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Nutritional Health Status and Urban Food Economies: The View from Roman Britain

A thesis submitted in partial satisfaction
of the requirements for the degree Master of Arts
in Anthropology

by

Brittany Layne Jackson

2013

ABSTRACT OF THE THESIS

Nutritional Health Status and Urban Food Economies: The View from Roman Britain

by

Brittany Layne Jackson

Master of Arts in Anthropology

University of California, Los Angeles, 2013

Professor Gail E. Kennedy, Chair

My analysis centers on nutritional health status and dental health in skeletal remains (n=63) from the British town of Gloucester during the Roman period (AD 43- 410). By comparing my results to those from another major town, Roman York (n=262), I discuss nutrition and social difference among Romano-British urban populations and demonstrate that the Gloucester population experienced relatively poor nutrition. Gloucester's history as an early colony with an economy derived primarily from its chartered status made it difficult to draw a strong food economy to the location. As a result, its population was more vulnerable to nutritional deficit than the more organically developed town of York. Despite continued perceptions of a positive Roman influence in Britain, evidence from Gloucester demonstrates that, imperially planned settlements with high rank did not necessarily result in healthy citizenry.

The thesis of Brittany Layne Jackson is approved.

Dwight Read

Li Min

Gail E. Kennedy, Committee Chair

University of California, Los Angeles

2013

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Chapter 1: Introduction

Health status comprises a number of different factors including nutrition, contagious disease, workload, and trauma (and, in women, parity and reproductive status). This study focuses on the first of these elements: the contribution of nutrition to overall health status in ancient societies. The secondary focus of this thesis is to consider how food economies in complex societies impact the nutritional health status of individuals living in those groups. I am particularly interested in exploring the role that food access plays in individual health status. My tertiary focus for this thesis is to consider the actual “on the ground” impact of Roman conquest and resulting urbanization from the perspective of nutrition in urban populations in Roman Britain. How did the related variables of food access and food economies interact in the establishment of nutrition health during the Roman Period in Britain?

To achieve these three goals, I present the concept of “food access” as a means for modeling the economic and cultural interactions that result in what individuals ingest during the course of their lifetimes. Based on my theoretical approach, (H₁) if individuals in two populations have similar indicators for social identity and occupy similar relative locations in their respective food economies, they should have similar nutritional health status.

As a case study, I apply this idea to urban populations at Gloucester and York in Roman Britain. Archaeological evidence suggests that both towns occupied similar positions within their respective food economies and that the available cemetery populations had relatively similar socioeconomic status. I measure the expression of individuals’ food access through evaluation of health status using bioarchaeological measures of nutrition. The end result of this approach is to (1) re-affirm nutritional health status as a useful tool in bioarchaeological inquiry and to (2) present a new model for considering how cultural factors impact nutrition.

My bioarchaeological analysis shows that the population at 120-122 London Road, Gloucester had significantly higher rates of systemic stress and poorer nutritional health than the population from Trentholme Drive, York. Due to insufficient archaeological evidence, it is currently not possible to clearly link these results to any particular aspect of food access, such as differences in social identity or in local food economies. Future research will seek to improve the effectiveness of this approach by considering evidence for more complex identities active in foodways and by scrutinizing excavation data for food economies at specific sites. Through continued research, the still pertinent research questions explored here will have broader relevance for the economic and social conditions of urban food systems in the present-day.

Chapter 2: Theoretical Approach

2.1 Nutritional Health Status and Health Status

In order to understand these research questions in a manner that incorporates economic, social, and biological factors, it is vital that I first establish my approach to nutrition in a biocultural perspective.

Historically, humans have met their subsistence needs through a wide array of consumable substances (e.g., meat, fruit, vegetables, roots, insects, molds, fungi) (Brickley and Ives 2008: 42-44, 83; Ortiz de Montellano 1990: 116-117; Powell 1988: 48-49). The foods individuals consume, however, are heavily influenced by factors such as socioeconomic status and personal preference that I include under the admittedly overly broad term “social identity” (see Figure 1). In order to determine why some people have adequate nutrition and others have poor nutrition in any particular population, first we need to understand both the factors affecting decisions about what to eat (e.g., availability, price, cultural prohibitions, personal preferences) and how food moves across a cultural and economic landscape and then into the domain of paleopathology.

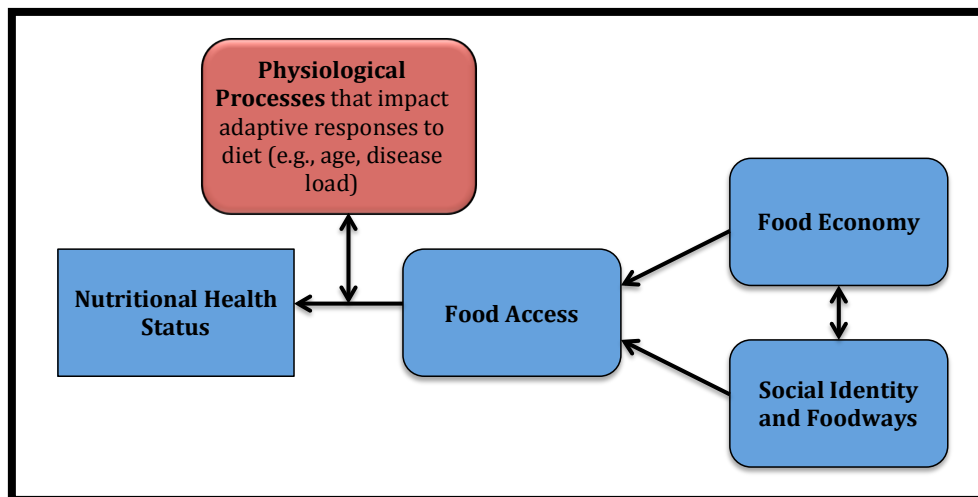


Figure 1. Theorizing Nutritional Health Access.

2.1.1 Defining Nutritional Health Status:

All physical expressions of nutrition from blood sugar levels to bone mineral content are filtered through biological reactions to food. For many years, bioarchaeologists have sought a means to quantify and compare the health of past populations through the use of physical human remains (e.g, Hooton 1930; Armelagos and Cohen 1984; Cohen 1989). Most recently, scholars from the Global History of Health Project have devised a standardized means of data collection that produces a “health index” meant to represent the overall health of past populations (Steckel and Rose 2002). Using a “biosocial framework”, the researchers assert that the biocultural process produces health indicators through a multi-factorial stress approach (Goodman and Martin 2002: 11-12). Because many experiences of disease or stress do not have consistent, predictable relationships to specific osteological lesions, each marker documented on bones and teeth must be interpreted as potentially resulting from multiple potential stress experiences. As a result, their “health index” or health status is explicitly designed not to speak to any one kind of health experience, but rather a whole range of biosocial factors.

Despite the fact that most health indicators have multifactorial etiologies, as explained above, it is my contention that through a careful reading of the bioarchaeological record, analysts can, in fact, produce details about individual aspects of health, such as nutrition, that are masked in the GHH approach to overall health status. For the purposes of this study, I build from health status as laid out above and attempt to isolate osteological indicators that speak specifically to *nutrition* in bioarchaeological contexts. I call this quality of health “Nutritional Health Status”.

2.1.2 Defining Food Access:

Nutritional health status is the result of physiological impacts and nutritive contributions to the human body. I call the series of economic, social, and cultural factors that influence the

substances that people consume “food access.” This is an inherently abstract, multifactorial concept that incorporates a wide range of social, economic, political processes impacting individual diets. As such, food access must be understood from the perspective of its components: social identity and food economy (see Figure 1). While the representation of this notion is seemingly simplistic, each of these terms is vested with multiple levels of social theory.

Social identity is used in this model as a means of representing the myriad social factors that play into individual food selection and availability, based on their relative status and relationships to others. These influences can include things such as religious or philosophical affiliation, socioeconomic status or wealth, redistributive status in a centralized food system, and ethnic food preferences. While these categories are necessarily situational and subjective, it is precisely because they are rooted and expressed in ongoing, daily practices of various kinds that they are useful when considering food choice, specifically (Jones 1997: 13). In anthropology, scholars typically utilize the overarching category of “foodways” to study the interaction between these factors (Mintz and DuBois 2002).

The concept of “food economy” comes from 19th century philosophy and economic studies of agriculture and food policy (Atwater 1895; Mills 1873). It is regularly used, but poorly theorized, across multiple disciplines including archaeology, political science, geography, and economics. Generally speaking, the term involves all economic aspects of the processes that move food from its source to individuals that consume it. These steps include food collection or production (e.g., foraging, hunting, agriculture, pastoralism), food processing (e.g., butchering practices), transportation, and exchange. In archaeology, this term has been conceived as “the complexity and organization of food production and distribution patterns” (Twiss 2012: 366).

For any society, food economies do not occur in a single location. They begin at the food collection or production site and end with redistribution or purchase and consumption of comestibles. As a result, it is necessary to consider food access across spaces and populations in the archaeological landscape. I use some aspects of central place theory in order to consider how the food economy may have acted across landscapes in the ancient world.

Since the theory's inception, scholars have utilized central place theory in two distinct ways. To begin, the theory was highly structured and economically bound since the basic tenets were established first in economic geography. This form of central place theory represents economies as acting accord to a kind of gravitational logic of supply-demand relations; as a result, the size and distribution of towns reflects the economic structure of the society (Christaller 1966: 1-7). Suppliers distribute themselves according to the number of consumers who can pay for their services. Thus, they are differentially attracted to places of higher population density. Additionally, suppliers are also attracted to one another and to those who supply their businesses (Smith 1976: 24). As a result, central places come into existence where these kinds of economic behaviors take place. From this basic outline, central place theorists argue that economic and social activities between settlements within this system are structured through these central places and across landscapes.

Traditional archaeological applications of central place theory have focused on complex societies (particularly in Western Europe) (e.g. Hodder and Hassall 1971, Renfrew 1975). In such applications, central place theory sets out to describe patterns of sites and site hierarchies (meaning the relationship between larger and smaller sites) across landscapes (Smith 1976: 18-20). These patterns are based on a rank-size ordering of sites and are interpreted to represent

different kinds of networks and relationships between populations (e.g., market, transport, administrative).

A seminal example of this logic comes directly from the study of Roman Britain. In their study of walled towns from the period, Hodder and Hassall show that the placement of these towns closely follows the basic tenets of central place theory (1971: 404). They explain the placement of towns as being related to travel time along the newly constructed Roman roads and then predict the roles of different towns within this system. Indeed, they theorize that the different levels of the settlement hierarchy played different kinds of roles within the economy and food economy, specifically. For example, minor unwalled settlements “probably acted as a simple market centre for the exchange of cereals, livestock, and other goods” while larger unwalled settlements would have acted as centers of other industries like iron smelting and pottery production (Hodder and Hassall 1971: 405-406). The walled towns, on the other hand, are theorized to have similar industries to the larger unwalled settlements, but with the addition of tax collecting activities (Hodder and Hassall 1971: 406).

In reality, these economic and social systems are necessarily intermixed (Renfrew 1975: 4-5). For Renfrew, the functioning of civilizations or states “[implies] an organization, a specialized administration, which regulates human activities both in terms of procurement (movement of goods including raw materials) *and of social relations*” (Renfrew 1975: 4, my italics). In these kinds of environments, people are necessarily economically and socially interdependent, and the economy is embedded in this social matrix, making interdependence the very “essence” of the system (Renfrew 1975: 4-5).

As scholars have adapted central place theory to a wide array of societies over time and space, the high level of descriptive and mathematical rigor with which the theory was previously

applied has given way to a focus on central places as metaphorical entities where humans tend to gravitate for particular purposes - not just towns and cities. Isaac, for example, utilized this concept to structure his “central place foraging hypothesis” in the Plio-Pleistocene (1978: 15). He argues that the simple evidence of clustered food processing locations, as opposed to diffuse scatters, during this period suggests that centralized food sharing activities (whether intentional or not) existed earlier in human evolution than traditional central place theorists would have initially proposed (Isaac 1987: 15). In this way, central places are not simply urban centers but are rather a gathering of people and resources, no matter the cultural context.

