ECHOES IN THE BONES: AN OSTEOLOGICAL ANALYSIS OF THE BIOLOGICAL IMPACT OF ROMAN RULE AT CORINTH, GREECE

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ABSTRACT

The effects colonial regimes have on health has emerged as an important focus in bioarchaeological research. This study contributes to our understanding of this phenomenon by assessing the impact Roman colonization had on health in Corinth, Greece. Using previously published bioarchaeological data, frequencies of cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia, and carious lesions were compared between pre-Roman (7th century B.C-146 BC) and Roman period (44 BC- 4th century AD) populations from three cemeteries in Corinth: the North Cemetery, the Northern Cemetery, and Anaploga Cemetery. Results indicate a statistically significant decrease in the frequency of nonspecific indicators of physiological stress and carious lesions during the Roman period at Corinth, suggesting a change in disease ecology or food security after the onset of Roman imperial rule. This upward trend in health indicators diverges from previous bioarchaeological studies of colonialism in the Roman world and beyond, demonstrating the diversity of colonial experiences and encouraging scholars to question previous assumptions associated with colonizer/colonized models. By integrating multiple lines of bioarchaeological and historical data, this research promotes interdisciplinary exploration of the embodied effects of colonialism.

BIOGRAPHICAL SKETCH

Lindsay Petry is the daughter of Dana and John Petry. She attended The College of Brockport, State University of New York from 2011 to 2014, where she received her Bachelors of Arts in Anthropology and Criminal Justice. In 2017 Lindsay returned to her home city of Ithaca, New York to begin a Masters of Arts Program in Archaeology at Cornell University. She plans on starting a Doctoral program in Forensic Anthropology in the Fall of 2020.

For my family,

whose love and support made this possible

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1.0 Introduction

Research on situations of colonial contact has historically operated upon a binary opposition of 'conquering' and 'native' groups, to the exclusion of more nuanced accounts of their interactions and entanglements (Haverfield 1915; Millett 1990; Collingwood 1932).[1] Haverfield (1915), for example, viewed Romanization as a unidirectional process of assimilation, with Rome spreading its 'greater' culture to amenable barbarians. In response, a 'nativist turn' within the discipline shifted the driving force behind Romanization from Romans to local elites whose power and influence relied heavily on the adoption of Roman material culture (Millet 1990). Yet, in emphasizing native agency, postcolonial approaches risk inverting the colonizer/colonized dichotomy by merely swinging the pendulum from Romans to natives, empire to resistance, urban to rural, and so forth. Recently, scholars have challenged the colonizer/colonized dichotomy altogether on the grounds that it masks internal diversity in the *coloniae* and ignores the potential cross-cutting interests of the multiple social groups entangled in the colonial process (Versluys 2012; Ferris et al. 2014; Silliman 2016; Van Oyen 2017). Perhaps nowhere else are the complexities of colonial experiences more salient than in the Roman Empire, where local elites in the *coloniae* could rise to the Senate and colonial populations could earn Roman citizenship (Terrenato 2005; Wallace-Hadrill 2008). Such fluid political and legal boundaries illustrate how binaries oversimplify the nuances that existed in situations of colonial rule and demonstrate how they fail to address the complexities of people's experiences in imperialist contexts.

Bioarchaeology has also played an important role in the call to revise these binaries by utilizing skeletal analysis of social identity, occupational stress, and disease prevalence to call attention to the varied embodied effects of colonial processes. Recent bioarchaeological developments in the Americas have shown a diverse array of impacts on health outcomes during colonial situations, influenced by the context of the site

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[1] Colonialism is defined in this paper as foreign control over a society with an imbalance of power and the process of social and cultural transformation as a result of these interactions (Dietler 2004, 15-17).

and the local conditions prior to colonization (Larsen and Milner 1994; Murphy and Klaus 2017). These results have demonstrated that colonial encounters are not unidirectional, and that native actors *are* active participants in colonial situations. Bioarchaeology is especially well poised to expose the experiences of marginalized groups, such as women, children, and the poor, who are often absent from the literary or historical record. With methods to reveal demographic and (osteo-)biographical information that may not be discernible through other material remains, bioarchaeologists can work towards deconstructing previous dichotomies and exploring intra-population variation in areas such as health, violence, mobility, and connectivity.

