated seven numerical codes to be assigned to each carious lesion, indicating location and size of the lesion (Buikstra and Uberlaker 1994: 55). Hillson (2001) developed a very detailed technique for analyzing carious lesions, expressing the number of carious teeth as a percentage of "teeth at risk" of developing caries (258). Hillson emphasizes separate analysis of each tooth class and age group, as well as a differentiation of male and female dentitions. Hillson's technique is very useful, but too involved for the purposes of this study. I will focus on recording presence and absence of each tooth, as well as the number, location and size of carious lesions for each tooth.

The methodology that will be used for this study comes out of a reading of each of the landmark methodologies discussed above, as well as several others. I will begin by examining each dentition macroscopically and recording a general dental inventory, as well as location of carious lesions by tooth and tooth surface. This study will be conducted on a sample of 700 individuals. In addition, I will record the actual size of each carious lesion in millimeters. In the dental inventory, the absence of teeth will be marked, taking into consideration whether the absence is ante- or post-mortem, or

unerupted teeth. I will perform the inventory using a number in association with each level of presence or absence. Because the individuals in this collection were autopsied at the time of death, information on age, sex, ethnic background, and year of death are already available. Therefore, a discussion of age, sex and race estimation is not necessary for this study. The information already associated with the remains will be used in the statistical analysis of the data collected. Statistical analysis will then be conducted on the dental data recorded. I will use the chi-square test, which compares categorical variables such as sex and race. The purpose of this test is to determine if observed frequencies differ significantly from frequencies stated in a null hypothesis (Madrigal 1998: 192). My null hypothesis will be: there is a significant difference between males and females in frequency of lesions. In addition, I will use a t-test to compare the lesion frequency means of different age groups. The null hypothesis for the t-test will be: There is no difference in the frequency means of different age groups.

V. Expected findings:

The expected findings for this study are that males and females have significantly different frequencies of carious lesions. Previous research, including the study by Higgins and coworkers (2002), has found that females tend to have a higher incidence of dental caries than males. Due to the previous results, I would also expect the females included in my study to exhibit higher occurrences of dental caries. I also expect to find a lower frequency of lesions in younger individuals as compared to the older age group. Older individuals tend to have higher frequencies of lesions because their teeth have been exposed to causation agents for a longer period of time. In addition, because the members of the population were living under similar social and economic conditions, I do not

expect a difference in incidence of dental caries between blacks and whites. However, other factors, such as diet could affect the results of that comparison.

VI. Schedule:

I have preliminary approval, in the form of an email attached to this proposal, from the Cleveland Museum of Natural History at Case Western University to work with the collection. I plan to record my data in January during the winter break. My data analysis will take place between January and March 2007. I will begin writing the thesis during the Fall of 2006, focusing on sections that I have already researched, such as the Literature Review and Methods. After I collect my data and simultaneously with analyzing the data, I will write other sections. I hope to have the thesis finished in May of 2007.

VII. Committee

Mark Griffin – Major advisor
Jim Quesada – 2nd reader

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