For this study, I do not seek to establish a particular kind of economic system in the style of “traditional” central place theory. Instead, I simply use the logic of ranked settlements within the food economy in order to assume comparability of food availability and quality between settlements of relative location within an economic and social system.

2.2 Archaeological Proxies for Food Access

Because food access includes a number of different factors, I do not expect to find any direct archaeological proxies for the concept. Instead, I will find archaeological evidence for its contributing aspects: food economy and social identity.

Archaeological proxies for food economy include a wide variety of evidence such as agricultural field organization and other landscape evidence, paleobotanical remains, faunal distributions that suggest production emphases (secondary products/meat production), evidence for particular kinds of animal butchery, and architectural evidence for grain storage. Based on the distribution of such factors, it is possible to build a theory for the food economy in a region that incorporates the multiple-sites of production, processing, and distribution that make up a food economy.

For example, in Zeder's analysis of animal bones from Tell Leilan in modern-day Syria, she (1994: 175-191) clearly traces the development of specialized food production for an urban workforce. She indicates that rural food producers expressed their personal agency and autonomy in non-elite food provisioning. Zeder's analysis shows that non-elites regularly consumed food resources not officially allotted to them within the elite-controlled food economy in Syria. This tells us that even in centralized economies, groups of lower rank were capable of significantly impacting their nutritive input. Through such work, archaeologists have illustrated the complicated exchanges that make up food economy.

Explicit archaeological proxies for social identity do not exist, as such— they are culturally contingent and impossible to articulate in a simple manner. The variances in kinds of identities present in daily life are such that one cannot create a single, universal identity marker in the archaeological record (Jones 1997: 106-108). It is not the purpose of this study to resolve this complex archaeological problem. Instead, in order to establish comparability of my samples in terms of social identity, I plan to utilize burial practices and foodways as proxies for “social identity”. While burial practices are generally characterized as embedded with identity markers of various kinds (Parker Pearson 1999), the wide variety of evidence present in mortuary contexts provides sufficient data with which to establish relative comparability between samples. For the purposes of this study, use of inhumation graves with few or no burial goods, non-linear organization of interments, and evidence of recurrent cuts through previous interments in antiquity are used to represent comparable social identity through mortuary contexts.

While it is difficult to establish clear ethnicity or identity boundaries between populations using foodways, it is possible to establish some similarities between populations using archaeological evidence (Gumerman IV 1997, Twiss 2012). Because feasting evidence in

mortuary contexts is not usual for all burials during this period in Britain, comparability for foodways must be taken at the larger site level and not applied to specific subpopulations in a cemetery.

2.3 Bioarchaeological Correlates for Nutritional Health Status

Despite assertions to the contrary (Wood et al. 1992), many scholars utilize a combined biocultural and contextual approach to link osteological disease indicators to quality of life in archaeological societies (Goodman 1993: 281; Goodman et al. 1988: 169). By the end of the last century, osteologists identified several major cross-cultural trends and connections between political organization and nutritional health status (Cohen 1989; Danforth 1999). In her review of literature concerning nutrition and political complexity, Danforth (1999: 5-7) argues that in “less complex,” non-urban societies, populations had fairly good health across the board. In complex urban societies, however, individuals had quite variable health, and average health was much poorer (Danforth 1999: 11-14). More recently, other specialists have shifted from these broad, cross-cultural comparisons and unidimensional narratives about food and health to studies of nutritional health *within* complex societies. For example, Buzon (2006) utilizes a number of bioarchaeological markers to study non-elite health in colonial Nubia during the New Kingdom. Similarly, Wheeler (2010) considers juvenile health and nutrition during the Romano-Byzantine period in Egypt.

Bioarchaeological approaches draw from secondary expressions of nutrition in the human body. As Brickley and Ives (2008: 47-48) note in their detailed discussion of metabolic diseases in bioarchaeology, it takes long term and extreme deprivation for many diseases (e.g., scurvy, rickets) to exhibit in the bones. The bodily response to deprivation is so dynamic that any osseous evidence for nutrition-related disease is in fact an indicator of extreme problems of food

access or malfunction of metabolic processes (e.g., infection, congenital disorders). Thus, aiming studies of nutritional status exclusively at such extreme indicators of nutritional deprivation would not be productive, except in the most severe cases of malnutrition.

One potential means of linking diet to bioarchaeological remains is to utilize osteological remains from well-excavated cemeteries to link certain social groups to specific osteological conditions (e.g., osteoporosis in women). The effectiveness of this approach is well documented in the intercemetery analysis by Pitts and Griffin (2012). Alternately, analysts can link certain social groups to certain disease indicators using historical sources (e.g., older females and osteoporosis).

Thus, it is my responsibility to tease out the relationship between the biological measures that make up the data for this project and the corresponding human behaviors and experiences. It is only from a consideration of the relationship between available data and lived experiences that we can extrapolate hints about the situations of food access and social difference in Roman Britain. Then, these results must be read in tandem with other archaeological evidence in order to present a fair and meaningful picture of food access during the period in question.

2.3.1 Identifying Nutritional Health Status:

Established methods for identifying nutritional status in the bioarchaeological record generally focus on dental disease, stature, and general health stressors such as *cribra orbitalia*, porotic hyperostosis, and linear enamel hypoplasias (LEH)¹ (Buzon 2006; Buzon and Bombak 2010; Wheeler 2010).

¹ While useful, I do not focus on isotopic analyses or specific deficiency diseases (e.g., scurvy, rickets) in this study.

Dentition is one of the commonly used and best-preserved skeletal material used for discussing health (Huss-Ashmore et al. 1982: 441). Dental analysis comprises a variety of elements useful in considering nutrition. Among these are dental caries, dental calculus, periodontal disease, abscesses, and *ante mortem* tooth loss (AMTL). Each of these indicators have their own separate etiology and literature of causation and interpretation. Generally, dental remains “can tell us about subsistence strategy and about the content, texture and preparation of diet” (Freeth 2000: 227). These indicators may be difficult to interpret appropriately, however, because of the multifaceted and interrelated factors that interact in their formation.

Carious Lesions:

Dental caries is a disease process leading to the “progressive demineralization of the enamel, dentine and cement” (Hillson 2005: 290). It begins with general weakening of the tooth matrix and exhibits typical cavities in a late stage of lesion development (Hillson 2005: 291).

Specifics of the etiology play an important role in the archaeological implications of caries in populations. While organic acids made during the fermentation of carbohydrates in the mouth actually cause the demineralization (Hillson 2005: 291), the infectious pathogen also requires exposure of the teeth to the oral environment, oral bacteria, and dental plaque in addition to a diet that provides carbohydrates necessary for the chemical reaction (Larsen 1997: 65).

But what do dental caries mean for diet in past populations? Larsen (1997: 66) emphasizes that both the “intrinsic characteristics of food” and its preparation impact cariogenesis. Additionally, Powell (1985: 309) notes that slow, gradual dental attrition may be negatively correlated with occlusal caries, largely as a result in a decrease in the number of oral environments (e.g., crevices in the occlusal surface) in which cariogenesis can occur. Dental

attrition can encourage food trapping in interproximal spaces, however, and result in increasing numbers of lesions in those areas. This relationship is fraught with complications, because an increase in abrasiveness in food as well as foods high in carbohydrates can increase carious processes, as opposed to decreasing them. Thus, both diet and subsistence technologies are very important when considering differences in caries between populations (Larsen 1997: 68).

More recently Hillson (2005: 291) has associated the caries disease with proportions of added sugar in the diet. Citing evidence from World War II populations, he concludes sugar plays the clearest role in caries development and that while “the relationship of other carbohydrates, such as starch, with caries is less clear but they do seem to have a role” (Hillson 2005: 291). Studies of dental caries in antiquity, however, seem to support Larsen’s previous hypothesis by showing that the modern “sugar-based” dental caries patterns on the occlusal surfaces of teeth did not begin until the 17th century AD in Europe (Holloway 1983: 189). Prior to the 17th century, it was more common for caries to exhibit on interstitial surfaces of teeth (Moore and Corbett 1971: 148). This pattern has been associated with a generally rough diet that caused receding of gums and exposure of more of the tooth surface. Thus, the prevalence of sugar in the diet was not the most important factor in caries formation during those periods.

There are some cross-cultural trends noted in analysis of caries. Caries are more numerous in females in many populations (Lambert and Walker 1991: 967; Lukacs 2011: 649; Walker and Hewlett 1990: 383); additionally, caries are less numerous in individuals of higher social rank (Larsen 1997: 72, 76-77). Larsen attributes these trends to a number of different causes including better overall diet and an increase in meat intake in individuals of higher social rank that loosened carbohydrate deposits in the oral environment (sic) (1997: 76-77).

Calculus:

Dental calculus is mineralized plaque preserved on teeth. It forms from a combination of plaque and calcium phosphate from the saliva (Hillson 2005: 288). It is generally found along the cement-enamel junction, but can occur on roots or other surfaces that become exposed during life (Freeth 2000: 227-228).

The indicator itself is a reflection of the state of dental care in an individual as well as the composition of his or her diet, since dental plaque forms most readily from a carbohydrate-rich diet. Dental calculus does not always preserve well in the archaeological record, however, and is easily removed in the course of excavation and processing (Freeth 2000: 228). Thus, its power to speak to nutritional experience is not stable. Nonetheless, by documenting its presence in archaeological populations, analysts can make inferences about diet and relate calculus presence to another indicator – periodontal disease.

Periodontal Disease (Periodontitis):

In bioarchaeology, periodontal disease refers to the osseous lesions on the alveolar bone that result from long term inflammation of the gums in life (Larsen 1997: 77-82). It is recognized osteologically by the resorption of alveolar bone around teeth as well as the bone “pulling away” from teeth in the affected areas (Freeth 2000: 228). Larsen (1997: 78, 82) notes that periodontal disease seems to follow similar patterns of decreasing severity and prevalence as social status increases.

Abscesses or Periapical Lesions:

Abscesses are caused by infection of the dentine and root canal that spreads from other oral infections, like dental caries, eventually resulting in its appearance on the exterior surface of the

mandible or maxilla (Freeth 2000: 231). Analysts have commonly associated abscesses with extreme dental caries that have spread to the tooth canal, but recent research emphasizes the need to distinguish abscesses and peri-apical granuloma or apical periodontal cysts, because the latter are generally benign while abscesses can potentially be fatal (Freeth 2000: 231). Characteristics like size, margin characteristics, and wall cavity characteristics are emphasized for how to distinguish between benign and infectious indicators (Freeth 2000: 231).

Tooth Loss:

Ante mortem tooth loss can be a symptom of multiple dental diseases. Larsen (1997: 77) associates it with the recession of alveolar bone in periodontitis, but it can also be caused by ablation or gross caries in the tooth (Hillson 2005: 293-294).

Linear Enamel Hypoplasia:

Linear enamel hypoplasia (LEH) is a class of enamel defect that creates regular, horizontal ridges of enamel on tooth surfaces as a result of extreme health events during the childhood of the individual (Larsen 1997: 44). The nature of the event may vary, but it is significant enough to cause “a body-wide, metabolic insult sufficient to disrupt ameloblastic physiology” (Langsjoen 1998: 405). The event causing this disruption does not need to be as significant as those required for deficiency diseases (e.g., scurvy) because tooth enamel is particularly sensitive to “metabolic insults arising from nutritional deficiencies or disease, or both” (Larsen 1997: 44). Additionally, this material does not remodel once it is formed unless removed by attrition, so it remains a stable osteological indicator for analysis.

There are three potential causes for LEH: hereditary causes, localized trauma, or systematic metabolic stress. Of these, the first two are very uncommon, and most documented

instances “are linked to systematic physiological stress” (Larsen 1997: 45). The most common interpretations for such marks include weaning, enslavement, poor nutrition or hygiene, and illness. Thus, except in the case of hypoplastic lines associated with weaning age (prior to age 2), it is difficult to definitively link LEH to nutrition (Larsen 1997: 48-49). Nonetheless, some archaeological cases do link the prevalence of such lines, like caries and periodontal disease, to rank (Larsen 1997: 48-49, 54).

