Dental Caries Prevalence from a Late 19th to Early 20th Century Cemetery in San Jose, California

M.A. Thesis Proposal

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I. Abstract

The purpose of this study is to examine dental caries prevalence from an historic hospital cemetery located in Santa Clara, California. The Santa Clara Valley Medical Center discovered a forgotten cemetery originally dating to the late 19th century during construction work in early 2012. I will be examining the dental caries prevalence within this population in order to gain an understanding of the general health status of individuals from the late 19th and early 20th centuries. The study population is currently being housed at San Francisco State University. My research hypothesis is: 1) There will be a similarly high occurrence of dental caries within this population as is seen in other populations from the same time period (Nystrom 2011; Wasterlain et al. 2009; Gust et al. 2006; Buzon et al. 2005; Edwards et al. 2005; Wols and Baker 2004; Saunders et al. 1997; Corbett and Moore 1976). This research is significant because it will provide information about general health from an historic population. This research will contribute to the literature of how dental caries have changed over time due to social, environmental, and dietary factors.

II. Introduction

The purpose of this study is to examine dental caries prevalence from a cemetery located at the Santa Clara Valley Medical Center (SCVMC) in Santa Clara, California dating from approximately 1876-1935 (Rossi 2012). This historic population is currently being housed at San Francisco State University. This study will also look at if there are significant differences in dental caries prevalence between individuals in different age groups and between different tooth types. Since this population is from an historic time period, I will also be looking at the availability of dentistry for treating dental caries. This research is significant because it will inform about the general health conditions from an historic population.

Bioarchaeological studies are useful for investigating disease, physiological stress, trauma, physical activity, tooth use, diet, and demographics in archaeological populations (Larsen 1997). According to Buikstra and Ubelaker (1994:107), “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”. Teeth, in particular, are considered to be valuable for bioarchaeological studies.
because they are durable and often survive better than other skeletal elements, contain genetic traits, and are reflexive of diet (Scott and Turner 1988).

Paleopathology is the study of diseases that affected past populations using human skeletal remains (Ortner 2011: 247). There are three main goals for paleopathological research: 1) diagnosing specific diseases in skeletal remains; 2) analyzing the effects of diseases in human populations through time and geographic regions; 3) explaining evolutionary interactions between humans and diseases (Miller et al. 1996). However, there are several problems with determining relative health in past populations from skeletal remains. Wood and colleagues (1992) identify some of the main problems with paleopathological research: selective mortality; variation of an individual’s risk of disease and death; the non-stationary nature of human populations.

Dental caries are considered to be an infectious disease (Cura et al. 2012). Although there is typically a complex relationship between dental caries and other dental diseases (i.e. periodontal disease, dental attrition, abscessing), it is not necessary to discuss these relationships for the purposes of this study (Lukacs 1989). The presence and pattern of dental pathology can be used to infer diet, dietary change, and social status in prehistoric and historic past populations (Larsen 2002; Larsen et al. 1991; Powell 1985; Saunders et al. 1997). Past prehistoric research has shown that dental caries increased significantly with the advent of agriculture (Larsen 1995; Larsen et al. 1991; Lukacs 1989; Powell 1985). Research on historical populations have shown similar patterns with the increasing availability and consumption of sugar and other fermentable carbohydrates (Corbett and Moore 1976; Nystrom 2011; Saunders et al. 1997). This research will contribute to the literature of how dental caries have changed over time due to social, environmental, and dietary factors.
My research hypothesis is: 1) There will be a similarly high occurrence of dental caries within this population as is seen in other populations from the same time period (Nystrom 2011; Wasterlain et al. 2009; Gust et al. 2006; Buzon et al. 2005; Edwards et al. 2005; Wols and Baker 2004; Saunders et al. 1997; Corbett and Moore 1976). Within this population sample, I will compare dental caries frequencies between tooth types, age groups, and sex. I will use independent samples chi-square in order to obtain statistical significant values.

III. Background

Dental caries, meaning rottenness in Latin, is characterized by the destruction of enamel by acidic by-products caused by bacterial fermentation of carbohydrates (Powell 1985). Dental caries have been shown to be an infectious and transmissible disease (Marsh 1995). Dental caries is a multifactorial, progressive dental disease that is initiated by bacterial biofilm (dental plaque) covering the enamel (Frazão 2012). Caries are influenced by: 1) consumption of dietary sugars and starches; 2) salivary flow and microflora within the oral cavity; 3) tooth structure; 4) preventative dental hygiene practices such as the use of fluoride (Frazão 2012; Lingström et al. 2000). The primary bacterial agents attributed to dental caries are Streptococcus mutans and Streptococcus sobrinus; the secondary bacterial agents are the Lactobacillus species as well as some of the non-mutans acid-tolerant streptococci: Streptococcus sanguis, Streptococcus gordonii, and Streptococcus oralis (Liljemark and Bloomquist 1996).