Analysts have made use of the fact that tooth enamel forms at regular intervals in childhood to document the succession of health events in an individual’s childhood using LEH. Current methods for this task vary according to the requirements for precision in dating. Microscopic methods are more precise and detailed than macroscopic methods (Hillson and Bond 1998). Nonetheless, analysts have demonstrated that macroscopic methods function appropriately for certain kinds of research questions (Martin et al. 2008).

Since the 1960s, analysts have used a regression equation developed for each anterior tooth in order to calculate the approximate age at which hypoplastic events occurred (Swärdstedt 1966). More recently, Reid and Dean (2000) published a revised method that involves the calculation of the placement of the LEH event according to its placement on a decile chart for each tooth. Martin et al. (2008: 364-365) compared the precision of each method and show a difference of approximately +/- 4 to 6 months for each hypoplastic event. While the analysts state that there is a statistically significant difference in the two methods, the impact on bioarchaeological interpretations is likely minimal. Ritzman et al. (2008) see things differently. In their comparison of the two methods, they posit that currently utilized macroscopic methods are not at all appropriate, because they do produce significantly different results that impact

interpretation of bioarchaeological data, particularly in the case of early forming hypoplastic lines (Ritzman et al. 2008: 358-359).

This debate is certainly not resolved at present and has the potential to impact interpretation of archaeological data in the future. For the purposes of this project, I utilize the traditional regression analysis for LEH age calculation in archaeological samples (Martin et al. 2008, Swärdstedt 1966) because this method is most prevalent in archaeological samples. Additionally, poor preservation of the archaeological sample made it impossible to accurately calculate the decile height needed to compare the Reid and Dean method with the regression equation method. If in the future, the regression formulae are fully discredited, reanalysis of these data will be necessary.

Stature:

Unlike linear enamel hypoplasias, the methods for estimating height in archaeological individuals are well established (Krogman and İşcan 1986: 302). Since the 19th century, scholars have associated longbone length (particularly the femur) with terminal height in medical studies. Since analysts developed the accepted methods using modern populations and distinguish between different geographical population groups, it is important to apply the appropriate regression tables from the most closely related modern population to the archaeological population under study (Ubelaker 1989: 44-45).

The interpretation of height differences is slightly more complex. While Larsen (1997: 13) notes, “the close ties between stress – especially poor nutrition – and stature are abundantly documented”, the responsible analyst must keep in mind that drastic disease episodes may also prevent continued growth during childhood. Thus, “terminal height is a product of nutritional

adequacy and, to a lesser extent, disease history. Individuals with adequate nutrition tend to reach their genetic growth potential; those with poor nutrition do not” (Larsen 1997: 14).

Like dental caries and periodontal disease, past scholars have shown some general trends in the relationship between terminal height and social status in archaeological populations (Larsen 1997: 18-19). Generally, individuals of higher social status tend to reach their growth potential more successfully. The application of this, like any other generalization, must be considered carefully. While there is a height differential (e.g., increased height with increased social status) in males, this difference does not appear to be as marked in females (Larsen 1997: 19).

Cribra Orbitalia and Porotic Hyperostosis:

For many years, bioarchaeologists interpreted the hypertrophy of the diploic bone of the skull, resulting in porosity of orbits (cribra orbitalia) or of outer table of the frontal, parietal, or occipital bone (porotic hyperostosis) to be associated with anemia (Aufderheide and Rodriguez-Martin 1998: 349).

In the last twenty years, analysts have challenged this previous interpretation based on the knowledge that anemias can be symptoms of a variety of underlying diseases, traumas, and conditions (Aufderheide and Rodriguez-Martin 1998: 349; Larsen 1997: 39; Walker et al. 2009: 119-120). Now it is seen as being largely linked to general infection. It is very rare in archaeological contexts to link specific individuals with such lesions to any specific health problem, such as congenital anemias. Thus, analysts now interpret the presence of cribra orbitalia and porotic hyperostosis as symptomatic of some kind of general “stress indicator” rather than linked to any specific condition.

This is not to say that there may be a difference in the distribution of these lesions across and within populations. Roberts and Cox (2007: 157) note a shift in the prevalence of these indicators between periods in Britain. Additionally, Larsen (1997: 39) asserts that some New World populations exhibit rank-based differences in porotic hyperostosis and cribra orbitalia.

Chapter 3: Materials and Methods

3.1 Materials 1: Primary Population: 120-122 London Road, Gloucester

The primary study sample comprises the adult inhumation burials from excavations at 120-122 London Road, Gloucester. I present a demographic summary of the skeletal remains from the excavations (see Tables 1-3).

Table 1: Burial Classifications of 120-122 London Road Population
(Simmonds et al. 2008: 68, 74)

| Burial Type | MNI |
|--------------------|------------------|
| Inhumations | 64 (63 analyzed) |
| Cremations | 9 |
| Mass Grave | 91 |
| TOTAL | 164 |

Table 2: Age Distribution of 120-122 London Road Inhumations
(Simmonds et al. 2008: 30, 33)

| Age Classification | Age (years) | # Individuals |
|---------------------------|--------------------|----------------------|
| Fetus to Infant | Up to 2 | 1 |
| Young Child | 2-5 | 2 |
| Older Child | 5-12 | 2 |
| Adolescent | 13-17 | 3 |
| Young Adult | 18-25 | 12 |
| Middle Adult | 26-35 | 11 |
| Mature Adult | 36-45 | 3 |
| Older Adult | >45 | 7 |
| Subadult (general) | Less than 18 | 1 |
| Adult (general) | Older than 18 | 18 |
| Unknown | Unknown | 3 |

Table 3: Sex Distribution of Adult Inhumations in the 120-122 London, Gloucester
(Simmonds et al. 2008: 34)

| Sex | # Individuals |
|-----------------|----------------------|
| Male | 11 |
| Possible Male | 12 |
| Female | 4 |
| Possible Female | 7 |
| Indeterminate | 17 |
| TOTAL | 51 |

3.2 Materials 2: Comparative Population: Trentholme Drive, York

A recent reanalysis of the human remains from York provides significantly improved comparative data for the current study (Peck 2009; see Tables 4-10).

A demographic summary is presented in Tables 4 and 5.

Table 4: Age Distribution of Population at Trentholme Drive, York
From Peck (2009: 103)

| Age (years) | # Individuals |
|--------------------|----------------------|
| Fetus | 1 |
| 0-4 | 0 |
| 5-9 | 13 |
| 10-14 | 10 |
| 15-19 | 11 |
| 20-34 | 105 |
| 35-49 | 83 |
| >50 | 16 |
| Indeterminate | 23 |
| TOTAL | 262 |

Table 5: Sex Distribution of Adult Inhumations at Trentholme Drive, York
From Peck (2009: 105)

| Sex | # Individuals |
|------------|----------------------|
| Male | 104 |
| Female | 59 |

A series of health status indicators are presented in Tables 6-10.

Table 6: Frequency of Cribra Orbitalia by Sex at Trentholme Drive, York
(Peck 2009: 108)

| Sex | % with Cribra Orbitalia |
|---------|-------------------------|
| Males | 7.9% |
| Females | 25.0% |
| TOTAL | 16.2% |

Table 7: Mean Femoral Length at Trentholme Drive, York
(Peck 2009: 108)

| Sex | Mean Femoral Length (mm) |
|--------|--------------------------|
| Male | 458mm |
| Female | 428mm |

Table 8: Dental Disease at Trentholme Drive, York
From Peck (2009: 121-125)

| | Caries (n = # teeth examined) | AMTL (n = # sockets examined) | Abscesses (n = # sockets examined) |
|---------|---|---|--|
| TOTAL | 6.7% (2463) | 6.4% (2762) | 2.3% (2644) |
| Males | 7.5% (1031) | 5.8% (1138) | 2.4% (1098) |
| Females | 7.7% (574) | 8.8% (694) | 2.2% (647) |
| ≤ 34* | 5.5% (1374) | 4.5% (1482) | 1.7% (1440) |
| ≥ 35 | 8.5% (996) | 9.7% (1150) | 3.3% (1074) |

* Includes subadults and adults less than or equal to age 34.

Table 9: LEH Distribution by Tooth at Trentholme Drive, York
From Peck (2009: 111)

| Tooth | % Individuals* (n) |
|------------------|--------------------|
| C ¹ | 17.4% (86) |
| I ¹⁺² | 8.5% (82) |
| C ₁ | 17.2% (99) |
| I ₁₊₂ | 9.1% (88) |
| TOTAL | 13.4% (355) |

* % of individuals with at least one tooth to examine

Table 10: LEH Distribution by Sex at Trentholme Drive, York
From Peck (2009: 112-113)

| Sex | % Presence (# teeth examined) |
|--------|-------------------------------|
| Male | 14.1% (142) |
| Female | 6.1% (82) |

3.3 Methods for Data Collection

For the population at Gloucester, I used accepted standards established and regularly used by Steckel and Larsen’s *Global History of Health Project* (Ohio State University) and Buikstra and Ubelaker’s *Standards for Data Collection from Human Remains* (Buikstra and Ubelaker 1994; Steckel et al. 2006 (edited 2011); Steckel and Rose 2002) as the basis for data collection. I did not perform any direct data collection on the comparative population from Trentholme Drive, York.

I collected data for all adult skeletons using the following methods:

Age Categories (Buikstra and Ubelaker 1994: 9):

- Young Adult (approx. 20-34 years)
- Middle Adult (approx. 35-49 years)
- Mature Adult (approx. 50+ years)

Sex Categories (Buikstra and Ubelaker 1994: 9):

- Male (M)
- Possibly Male (M?)
- Female (F)
- Possibly Female (F?)
- Indeterminate Sex (Indt)

Cribra Orbitalia: For all lesions observed as 1cm² or larger in size, I observed and recorded the trait as “present”. If no lesion was observable, I recorded the trait as “not present” or “unobservable” for all orbits.

Stature: I measured the maximum length of each observable femur, tibia, radius, ulna, and humerus. Then, I calculated stature using Trotter and Gleser's (1958) regression tables for Euro-American males and females.

Dental Caries: I observed all teeth and recorded the trait as: "present", "not present", or "unobservable". I recorded the trait as present when I observed a lesion at least 1mm in size. When a carious lesion was present, I also recorded the location of the lesion on each tooth (e.g., occlusal, interstitial).

Abscesses: I observed all available teeth or sockets with associated mandibular or maxillary bone and recorded the trait as: "present", "not present", or "unobservable".

Ante Mortem Tooth Loss (AMTL): For all teeth, I observed and recorded the trait as: "present", "not present", or "unobservable" for all sockets. AMTL was recorded as present when active or previous resorption of the alveolus is evidenced by the sealing of cancellous bone in the tooth socket.

Dental Calculus: I observed all teeth and recorded the trait as: "present", "not present", or "unobservable".

Periodontal Disease: For all teeth with associated mandibular bone, I observed and recorded the trait as: "present", "not present", or "unobservable". Presence of the trait was determined by the loss of alveolus around the tooth via "lipping" or retraction of the bone exposing at least 10mm of tooth root.

Linear Enamel Hypoplasias - Presence: Using the “thumb nail” test, I observed and recorded the trait as: “present”, “not present”, or “unobservable” for all teeth.

Linear Enamel Hypoplasias – Age of Occurrence:

I measured the location of each observed LEH in relationship to the cement-enamel junction (CEJ) on all incisors and canines. Then, I calculated LEH timing based on the regression tables as presented in Table 11.

Table 11: Regression Equations for Calculating Age for LEH Events
(Martin et al. 2008)

| <u>Tooth</u> | <u>Equation</u> |
|----------------|---|
| C ¹ | Age ^a = (-0.609 x Ht ^b) + 6.00 |
| I ² | Age = (-0.396 x Ht) + 4.60 |
| I ¹ | Age = (-0.439 x Ht) + 4.55 |
| C ₁ | Age = (-0.588 x Ht) + 6.50 |
| I ₂ | Age = (-0.422 x Ht) + 3.90 |
| I ₁ | Age = (-0.465 x Ht) + 3.90 |

^a age in years

^b height (mm) of LEH defect from the CEJ to the middle of the defect.

Chapter 4: Archaeological Literature Review

4.1 Food Access in Roman Britain

Archaeological and bioarchaeological data from Roman Britain provide an excellent opportunity to consider differential nutrition across an urban landscape. Beginning with military invasion and conquest, Roman control of Britain (AD 43- 410) influenced many aspects of Romano-British lives. In addition to well-known impacts of Roman occupation such as the establishment of Roman infrastructure, scholars attribute the development of the first large-scale settlements in Britain to Roman influence (Jones 2004: 162). British historians and archaeologists have carefully studied these towns, documenting their large public buildings, fortifications, and established grid systems as part of a process of “Romanization” (Millett 1990).

The conquerors established several kinds of cities in Britain during and after its conquest, and scholars continue to utilize the Roman designations for these settlements. *Civitas* capitals were existing settlements that the Romans destroyed upon conquest and then rebuilt. After their reconstruction, these towns functioned as cultural and administrative centers for local tribal elites (Jones 2004: 162; Wachter 1995: 20). *Coloniae*², on the other hand, were large towns initially identified by their military importance and frequently marked by a garrison or fort established on the site (Jones 2004: 266; Wachter 1995: 11). Constructed expressly for Roman settlement, they received official charters from the emperor and special identification as places of Roman civilization. For this reason, Roman officials considered them to be of the “highest status”, although differences between these types of towns diminished over the course of the Roman period in Britain.

² *Coloniae* is the plural form of “*colonia*”, meaning colony. I will use both forms throughout the document, as appropriate.

Though many scholars have researched the “Roman attributes” of these towns (e.g., architecture, inscriptions) for centuries, relatively few historians have investigated the food economy. Food archaeologists are now developing a more complex “civic organization” model for how urban populations obtained food (Jones 2004: 184-85). They derive evidence for this model largely from intensive analysis of cattle processing at three of the four *coloniae* – Lincoln, York, and Gloucester. At each of these locations, researchers successfully identified culling patterns consistent with a generalized use of cattle for meat, milk, and traction and central locations for large-scale, standardized slaughter of animals (Dobney et al. 1999: 22-23). From this evidence, it is clear that Romano-British towns centralized their meat economies and managed them through political or economic authority of some kind. Such production methods made larger amounts of meat more accessible to those who could pay for it.

Landscape studies provide some insights that may shed light on urban food crop provisioning. In their examination of the agricultural and industrial landscapes of Roman Britain, Dark and Dark (1997) consider the Romano-British food economy using evidence from settlement, field, and crop distributions through time and across the landscape. In doing so, they identify increasing social differences in rural communities through changes in crop distributions and a pattern of either villa clusters or small, non-villa settlements along the roads near large towns (Dark and Dark 1997: 115). Additionally, they report evidence that the contents of some urban buildings show evidence for secondary crop processing (Dark and Dark 1997: 117).

Archaeological evidence for the food economy is only part of the story of social differences in access to food. In order to fully consider what factors drew food to certain subpopulations and thus identify where food travelled across the social landscape, one must also consider who lived in Roman Britain, and where. The Roman army made up a significant portion

of the population throughout the Roman period in Britain, approximately 3.5-10% of the total population including dependents, so we can expect that they made some demands on the local economy (Mattingly 2006: 356; Millett 1990: 186). Military and historical scholars estimate that the army consumed hundreds of thousands of pounds of grain, meat, and vegetables per annum, making it a substantial consumer of food products during the period (Salway 1993: 431-432). This situation certainly guaranteed consumers for Britain's regular surplus of grains. The supply process is poorly understood, however, and what little that is known points to a complicated and potentially problematic system. The military set its own prices for food and then issued requirements to local governments. Then, local authorities were responsible for acquiring the needed supplies (Salway 1993: 432).

In the case of non-military food supplies, scholars agree that a more "open market economy" functioned, and food supplies went for "the largest price it could fetch" (Salway 1993: 435). Food producers sold all supplies not claimed by the military to the remaining 90-96.5% of the British population not involved in the Roman army -- 6.5-10% urban dwellers and 80-90% in the countryside (Mattingly 2006: 356; Millett 1990: 181-186). This kind of distribution complicates arguments for how a Romano-British food economy functioned. Based on population needs, food should have stayed relatively accessible in the countryside with the majority of the population. The distribution of wealth, however, may have systematically selected for certain kinds of settlements over others (e.g., urban towns and rural Roman or Romanized villas). Thus, the study of nutrition and food access for Roman Britain still leaves many questions about quality of life unanswered and the function of Roman-inspired urbanism and increasing the well being of British constituents.

4.2 Social Identity and Foodways

Cool (2004) and others who study food generally focus on cuisine and the “Romanizing” of crops and diets rather than how the growing population obtained enough food to survive. During the course of the Roman period, at least 50 new crops were introduced to Roman Britain, and cattle became the prominent form of meat. These shifts reflect an increasing Roman influence in British foodways (Albarella et al. 2008: 1828; Dark and Dark 1997: 111-112; Van der Veen et al. 2008: 11). Additionally, increased import of olive oil and wine and consumption of fish and meat indicate at least the partial shift in British foodways as a result of Roman influence.

The increased diversity in the British population during this period, however, makes it very difficult to identify who participated in these changing foodways. A recent paleobotanical study on the distribution of new food imports demonstrates that the new imports were largely focused in large towns, particularly in the southeast of the country (Van der Veen et al. 2008: 34). While any interpretation must be considered within the context of the data’s limitations (in this case, the under-representation of rural and north and western samples), it is still suggestive of the kinds of limited distribution of these kinds of changes to urban and southeastern locations.

4.3 Bioarchaeology and Roman Britain

Osteological studies of Romano-British skeletal populations demonstrate a decline in general health during the period (Roberts and Cox 2003, 2007). Overall increases in the incidence of dental caries, linear enamel hypoplasia, and cribra orbitalia in the Iron Age suggest that something related to Roman presence in Britain resulted in an overall decline in health for the general population.

In their detailed survey of all the bioarchaeological evidence from Britain, Roberts and Cox argue that life and health in Roman Britain certainly had their challenges, but most people had access to adequate food sources. The analysts carefully summarize trends in many factors of osteological health over the course of British prehistory and history; the pertinent data are presented in Table 12.

Table 12: Diachronic Change in Dental Disease (Iron Age - Early Medieval Period)

| % Individuals | Iron Age | Roman | Early Medieval |
|--|-----------------|---------------|-----------------------|
| Dental Disease | 7.5% | 11.3% | 4.4% |
| Caries | 3.2% | 17.7% | 5.2% |
| Calculus ¹ | 5.4% | 11.2% | 13.2% |
| Ante Mortem Tooth Loss (AMTL) ¹ | 11.7% | 8.3% | 6.5% |
| Abscesses ¹ | 11.7% | 10.7% | 3.9% |
| Periodontal Disease ¹ | 1.4% | 12.3% | 10.1% |
| Mean Stature (M/F) | 168 cm/162 cm | 169 cm/159 cm | 172 cm/161 cm |
| Cribra Orbitalia | 5.4% | 8.0% | 5.7% |
| Linear Enamel Hyp. | 2.0% | 6.6% | 9.0% |

From (Roberts and Cox 2007); ¹ From (Roberts and Cox 2003: 107-163). No sample sizes included in publication.

During Roman rule, the percent of individuals showing evidence for dental disease and “stress indicators” (cribra orbitalia, periodontal disease, linear enamel hypoplasias) significantly increase compared to the Iron Age (ca. 2800 BP – first century AD; see Table 12). In the following Early Medieval Period (ca. AD 410-1050), dental disease indicators drop back down to their previously low levels. In the same way, mean stature drops temporarily during the Roman Period. Interestingly, the relationship between stress indicators (cribra orbitalia and LEHs) is more complicated than this general trend of reduced health during the Roman period. While cribra orbitalia drop back down after the Roman Period, rates of LEH continue to elevate into the Early Medieval period and continuing through the Post-Medieval Period (ca. AD 1550-

1850) (Roberts and Cox 2007: 157). Thus, in the case of diachronic health trends in Britain are more complicated than simply a dichotomy between better or worse.

Based on this evidence, Roberts and Cox argue that the majority of Romano-Britons experienced a generally sufficient diet, in terms of quantity and quality (2003: 143). They posit that, “the staple diet was porridge, bread and pasta supplemented by meat, fish, fruit and vegetables” but “their diet was not adequate for some people is illustrated by” the presence of metabolic deficiency diseases such as rickets and scurvy (Roberts and Cox 2003: 140-143).

Roberts and Cox’s explanation of the presence of other markers of diminished health is not as clear. In one publication, they explain issues like caries and LEH through poor cooking practices (e.g., over-stewing, resulting in destruction of nutritive qualities), not food access (2004: 250). In others, the authors cite “dental defects” and cribra orbitalia as potentially linked to poor diet and a general increase in disease-load, while the increase in caries is associated with an increase in sucrose-rich foods such as honey and other sugar-containing foods (2003: 134). Overall, their interpretations do not sufficiently or systematically address the osteologically evident nutritional disease present during this period.

Roberts and Cox’s argument seems at odds with broader theories for caries formation and with the relationship between lived health and osteologically identifiable nutrition. For example, they argue that caries are reflections of increased sugar in the diet (e.g., honey), which implies a general increase in access to specialized non-essential food products. If it is true that carious lesions are reflective of this necessarily relatively affluent diet, then perhaps we could say that people were not deprived. Additionally, other stress indicators such as cribra orbitalia and LEHs suggest that such an interpretation of general affluence would not be true, if it were asserted.

Finally, the drop in mean stature recorded for this period generally argues against a characterization of generally sufficient nutritional health in Roman Britain.

Other scholars have looked at smaller regional trends and concluded that declines in nutritional health in Romano-British populations did occur. They generally contribute these shifts to urbanization and intensified agricultural practices (Redfern and DeWitte 2011: 80). Molleson found that, beginning in the second century AD at Poundbury, economic intensification and Romanization resulted in demographic changes in the population (Molleson 1992: 188). More recently, researchers have found similar trends in Roman Dorset. Lewis, for example, found that *cribra orbitalia*, rickets and scurvy were prominent in children's bones³ (Lewis 2010: 405-416). Additionally, she has found bony evidence of pulmonary tuberculosis in 4.1% of non-adults (Lewis 2011: 12). Carbon and nitrogen isotope values for some samples suggest a slight enrichment of isotopic ratios between the Iron Age and Roman Period (Redfern et al. 2010: 1158). If statistically significant, this shift would suggest greater dietary variation at the population-level. Redfern, on the other hand, concludes a larger mortality study for Dorset by showing that while bioarchaeologists have not sufficiently identified risk, they "did observe a post-conquest decline in health" (Redfern and DeWitte 2011: 281). The results of her studies with colleagues show that the young, old, and men were particularly impacted by Roman rule in Dorset (Redfern and DeWitte 2011: 281; Redfern et al. 2012: 1257). In sum, their findings conflict with generally positive perspectives on life in the Roman Empire (Redfern and DeWitte 2011: 281).

Similar results complicate the traditional assumption of improved quality of life resulting from Roman conquest. Peck interprets increases in systematic stress markers in bone as well as

³ 38.5% *cribra*; 11.2% rickets and/or scurvy

declining dental health as a “decrease in dietary breadth and a less nutritious and more cariogenic diet” in his examination of nutritive trends in Roman York (2009: 53). In the same way, Pitts and Griffin find that health patterns can be found based on settlement type, and that individuals living in urban centers tended to have better health than their non-urban counterparts (Pitts and Griffin 2012: 253). They also find that urban cemeteries tended to have more burial goods and “greater equality in their intracemetery distributions” than at nonurban sites (Pitts and Griffin 2012: 253). Their method and results demonstrate the complexity of social factors that impact the distribution of health indicators as well as the intricacies of interpreting general population trends.