Dental caries can form anywhere on either the crown or the root, including the enamel, cementum, and the dentine (Selwitz et al. 2007). Dental caries first appear as white spot lesions in enamel, whereas in root caries, the surface can become softer more rapidly with the penetration of bacteria (Selwitz et al. 2007). Calcium, phosphate, and fluoride can all reverse the
demineralization of a tooth in its early stages (Frazão 2012; Lingström et al. 2000). Continual consumption of sugars and other dietary carbohydrates affects the delicate pH balance within the oral cavity and influences the progression of dental caries (Lingström et al. 2000).

The Santa Clara Valley Medical Center is located in Santa Clara County, in the city of San Jose. Originally named the Santa Clara Infirmary, this hospital was built in 1876 in its current location by Doctors Benjamin and A.J. Cory, two of the city’s first medical professionals (Robison 1976). Like other hospitals built in the same era, the SCVMC, was originally built to serve the county’s indigent (Robison 1976). As the population in Santa Clara grew, the hospital had to accommodate the swelling masses by building new hospital wings onto the existing facility (Robison 1976). The history of the SCVMC cemetery is not well-documented. The cemetery last appeared on a County Survey map from 1932, whereas later maps show parking structures built over parts of the cemetery (Rossi 2012).

There are several important studies conducted that use a population dating to the late nineteenth century and is demographically similar to the one that will be used in this study. One significant study by Edwards and others (2005) discusses the excavation and general health findings of seventy-eight burials from a forgotten cemetery at the Sacramento County Hospital dating from 1891-1927. Although County Hospitals from the late nineteenth century were supposed to serve only the county’s indigent, this does not necessarily seem to be the case at the Sacramento County Hospital. Old age and quarantined diseases seems to have drawn people to the Sacramento County Hospital, reflecting a more dynamic population represented within the cemetery than originally thought (Edwards et al. 2005). Census records from 1900, 1910, and 1920 indicate the majority of the hospital patients were single middle-aged males of European ancestry (Edwards et al. 2005).
Of the 78 individuals examined for this study where sex was able to be assessed, 68% were determined to be male, probably male, or possible male, compared to only 8% were determined to be female, probably female, or possible female (Edwards et al. 2005). Edwards and colleagues (2005) suggest the gender imbalance in the Sacramento area might be related to the increased number of males settling in California during the Gold Rush. Forty percent of the individuals from this cemetery fell into either the mid adult age range (35-50) or the mid/late adult age range (40-50), which is consistent with records detailing the patient’s ages (Edwards et al. 2005).

The dental health of the individuals represented within the Sacramento County Hospital cemetery was relatively poor, with the primary dental problems relating to dental caries, pits and cracks of the crowns, and antemortem tooth loss (Edwards et al. 2005). Approximately one-third of the individuals had at least one dental caries and antemortem tooth loss (Edwards et al. 2005). At least fifteen individuals within this population had fillings, bridges, shell crowns, or dentures, showing that these individuals had access to dental care at one point in their lives (Edwards et al. 2005).

Another important study conducted by Buzon and others (2005) examines health and disease within a San Francisco cemetery population roughly dating to 1868 to 1906. This cemetery is located at the Legion of Honor, an area formally part of the Golden Gate Cemetery, and was forgotten and subsequently re-discovered in 1994 during renovations (Buzon et al. 2005). Buzon and colleagues (2005) report that the people within this cemetery were forgotten individuals of low socioeconomic status. Although over 900 burials were discovered, only a small subsample of ninety adult skeletons with well-preserved crania was examined in this study due to limited time constraints (Buzon et al. 2005). Eighty of the ninety individuals were well-
preserved enough for sex determination, revealing that thirty percent were female, and seventy percent were male (Buzon et al. 2005). The large proportion of males within this population is consistent with other pauper cemeteries reporting a higher occurrence of males than females (Buzon et al. 2005). Only half of the ninety individuals were decently preserved enough for age-at-death determination. Of these, 22% were young adults, 64% were middle-aged adults, and 13% were elderly adults (Buzon et al. 2005).

Buzon and colleagues (2005) examined the following dental pathologies: dental caries, enamel hypoplasia, antemortem tooth loss, and abscesses. The results for this study showed that 43% had at least one carious lesion, 80% exhibited antemortem tooth loss, 34% had at least one abscess, and 50% had at least one incisor or canine with enamel hypoplasia. Buzon and others (2005) report that there are no statistically significant differences between the age groups or the sexes for any of the dental pathologies.