4.4 Primary Context: Roman Gloucester

Gloucester (*Colonia Nervia Glevensium*) was founded as a Roman garrison sometime during the mid-first century AD (circa AD 48-50), during the Roman conquest of western England and Wales (Todd 2004: 56). The original site was located at Kingsholm, on the north side of the present city, and consisted of a large legionary garrison. The fort was a key strategic site for approximately 20 years before it was supplanted by a newer construction just to the south, in the center of the present town (c. AD 67) (Wacher 1995: 150).

From the beginning, Gloucester was a planned settlement. Once the military no longer needed a large presence to control the vicinity, officials and settlers converted portions of the fortress into civilian structures for military veterans. They also constructed major public buildings (e.g., forum and basilica) on the former site of the legionary principia. Gloucester received “colony” status by the end of the first century (c. AD 96-98?) (Jones 2004: 166). At least by AD 125 and continuing until the end of the century, Roman civilian architecture influenced the reconstruction of houses (Wacher 1995: 156). Excavators interpret this shift as

indicating a transition from the original, relatively wealthy military veteran population to their descendants.

The population of Gloucester consisted of more than just military veterans. Merchants and craftsmen provided economic outlets for the relatively well-paid legionaries and established markets attractive to the local population (Davies 2004: 110). Over time, the population of the colony grew to include Romans and local Britons. Although some scholars consider Gloucester's population to be "Roman" (Simmonds et al. 2008), it is more appropriate to see the late 1st century and later populations to be "something new entirely" (Salway 1993: 391). Salway (1993: 391) makes this particularly clear as he compares British *coloniae* to similar situations in Roman Denmark, where "expatriates mingled with the local population," eventually forming a new community altogether.

4.4.1 Cemeteries at Gloucester

Archaeologists have discovered several cemetery locations at Gloucester, including Kingsholm, Wotton Pitch, and Barton Cemetery (Heighway 1980: 58-61). Romano-Britons located most of their burial grounds along the roads leading away from the towns, and these cemeteries follow this pattern.

While most excavations of Gloucester's cemeteries occurred in a rather haphazard manner during the 19th century, archaeologists have preserved scattered information on them (Heighway 1980: 57). Kingsholm, located north of the *colonia* at the site of the original garrison, likely began with the military encampment. Archaeologists working in the 1960s and 1970s found evidence only for a late Roman (3rd to 4th century AD) cemetery there (Heighway 1980: 58-59). Likewise, the poorly studied Barton Cemetery also represents a late Roman burial ground, but it was located much closer to the Roman city walls (Heighway 1980: 58-59).

Archaeologists do not have any record of its contents. Finally, Wotton Pitch Cemetery was located on the road running east from Gloucester to the neighboring town of Corinium (Heighway 1980: 58). Early archaeologists uncovered inhumation and cremation burials, as well as at least two military headstones. While the beginning date of the cemetery is still uncertain, scholars date its use from 1st through 4th centuries AD (Simmonds et al. 2008: 9).

4.4.2 Bioarchaeology at Gloucester:

Over the years, there have been many excavations of graves from Gloucester, but published bioarchaeological evidence from Roman Gloucester is relatively sparse. There is only one complete, published report of any single excavation (Simmonds et al. 2008). Two other small publications describe some osteological anomalies for other excavations (Roberts 1987; Roberts et al. 2004). Additionally, a recent stable isotope study on the fully published report from 120-122 London Road provides some in-depth analysis of human remains from the colonia (Chenery et al. 2010).

Despite the dearth of full publications on cemeteries at Gloucester, we must attempt some outline of the remains. From the burial grounds at Kingsholm, Roberts et al. (2004: 390) report a total of 50 individuals (2 of which were very fragmentary). They summarize that of the 48 semi-complete individuals, twelve were definitely male, twelve female, three possibly male, and three possibly female, four adults of indeterminate sex, and seven sub-adults (below age 18). While there is no in-depth report on their overall health status, the authors do note that LEHs are present on at least one tooth for 21 of the 50 individuals (42%), suggesting that health stresses were relatively common for this population during childhood development (Roberts et al. 2004: 401). Additionally, Roberts (1987: 1659) reports a potential case of pituitary dwarfism for this population, and Roberts et al. (2004: 401) identify a foot deformity.

A recent excavation from 120-122 London Road, part of the Wotton Pitch cemetery, is fully analyzed and published; its remains make up the dataset for this study (Simmonds et al. 2008). Excavation uncovered a small portion of the cemetery, including nine cremation and 64 inhumation burials dating from the late 1st through 4th centuries AD as well as a large mass grave of at least 91 dating to the second half of the 2nd century AD (Simmonds et al. 2008: xv). The graves indicate some variation in observable social status for the individuals. While burial positions varied widely throughout the sample, 40 graves showed evidence of coffin nails and 1 had a stone cist; 17 burials had grave goods (Simmonds et al. 2008: 22-25). The grave goods varied and included ceramic vessels, jewelry, footwear, animal remains, and other items. Overall, the cemetery organization showed similar disorganization and cutting of previous internments (Simmonds et al. 2008: 15). Based on these finds, I believe these individuals to have comparable evidence for social identity based on burial evidence.

A recent isotope study from Gloucester sheds some additional light on the colonia population. Chenery et al. (2010) compared the remains from the mass grave found at 120-122 London Road with those from the discrete inhumations. Their results confirm that the isotopic signatures of the discrete inhumations are comparable to those of other colonia, including York (Chenery et al. 2010: 155). They conclude that the population at Gloucester had a diet relatively high in animal protein and consistent with a terrestrial diet base. Members of the reported mass grave show no difference in strontium or oxygen isotope levels and represent a random sampling of the local population at Gloucester. Chenery et al. (2010: 157) conclude that these findings appear to confirm the excavator's interpretation that this grave represents a local, catastrophic event such as an epidemic (2010: 157).

4.5 Comparative Context: Roman York

As with Gloucester, the clearest reason for York's initial growth lies in the installation of Roman military to the location (Roskams 1999; Wachter 1995: 167). Roman generals selected the location for Roman York because the site straddled two major tribal areas, thus allowing the military to control and then overtake those rival polities.

The military garrison at York was constructed on the northeast side of the river Ouse, as it intersects with the river Foss, in the marshy meadowlands of the Yorkshire Dales circa AD 73 (Ottaway 1999: 139; Wachter 1995: 167). In the late first century AD, no town existed in association with the garrison, though archaeologists have uncovered some buildings on the north side of the river, near the fortress, which show evidence of tile making and other supply-related industries for the military (Ottaway 1999: 140). This military occupation on the north side of the river Ouse continued and flourished throughout the 3rd century AD with some changes during that time. This interpretation is supported by the fact that, by the end of the 2nd century AD, bathhouses and other non-utilitarian structures appeared (Ottaway 1999: 140).

Unlike Gloucester, Romans did not initially envision York (*Eboracensium*) as the future location of a *colonia*. On the south bank of the river Ouse, where the eventual civilian town of York would stand, archaeologists have found little to no evidence of occupation through the early 2nd century AD. While the Romans did build a road crossing the river and heading southwest from the fortress, there was no immediately apparent use for the south bank (Ottaway 1999: 140). Some civilians did settle along the road in the late first or early second century AD, but these settlements were a few kilometers from the river and eventually were subsumed by the later town (Ottaway 1999: 140-141).

Scholars believe in the mid-2nd century AD approximately 75 years of intensive development (e.g., ground leveling, grid system and drainage construction) began, thus indicating that authorities had decided by that time to establish a planned settlement covering the whole area of Roman York (Ottaway 1999: 141). This, however, was not the establishment of a *colonia*, in the same way that the Romans constructed Gloucester. While both cities began with a planned settlement, probably involving some kind of centralized authority (and likely a Roman military one, since York's construction occurred at the same time as a major reconstruction of the fortress), York's construction did not proceed from a charter handed down from the emperor in Rome. Instead, it would appear that York's civilian town was "driven by economic factors, in which supply of the Roman army played a part" (Ottaway 1999: 146).

By the end of the 3rd century AD, York looked much like any other urban environment of the time. A "cosmopolitan population" resided there, including people from Gaul, Italy, and Sardinia (Ottaway 1999: 146). New immigrants included legionary veterans, government officials, and wealthy merchants. In terms of a food economy, archaeologists at York argue for "the import of a growing settlement on the rural economy in a region extending at least 20 kilometers from the city" (Hall and Kenward 1990: 415). Dietary evidence supports a generally various diet between inhabitants, including most forms of common domesticated animals and grains such as spelt, which were stored in granaries within the city such as that found in Rougier Street (Wacher 1995: 188). Evidence from another granary in Coney Street demonstrates the danger of such practices, since pests of all sorts have been discovered in analysis of environmental data (Addyman 1989: 256). Thus, "even in the highest grade of urban settlement in Roman Britain, with its running water, bathhouses and sewers, contained places that were foul, stinking, verminous, and disease-ridden" (Wacher 1995: 187).

4.5.1 Cemeteries at York

Current knowledge about cemeteries in and around Roman York is more complex than at Gloucester. The main burial grounds, frequently referred to as the Mount Cemetery, are now under a heavily developed area of modern York, along the Roman road to Tadcaster running southwest from the colonia (Wenham 1968: 5). Most knowledge about this area comes from pre-modern finds, and much of the area near the colonia has been characterized as representing the upper classes of society (Wacher 1995: 183). Finds generally demonstrate high variability in burial practices, including inhumations, cremations, as well as some individuals embalmed in liquid gypsum. Based on the presence of tombstones, lamentations, complex burial treatments and grave goods, scholars generally interpret these burial grounds to contain individuals from the upper classes of society, though within that grouping there are many gradations of the social scale and different kinds of social identities, religions, and geographic origins (Wacher 1995: 183).

The only modern excavation of the cemeteries at York comes from a portion of the Mount Cemetery referred to as Trentholme Drive (Wenham 1968: 4). Scholars have traditionally interpreted the evidence for Trentholme Drive to indicate that this was for the “poorer classes” of York, beginning around 140 AD and continuing until the end of the 4th century AD (Wacher 1995: 186; Wenham 1968: 4). Analysts draw this characterization from a general lack of stone coffins or grave markers. Additionally, over the course the cemetery’s use, people frequently cut older graves with later ones “often only a short time after burial, which led to half-composed limbs, heads and torsos being scattered in all directions” (Wacher 1995: 186).

A reconsideration of the grave evidence, however, may support a less harsh interpretation of individuals found at Trentholme Drive. While it is true that only two stone sarcophagi were

present at the time of excavation, many inhumations contained grave furniture, pottery, fabrics, and foods (Wenham 1968: 4). Those few graves that did contain personal adornments were few and of poor quality, but it is most likely that burials did initially have wooden coffins as well as burial goods, based on the presence of nails found during excavation (Wenham 1968: 36). Indeed, in examining the descriptions of finds, it appears more likely that imaginative interpretations by various scholars have resulted in an exaggeratedly negative representation of the people buried at Trentholme Drive.

4.5.2 Bioarchaeology at York

The only modern excavations at York have been at Trentholme Drive; thus, these are the only human remains available for study (Wenham 1968: 4). The condition of the cemetery made determination of the total number of individuals difficult. Indeed, there were 342 individual “finds”, but only a minority of those were discrete burials (Warwick 1968: 146). The total count of analyzed remains included 300 skeletons and 50 cremations (Warwick 1968: 148).

According to the initial osteological analysis, approximately 15% of the population at Trentholme died before the age of 20, and about 50% of the deaths occurred between the ages of 20 and 40 (Wacher 1995: 186). Female stature was about 1.549m, and the men were about 1.699 m tall. Based on cranial shape, analysts characterized males as more heterogeneous in origin than females, suggesting the presence of “inhabitants whose birth-places were as far away as the eastern Mediterranean” (Wacher 1995: 186).

Most paleopathological markers considered important in modern analyses were not included in the initial publication report (Warwick 1968). While the calculation of dental data is not congruous with modern analytical methods, some basic information concerning prevalence of caries may be useful (Cooke and Rowbotham 1968: 177-216). When considering sex

distribution, females have a slightly higher incidence of caries (females 5.2% of individuals; males 4.3% of individuals). Additionally, an age-dependent distribution of carious lesions is also recorded (see Table 13).

Table 13: Distribution of Caries by Age in Adults at Trentholme Drive in 1968
(Cooke and Rowbotham 1968: 206)

| | # Teeth Observed | % Teeth Impacted | # Individuals Observed | % Individuals Impacted |
|-------------|-------------------------|-------------------------|-------------------------------|-------------------------------|
| 20-25 years | 689 | 1.7% | 36 | 25% |
| 26-40 years | 2787 | 4.2% | 151 | 44% |
| 40+ years | 430 | 14.6% | 34 | 76% |

Chapter 5: Results of Osteological Analysis from 120-122 London Road, Gloucester

5.1 Demographic Summary

Of the 56 discrete inhumations available, 34 were appropriate to this analysis (e.g., adults with sufficient preservation to enable at least one aspect of the established methods). Of these 34, I identified 9 as female or possibly female, 20 as male or possibly male, and 4 as adults of indeterminate sex. 20 individuals were “young adults” (20-34 years), 3 were “mature adults” (35-49 years), and 4 were “senior adults” (50+ years). 7 individuals were adults of indeterminate age (18+ years).

Preservation for the 120-122 London Road sample was admittedly poor. Thus, all evidence must be measured not from the total examined population but rather from the number of individuals for which observation was possible. Because of the low number of individuals in this sample, individuals who are female or possibly female are treated as one group of “females” while males and possible males are treated as one group of “males”. Individuals of indeterminate sex are treated as a third, separate group.

5.2 Systematic Stress

Cribra Orbitalia:

Eleven of 21 observable individuals (52.4%), consisting of 9 males, 8 females, and 4 of indeterminate sex, demonstrated evidence of cribra orbitalia on at least one orbit (see Table 14).

Differences between males and females are not significant ($\chi^2 = 0.55$, $df = 1$, $0.5 > p > 0.2$).

Table 14: Sex-Based Distribution of Cribriform Orbitalia at 120-122 London Road, Gloucester

| | # Observed | # Present | % Impacted |
|---------------|------------|-----------|--------------|
| Male | 9 | 5 | 55.6% |
| Female | 8 | 3 | 37.5% |
| Indeterminate | 4 | 3 | 75.0% |
| TOTAL | 21 | 11 | 52.4% |

The age-based distribution of cribriform orbitalia is presented below (see Table 15). No differences in presence of cribriform orbitalia based on age are significant ($\chi^2 = 0.57$, $df = 2$, $1 > p > 0.5$).

Table 15: Age-Based Distribution of Cribriform Orbitalia at 120-122 London Road, Gloucester

| | # Observed | # Impacted | % Impacted |
|---------------------|------------|------------|--------------|
| Younger Adult | 14 | 8 | 57.1% |
| Older Adult | 4 | 2 | 50.0% |
| Indeterminate Adult | 3 | 1 | 33.3% |
| TOTAL | 21 | 11 | 52.4% |

Linear Enamel Hypoplasias – Presence:

Twenty-seven individuals were observable for LEH. 23 of these showed evidence of the pathology. 6 of these were female, 10 were male, and 7 were of indeterminate sex.

Twenty-nine (60.4%) of 48 canines and incisors on the left side of the mouth showed evidence of linear enamel hypoplasias (see Tables 16 and 17). Differences in rates of LEH by sex category were not very significant ($\chi^2 = 3.57$, $df = 2$, $0.2 > p > 0.1$; see Table 17).

Table 16: LEH Distribution at 120-122 London Road, Gloucester

| <u>Tooth</u> | <u># Teeth Observed</u> | <u># Teeth with LEH</u> | <u>% Teeth with LEH</u> |
|------------------|-------------------------|-------------------------|-------------------------|
| C ¹ | 8 | 6 | 75.0% |
| I ¹⁺² | 13 | 9 | 69.2% |
| C ₁ | 13 | 7 | 53.8% |
| I ₁₊₂ | 14 | 7 | 50.0% |
| TOTAL | 48 | 29 | 60.4% |

Table 17: Sex-Based Distribution of LEH at 120-122 London Road, Gloucester

| Category | # Teeth Observed | # Teeth with LEH | % Teeth with LEH |
|-----------------|-------------------------|-------------------------|-------------------------|
| Male | 21 | 10 | 47.6% |
| Female | 16 | 10 | 62.5% |
| Indeterminate | 11 | 9 | 81.8% |
| TOTAL | 48 | 29 | 60.4% |

Linear Enamel Hypoplasias – Age of Occurrence:

I identified 29 total hypoplastic lines on the left side of the mouth and 38 on the right side (67 in total). In order to gain more information about the timing of severe health and nutrition events during childhood, I calculated the estimated age at which these lines formed. For this portion of the analysis, I utilized all canines and incisors (left and right).

I measured 67 hypoplastic lines and then calculated their corresponding age range using Walker’s regression tables (Martin et al. 2008). Fifty-one events remained after I removed potential “repeat” events (see Table 18). There is no significant difference in the timing of LEH events between males and females ($t = -0.91, df = 31, 0.5 > p > 0.2$).

Table 18: Mean Age of LEH formation at 120-122 London Road, Gloucester

| | Male | Female | Indeterminate Sex | TOTAL |
|-----------------|-------------|---------------|--------------------------|--------------|
| # Lines | 19 | 14 | 18 | 51 |
| Mean Age | 3.17 | 3.54 | 3.41 | 3.47 |
| StDev | 1.19 | 1.40 | 0.95 | 1.23 |

5.3 Nutritional Health Status

Stature:

The mean femoral length for females was 429mm; only 1 male had a preserved femur, measuring at 398mm (see Table 19). This individual, however, has evidence of potential

pathology making him not representative of the total male population (see 5.5, Anomalous Findings).

Table 19: Mean Femoral Length at 120-122 London Road, Gloucester

| Sex | # Individuals | Mean femoral length (mm) | Standard Deviation |
|--------|----------------|--------------------------|--------------------|
| Male | 1 ¹ | 398 | (no data) |
| Female | 3 | 429 | 1.35 |

¹potential outlier (see 5.5, Anomalous Findings)

Using Trotter and Gleser (1958), I calculated the estimated height for the 6 individuals for whom appropriate long bone measurements (e.g., femur, tibia, humerus, radius, ulna) were available (see Table 20). While I have presented two separate means for estimated male stature to show the impact of the outlying individual's long bone length on the overall sample, a t-test argues that the 5.1cm difference between the two samples is not significant ($t=-1.33$, $df = 3$, $0.5 > p > 0.2$).

Table 20: Mean Estimated Stature at 120-122 London Road, Gloucester

| | # Individuals | Mean Estimated Stature (cm) | Standard Deviation |
|-------------------|---------------|-----------------------------|--------------------|
| Male ¹ | 3 | 164.17 | 0.22 |
| Male ² | 2 | 169.28 | 1.51 |
| Female | 3 | 160.17 | 4.72 |

¹all males; ²excluding outlier

Dental Disease:

Three hundred and one (72%) of the 418 teeth observable for calculus build-up showed evidence. 204 sites (88.7%) of the 230 sites observable for periodontal disease showed evidence for that trait.

Evidence for dental disease (carious lesions, AMTL, abscesses) largely demonstrates significant differences based on both sex and age at Gloucester (see Table 21).

Table 21: Dental Disease at 120-122 London Road, Gloucester

| | Caries (# teeth examined) | AMTL (# sockets examined) | Abscesses (# sockets examined) |
|---------------|--------------------------------------|--------------------------------------|---|
| TOTAL | 14.7% (423) | 6.3% (480) | 2.6% (267) |
| Males | 20.2% (183) | 10.6% (217) | 3.4% (117) |
| Females | 10.6% (161) | 2.9% (171) | 2.0% (101) |
| Unknown Sex | 10.1% (79) | 2.2% (92) | 2.1% (48) |
| ≤ 35 years | 14.6% (329) | 2.3% (351) | 3.1% (193) |
| ≥ 36 years | 9.9% (71) | 18.9% (90) | 1.6% (63) |
| Unknown Adult | 30.4% (23) | 2.6% (38) | 0.0% (11) |

Males had significantly higher rates of caries and AMTL than did their female counterparts ($\chi^2 = 6.37$, $df = 1$, $0.02 > p > 0.01$ for caries; $\chi^2 = 8.41$, $df = 1$, $0.01 > p > 0.001$ for AMTL).

Differences in abscesses between males and females were not very significant, however ($\chi^2 = 0.42$, $df = 1$, $1 > p > 0.5$). Differences in AMTL based on age category were significant ($\chi^2 = 37.0$, $df = 1$, $0.001 > p > 0$), but those for caries and abscesses were not ($\chi^2 = 1.10$, $df = 1$, $0.5 > p > 0.2$ for caries, $\chi^2 = 0.41$, $df = 1$, $1 > p > 0.5$ for abscesses).

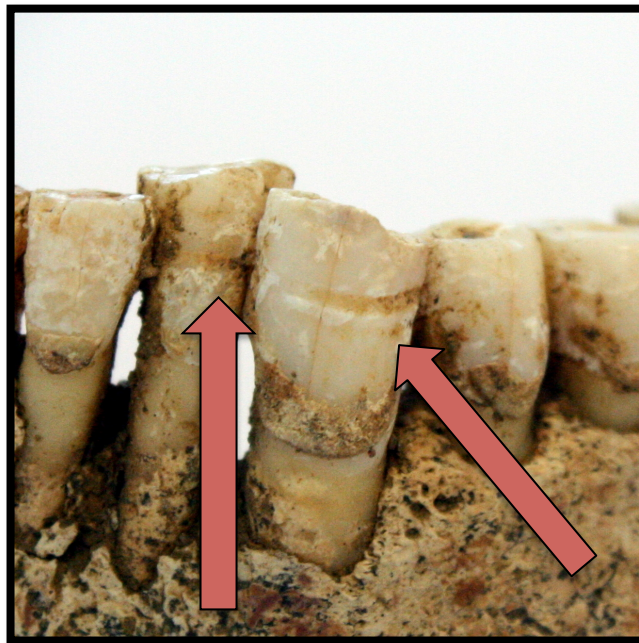
5.4 Summary

Rates of cribra orbitalia and LEH show no significant internal differences in systemic stress at Roman Gloucester, by either age or sex. Rates of dental health, however, suggest some significant differences in regards to nutritional health, particularly in the case of carious lesions and ante mortem tooth loss. For carious lesions, there is no significant difference in the age of individuals impacted. Males, however, show significantly higher rates of caries than females. In the same way, males have significantly higher rates of AMTL than females at Gloucester. In addition, older adults at Gloucester had significantly higher rates of AMTL than younger adults.

5.5 Anomalous Findings

Two individuals showed unique traits that altered the course of their analyses, though these traits do not appear to be directly related to their nutritional health status. Individual #1057 (possible male, older adult) showed evidence of significant cultural marks on the enamel of all canines and both lower lateral incisors (see Figure 2). I classify these marks as “cultural” because they frequently appear on one portion of the tooth surface but dissipate entirely on other aspects of the enamel. This is not consistent with cessation of enamel formation and would seem to be consistent with a pre-mortem dental modification resulting from use of the teeth as tools (Buikstra and Ubelaker 1994: 58). The marks measure approximately 1mm in width and vary in depth across the surface of each tooth, with the deepest marks appearing on buccal-medial surfaces.

Figure 2: Cultural Marks on Mandibular Incisor and Canine for Individual #1057



Note: These marks are present on both mandibular canines and lateral incisors and the maxillary canines.

Individual #1393 (male of indeterminate adult age) showed evidence of significant abnormalities in estimated stature and Crural Index (see Figure 3). The individual's Crural Index is 72.90; the rest of the individuals from the sample with tibiae and femorae available for examination had a mean Crural Index of 80.46 ($n = 3$, s.d. = 1.89).