Buzon and colleagues (2005) report that the 43% dental caries prevalence rate is lower than others seen in North America and suggest that this may be related to the high antemortem tooth loss and overall poor dental hygiene practices and the increasing consumption of sugar in the late nineteenth century. Since dental care services were not widely available in the nineteenth century, particularly not to people of a low socioeconomic class, it is not surprising there is no evidence of fillings within this sample population (Buzon et al. 2005).

Another important study by Wols and Baker (2004) examines the dental health of fifty elderly (60+) male individuals from the Texas State Cemetery who all died between 1907 and 1932. Ninety percent of these men were institutionalized at the Confederate Home for Men in Austin, Texas (Wols and Baker 2004). All of the men in this sample had documented
information about their sex and age-at-death from their headstones and other archival information (Wols and Baker 2004).

The goal of Wols and Baker’s (2004) study is to glean information about diet, disease, childhood stress, dental hygiene, and historic dental practices by examining dental caries, abscesses, enamel hypoplasia, and antemortem tooth loss. The results showed that of the 39 men who had teeth, 33 (84.6%) had dental caries, and ten (25%) of them had at least one hypoplastic line (Wols and Baker 2004). Wols and Baker (2004) report that at least one abscess was seen in 14 (28%) of the 50 individuals. The antemortem tooth loss rate was 57.2% and was based on a per tooth basis (Wols and Baker 2004).

Wols and Baker (2004) compared their results with other historical and contemporaneous population samples and found that differences in dental health may be related to the average age-at-death from this time period. This study is significant because it demonstrates the age-cumulative nature of dental diseases as well as the various factors that affect dental health such as diet, access to dental care, environment, hygiene, and socioeconomic status (Wols and Baker 2004).

Gust and colleagues (2006) prepared an archaeological and bioarchaeological report on the Los Angeles Cemetery (CA-LAN-3553) for the Cogstone Resource Management, Inc. This study is significant because it provides information about general health from a non-Native American population in the late nineteenth and early twentieth centuries. The authors indicated that the project area was impacted in June of 2005 during construction work on the Metro Gold Line Eastside Extension which led to the excavation and removal of roughly 118 individuals. The cemetery was in use from approximately 1880-1922 for the county’s indigent (Gust et al. 2006).
Gust and colleagues (2006) report that ninety of these individuals were examined for the following dental pathologies: dental caries, enamel hypoplasia, abscesses, antemortem tooth loss, extensive dental wear, and enamel pearls. This study found that 78% of these individuals displayed at least one dental pathology. Of the individuals affected by at least one dental pathology, 34 were male and 28 were female. All of the individuals that were identified to be of European descent all had evidence of a dental pathology, compared to 72% of the identified Asian individuals (Gust et al. 2006). Fifty-two percent of these individuals had at least one carious lesion, 46% had enamel hypoplasia, and 40% had evidence of antemortem tooth loss (Gust et al. 2006). Very few individuals had dental work done in their lifetime (2.5%), showing that few had access to dental care (Gust et al. 2006).

Gust and others (2006) compare the dental pathology results with the Golden Gate Cemetery in San Francisco and find that there is a relatively high occurrence amongst both of the populations. The high occurrence of dental caries and antemortem tooth loss are attributed to the increasing consumption of sugar and other carbohydrates (Gust et al. 2006).

All of the above mentioned studies are important for my thesis. The archaeological report prepared by Edwards and colleagues (2005) provides an excellent comparative population from another county hospital in California, as well as good historical information the late nineteenth century. This study contributes to what I expect to find in the SCVMC population. The study conducted by Buzon and others (2005) also provides a good comparative cemetery population from a similar geographic region as Santa Clara. This study is important because it explores some of the sociocultural and historical background in California from the same time period as the SCVMC population. The other studies also provide good comparative cemetery populations in the United States as well as information about the dental health practices that are
likely similar to what I will find in my thesis research. I hope to contribute to the literature of historic cemeteries in California because only a handful of studies reveal information about general health from the late nineteenth and early twentieth centuries using dental pathologies.