Figure 3: Tibiae and Femorae of Individual #1393



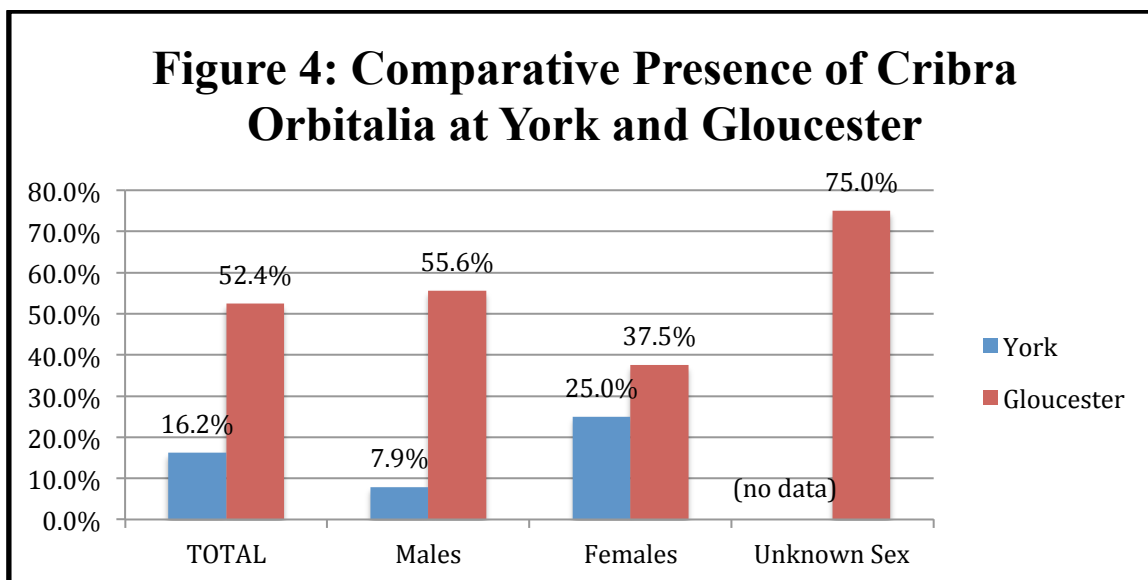
Examination of the elements did not show evidence of malformation of the limb. While tibial hypoplasia or a response to fibular hypoplasia may describe the pathology (Aufderheide 1997: 71), I did not observe any associated pathologies that may support such an identification (e.g., tibial bowing or malformations to the tarsals and metatarsals). If indeed this was the cause of this abnormality, it would most likely congenital in origin (Aufderheide 1997: 71).

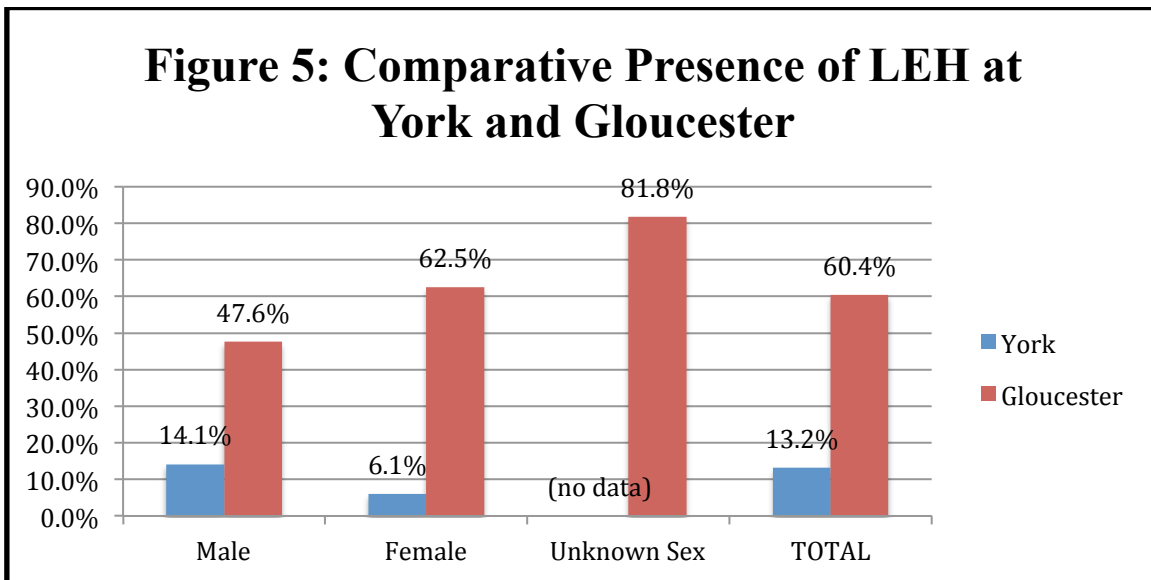
Chapter 6: Comparing Populations at Gloucester and York

6.1 Systemic Stress

The data collected suggest that the population at London Road, Gloucester had more systemic stress than the population at Trentholme Drive, York (see Figures 4 and 5). General differences in rates of cribra orbitalia between the populations were very significant ($\chi^2 = 15.1$, $df = 1$, $0.001 > p > 0$). There were also similarly distinct differences in the overall presence of linear enamel hypoplasias (see Figure 5; $\chi^2 = 61.5$, $df = 1$, $0.001 > p > 0$).

When considering sex, males at Gloucester appear to have had significantly higher rates of cribra orbitalia than males at York ($\chi^2 = 1.14$, $df = 1$, $0.5 > p > 0.2$). No significant differences in cribra orbitalia between females in the populations were evident, however ($\chi^2 = 0.53$, $df = 1$, $0.5 > p > 0.2$). Rates of LEH are significantly higher for both males and females at Gloucester ($\chi^2 = 43.7$, $df = 1$, $0.001 > p > 0$ for males, $\chi^2 = 32.9$, $df = 1$, $0.001 > p > 0$ for females).





6.2 Nutritional Health Status

Based on the available data, no meaningful comparison of stature between the populations can be presented. This is due in part to lack of long bone preservation at 120-122 London Road, Gloucester and to lack of data reporting from Trentholme Drive, York (see Tables 22 and 23).

Nonetheless, a brief survey of the sparse data available for mean femoral length shows that the available female individuals at Gloucester had approximately the same height as those measured in Peck's recent analysis at Trentholme Drive, York (2009: 119; see Table 22).

Calculated estimated stature between the two populations produces some additional points of comparison (Warwick1968: 149; see Table 23). While no standard deviation for mean stature from Trentholme Drive, it is possible that males at individuals at Gloucester were approximately the same size or a bit shorter than those at York. Females at Gloucester, however, may have been taller than their counterparts at York (see Table 23). Any statistical significance for these differences, however, cannot be determined.

Table 22: Comparing Mean Femoral Length between Populations

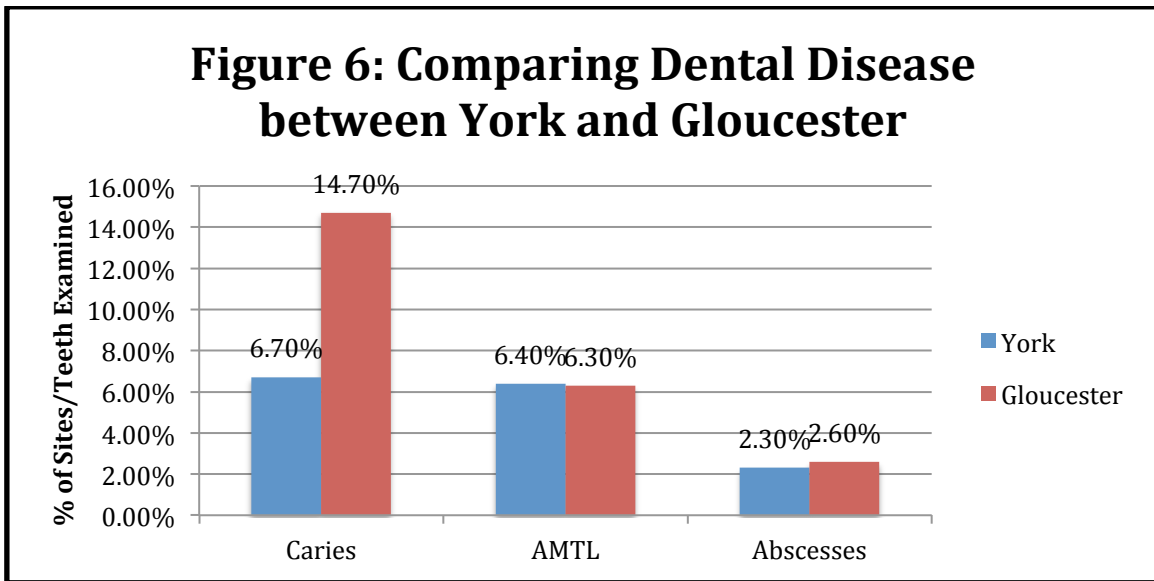
| | York ¹ | | | Gloucester | | |
|--------|-------------------------|--------------------------|--------------------|----------------|--------------------------|-------|
| | # Observed ² | Mean Femoral Length (mm) | StDev ² | # Observed | Mean Femoral Length (mm) | StDev |
| Male | --- | 458 | --- | 1 ³ | 398 ³ | --- |
| Female | --- | 428 | --- | 3 | 429 | 13.4 |

¹ From Peck (2009: 119); ² Not available; ³ Includes possible outlier

Table 23: Comparing Mean Estimated Stature between Populations

| | York ¹ | | | Gloucester | | |
|--------|-------------------------|-------------------|--------------------|------------------|----------------------------|------------------------|
| | # Observed ² | Mean Stature (cm) | StDev ² | # Observed | Mean Stature (cm) | StDev |
| Male | --- | 172.18 | --- | 2/3 ³ | 169.35/164.17 ³ | 1.51/0.22 ³ |
| Female | --- | 154.94 | --- | 2 | 160.17 | 4.72 |

¹ From Warwick (1968: 149); ² Not available; ³ Includes possible outlier



Individuals at Gloucester had poorer dental health than individuals at York. Differences in rates of AMTL and abscesses for the populations generally are not very significant ($\chi^2 = 0.02$, $df = 1$, $1 > p > 0.5$ for AMTL; $\chi^2 = 0.11$, $df = 1$, $1 > p > 0.5$ for abscesses). There are significant differences in rates of caries observed, however (see Figure 6; $\chi^2 = 31.5$, $df = 1$, $0.001 > p > 0$).