**IV. Methods**

Standardizing methods for recording dental caries is difficult due to the nature of the disease and the lack of established criteria for the diagnosis of dental caries (Hillson 2001). However, there have been several attempts at standardization the recording of dental caries within archaeological populations over the years (Corbett and Moore 1976; Buikstra and Ubelaker 1994; Hillson 2001). Corbett and Moore (1976) attempted to construct a standardized method for recording dental caries within a nineteenth century British population. Corbett and Moore (1976) divided individuals into different age groups based on attrition and recorded separate percentages for different tooth types and lesion categories. Buikstra and Ubelaker (1994) modified Corbett and Moore’s (1976) method by suggesting that researchers take an inventory of the dentition to differentiate missing or unobservable teeth from teeth without dental caries. Hillson (2001) advocates that dental caries be recorded separately for each tooth type, sex, age group, lesion type, and potential lesion type. Griffin and others (2010) recorded dental caries in a prehistoric Native American population in California by examining each tooth with a 3.5x dental loupes and a stainless steel dental probe. In this study, carious lesions were recorded when a definable pit was present. Griffin and colleagues (2010) recorded dental caries by location on the tooth and by their size in millimeters. Although aspects of all these methodologies are useful, they are too involved for the purposes of this study. Dental caries will be measured and recorded by tooth and site of origin when possible in order to obtain frequencies and to make comparisons.
Due to the varied preservation of the SCVMC burials, estimating accurate sex and age-at-death may prove to be difficult. However, previous on-site analysis of the burials has been conducted and will be used for sex and age-at-death. If sex or age-a-death have not been determined for some reason on an individual, I will conduct the assessment myself using the methods outlined below if the bony elements are available.

The methodology for recording dental caries that will be used for this study employs aspects of the studies mentioned above as well as a few other methodology approaches. A general dental inventory for all individuals and all tooth types will be conducted for this study and will be recorded as present or absent. If teeth are absent, it will be noted if it is due to ante or post mortem tooth loss, non-eruption, or congenital absence. In order to be considered for this study, an individual must have whole crowns, at least 75% of the anterior dentition present and 75% of the posterior dentition present. Dental caries will be recorded macroscopically, and if present, they will be measured and the initial site will be documented when possible. Fillings, fillings material, and other dental work will also be noted. Wear stages will be recorded for each available tooth using Smith’s (1984) chart. Antemortem tooth loss (AMTL) will be accounted for separately since it can be caused by other factors other than dental caries (Hillson 2001). Although some studies have indicated there is a link between AMTL and dental caries, I will not be making this assumption (Lukacs 1995). Antemortem tooth loss location will be recorded only when intact alveolar bone is present on both sides for a tooth position and when there is clear evidence that the alveolus is partially or completely resorbed.

Since studies have indicated a difference in dental caries prevalence between the sexes, sex will be determined for all individuals in this study when possible (Larsen et al. 1991). In adults, sex will be determined by examining the sex indicators on the cranium and pelvis as
outlined by Buikstra and Ubelaker (1994), and sex determining measurements that are summarized by Bass (2005). As many methods will be performed as possible in order to obtain the most accurate sex determination. Since there is a positive correlation between age and a greater occurrence of dental caries, making age-at-death important to determine in this study (Larsen et al. 1991). Age-at-death will be estimated when possible any of the following methods: the pubic symphysis, epiphyseal union of the bones, the iliac auricular surface, and Meindl and Lovejoy’s (1985) cranial suture closure method. As many methods will be used as possible in order to obtain as narrow an age range as possible.

After the data is collected, it will be entered into SPSS in order to generate frequencies. Since dental caries are associated with age, it is important to divide the individuals into specific age groups in order to make comparisons (Buikstra and Ubelaker 1994). Chi-square frequencies will be used in order to compare my results with those of other studies of populations from the same time period. Separate statistics will be run for each tooth type in order to avoid the issue of misleading caries rates due to the different preservation of the anterior versus the cheek teeth (Wasterlain et al. 2012).

V. Expected Findings

Since other studies from the same region and time period have revealed a high prevalence of dental caries, I expect to find similar results (Nystrom 2011; Wasterlain et al. 2009; Gust et al. 2006; Buzon et al. 2005; Edwards et al. 2005; Wols and Baker 2004; Saunders et al. 1997; Corbett and Moore 1976). I also expect to find an overrepresentation of male individuals due to the large number of male individuals residing in California during the late nineteenth century (Buzon et al. 2005; Edwards et al. 2005). Since dental caries become more common in older individuals than younger individuals, I expect to find a related pattern (Buikstra and Ubelaker
Fillings and other dental work are expected to be found, although it will likely only be found in a small percentage of the population due to the outcome of other studies from the same time period (Gust et al. 2006; Edwards et al. 2005; Wols and Baker 2004).

VI. Schedule

I will begin collecting the data for my thesis during the Fall semester of 2013. I will be entering the information into SPSS as I collect it so that it will be ready to be analyzed when I am finished with the data collection process. I will start writing my thesis towards the end of 2013 by working on sections that I have already researched such as the background, literature review, and methodology sections. After the data has been analyzed, I will write the results, discussion, and conclusion sections of my thesis. I hope to be finished by the Spring semester of 2015.

VII. Committee

Primary- Dr. Mark Griffin
Secondary – Dr. Cynthia Wilczak
LITERATURE CITED