Figure 7: Age-Based Differences in Dental Disease at London Road, Gloucester

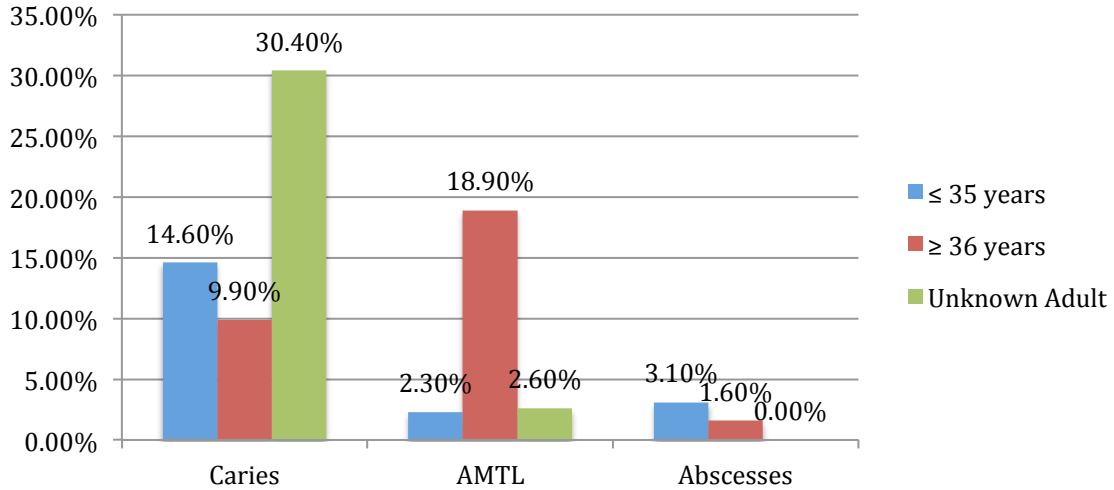
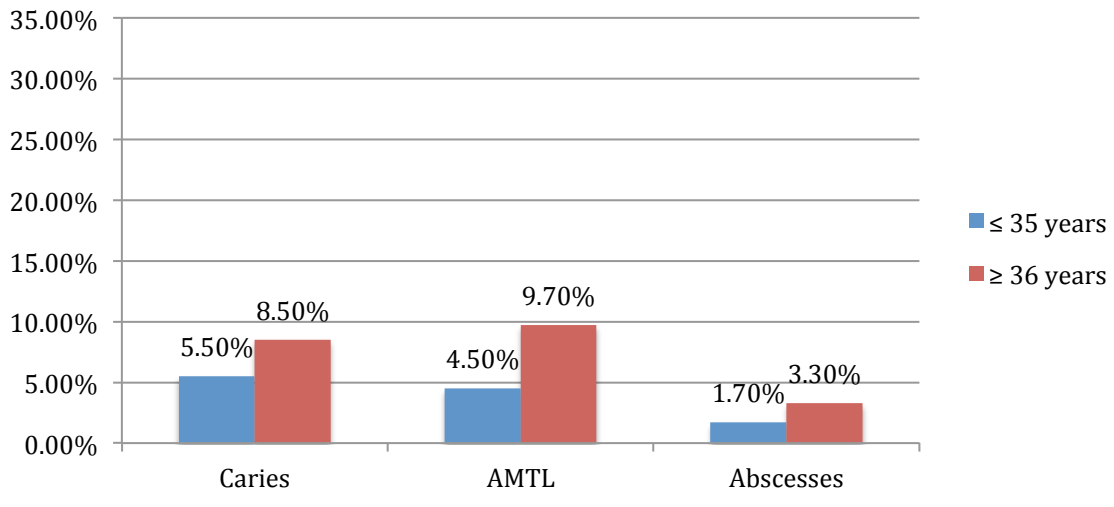


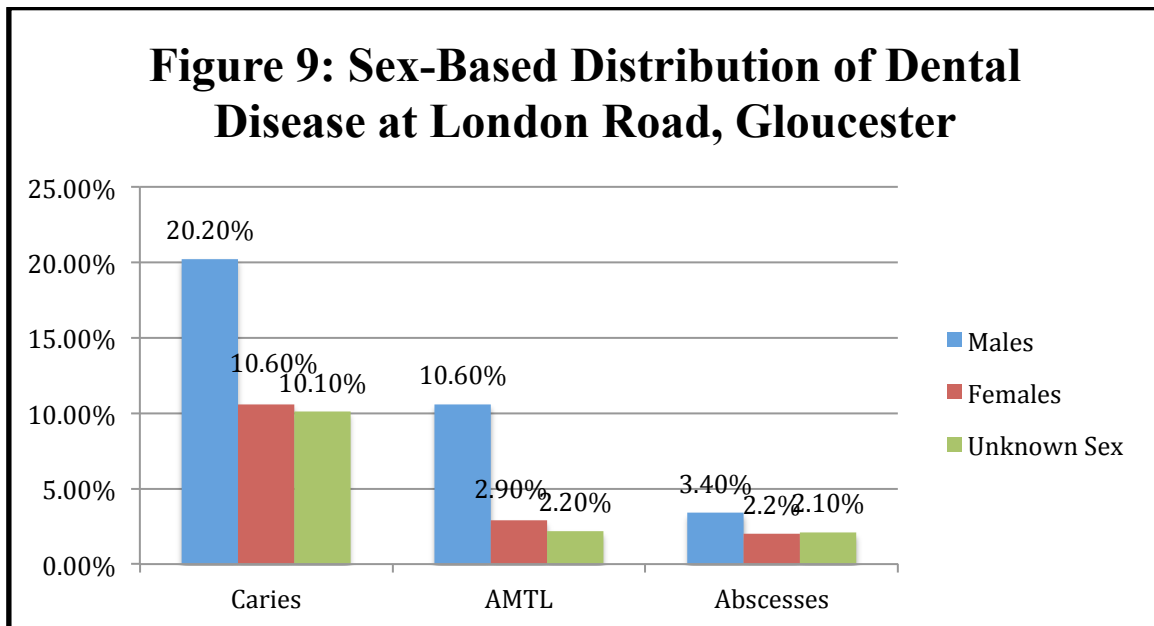
Figure 8: Age-Based Differences in Dental Disease at Trentholme Drive, York

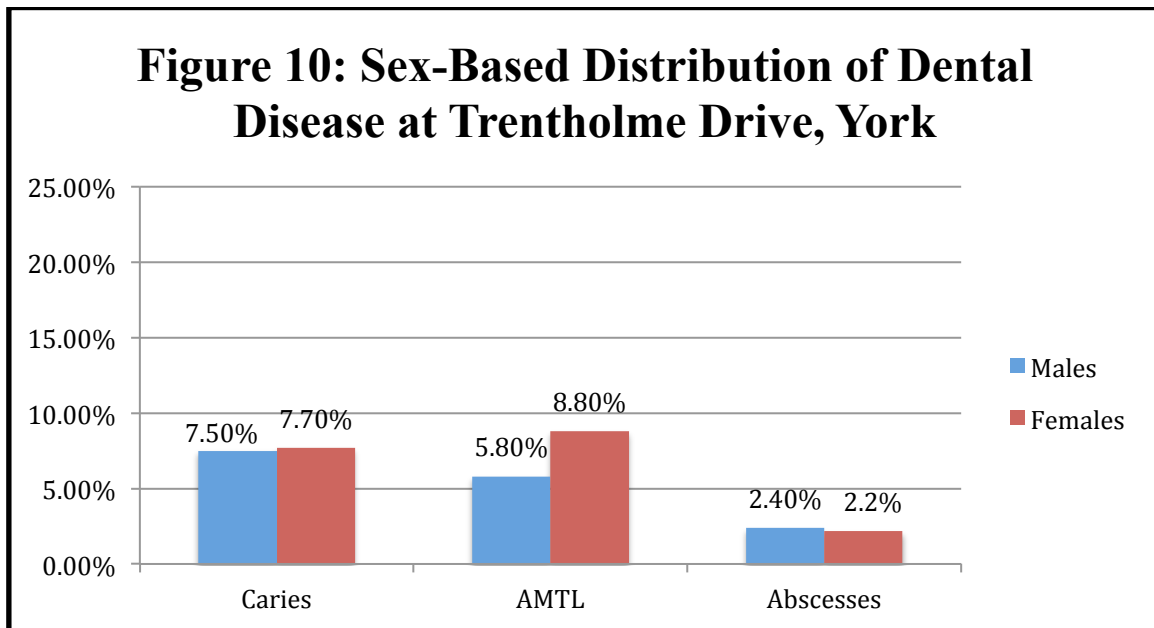


A closer examination of rates based on age category at Gloucester suggests an explanation for this pattern (see Figures 7 and 8). While rates of abscesses follow similar patterns across age categories in both populations ($\chi^2 = 1.96$, $df = 1$, $0.2 > p > 0.1$ for younger adults and $\chi^2 = 4.70$, $df = 1$, $0.5 > p > 0.2$ for older adults), the rates of dental caries and AMTL vary significantly. For

individuals in the young adult category, the population at Gloucester has a highly significant increase in caries ($x^2 = 32.3$, $df = 1$, $0.001 > p > 0$); differences in the populations among older adults are not every significant, however ($x^2 = 0.21$, $df = 1$, $0.2 > p > 0.1$). Differences in AMTL between young adults at York and Gloucester are not very significant ($x^2 = 3.63$, $df = 1$, $0.1 > p > 0.05$) while, among older adults, differences in rates of AMTL are significant ($x^2 = 7.50$, $df = 1$, $0.01 > p > 0.001$).

Because AMTL can be caused by gross caries consuming teeth earlier in life, it is possible that the drastic increase in rates of AMTL after the age of 35 in the Gloucester population may be the result of very high numbers of carious lesions present in younger adult individuals. Thus, one may suggest that that the population at 120-122 London Road, Gloucester generally had much higher speeds of dental decay than the population at Trentholme Drive, York.





Sex-based differences in dental health between York and Gloucester generally point to poorer dental health for males at Gloucester but better dental health for females (see Figures 9 and 10; $\chi^2 = 30.8$, $df = 1$, $0.001 > p > 0$ for males; $\chi^2 = 1.38$, $df = 1$, $0.5 > p > 0.2$ for females). Males at Gloucester had significantly more AMTL than those at York ($\chi^2 = 6.84$, $df = 1$, $0.01 > p > 0.001$); rates of abscesses between males in the two populations, however, are not significantly different ($\chi^2 = 1.14$, $df = 1$, $0.5 > p > 0.2$). Females at Gloucester had significantly fewer cases of AMTL and abscesses than females at York ($\chi^2 = 6.70$, $df = 1$, $0.01 > p > 0.001$ for AMTL; $\chi^2 = 5.60$, $df = 1$, $0.02 > p > 0.01$ for abscesses).

6.3 Summary:

The population at Gloucester generally had more systemic stress and poorer dental health than the population at York, particularly for younger adults and males. Higher rates of systemic stress are evidenced by significantly more cribra orbitalia and LEH at Gloucester. These indicators do not differentially impact males or females.

The population at Gloucester also had significantly poorer dental health than the population at York. Rates of dental caries were generally higher, particularly for young adults and males. Rates of AMTL and abscesses were not very different between the populations. Rates of AMTL among older adults and males at Gloucester were significantly worse than at York. Females at Gloucester, on the other hand, fared better for rates of AMTL and abscesses than females at York.

Chapter 7: Discussion

Despite its participation in a large, bustling, Romanized colonia, the population at Roman Gloucester suffered from higher rates of systemic stress and poorer nutritional health than did their counterparts at Roman York. This clearly contradicts my initial hypothesis that these populations should have similar nutritional health status because their locations in food systems and social status appeared similar based on the available archaeological data. Using the theoretical framework (see Figure 1), we can now theorize about why such differences in health status appear between the populations.

There are two clear options for why the study populations did not have similar nutritional health status indicators. One option is that the current methods for identifying archaeological social status of the population are not sufficiently robust to address aspects of social status that impacted food access in these contexts. The second option is that the overall food access of the populations was different enough to negatively impact the nutritional health of individuals at Gloucester. In other words, Gloucester did not have the same economic “pull” as York, so its population did not have the same access to food as their counterparts at York.

Based on the currently available evidence, it is not possible to fully explain the interactions between these factors. Nonetheless, it is clear that despite its status as an imperially planned settlement with high rank, Gloucester did not support a healthy citizenry, both in terms of systemic stressors and nutritional health.

Chapter 8: Conclusion

In this study, I have sought to relate some aspects of paleopathology to established archaeological evidence for food economies. First, I posited a general framework for understanding nutritional health status as being related to both economic and social aspects of food. Then, I created a particular historical framework using archaeological evidence in which the relationships between social identity, food economy, and nutritional health status may intersect.

The results of my bioarchaeological analysis suggest that the populations from the two study populations do not have the same aggregate nutritional health status. The reasons for their differences, however, are not resolved. Nonetheless, my theoretical framework does present a means by which the reasons for these differences may be understood. For example, the model suggests that because these populations have differential health status, future researchers should consider alternative evidence for social status to differentiate the roles of the study populations within their larger social environment. Additionally, the differences in nutritional health status within the population at Gloucester (namely, among males) point towards a phenomenon impacting food access (e.g., differential food access due to social identity factors) that has not been identified yet in other archaeological evidence.

Future research will seek to place these results within a larger framework for understanding both the complex relationship between nutritional health status and food access in past societies and the relationship of the population of 120-122 London Road, Gloucester within the larger Gloucester population and the population of Britain during the Roman Period.

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