Building upon these recent theoretical and methodological advances, this study utilizes one of the most archaeologically well-documented examples of imperialism, the Roman Empire, as a model for understanding how people experienced health under colonial regimes. While bioarchaeology has been a methodological cornerstone in studies of colonial rule in other regions, such as the Americas, there is a considerable absence of bioarchaeological data within Roman scholarship, which has not gone unnoticed (MacKinnon 2007; Sperduti et al. 2018; Killgrove 2018). In order bring the available osteological data into larger debates regarding "Romanization" and colonial processes, this study synthesizes and reinterprets previously published pathological data from three major cemeteries from Corinth, Greece – the North cemetery, Anaploga cemetery, and the Northern cemetery (Fox 1997; McIlvaine 2012) – analyzing overall changes in health and morbidity prior to (7th century BC-146 BC) and during the period of Roman rule (44 BC-4th century AD).[2] I focus particularly on the pathological indicators that reflect stress episodes during childhood (cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia) and poor dental health (dental caries), the latter of which is strongly tied to dietary behavior and overall nutritional health.

Corinth is particularly well suited to this analysis because its transition from Greek *polis* to Roman *colonia* was marked by the sack of the city, creating a clear destruction layer in the archaeological record and a

[2] Recent research suggests occupation of the site did not cease after the sack (Wiseman 1979, 491-96; James 2014). Therefore, it is possible that some graves could date to the period between Mummius' sack and the founding of the c*olonia*, despite being recorded as early Roman. More precise chronologies would be necessary to intervene in this debate.

basis for producing chronological divisions of osteological samples. Such precise chronological separation is crucial for examining the periods prior to and during colonization. Through the diachronic, contextualized analysis of population health at Corinth, this preliminary study aims toward three objectives: (1) to illuminate how bioarchaeology can be utilized to provide new lines of evidence with which to view colonial subjects and the 'Romanization' debate; (2) to suggest how future bioarchaeological analysis can be used to reveal crucial insights into the life histories and experiences of individuals living under colonial rule at Corinth; (3) to demonstrate how research on a complex colonial encounter, such as that at Corinth, can contribute to interdisciplinary debates on how people experience colonial regimes.

2.0 History of Colonization in Corinth

Ancient Corinth, located in the Greek Peloponnese just 50 miles west of Athens, experienced centuries of colonial rule. Corinth was a wealthy city and gained considerable influence and power due to its strategic location on the Greek landscape. Corinth's unique geographical position allowed for command of the sole land entrance to the Peloponnese and two major eastern Mediterranean ports, Kenchreai and Lechaion. However, this advantageous position also made Corinth an important military target for those wishing to control Mainland Greece.

Corinth remained a free Greek *polis* until around 340 BC when Phillip II of Macedonia set his sights on conquering Greece. Corinth fought against Macedonian aggression, but eventually surrendered to Phillip after the Battle of Chaeronea. Unfortunately, the precise date of Corinth's surrender to Macedonia is unknown (Dixon 2014, 19). Recognizing Corinth as a strategic key for securing control over Greece, Phillip installed a garrison on Acrocorinth, commencing more than a century-long Macedonian presence at Corinth. After Phillip of Macedon's assassination in 336 BC, Alexander the Great succeeded his father as ruler of Greece. Corinth remained stable during this time; however, this prosperity faded quickly after Alexander's death in 323 BC (Dixon 2014, 36, 46). Would-be successors vied for Corinth due to its strategic location and the archaeological record indicates that public works halted during this time (Dixon 2014, 46-67). However, the degree to which Corinth suffered during this transitional period is uncertain (Dixon 2014).

Corinth's foreign occupation did not end with Antigonid control. In 146 BC Lucius Mummius sacked and burned the city after Corinth rebelled against Roman aggression. While contemporary literary sources describe this event as total destruction, archaeological evidence indicates only political and civic buildings were completely destroyed (Paus 2.1.2; Strabo 8.6.23; Cicero 4.5.4; Wiseman 1979, 450-462; Romano 2003, 279-280). Roman control over Corinth was solidified in 44 BC when the *colonia* formally known as *Colonia Laus Iulia Corinthiensis* was founded by Julius Caesar (Walbank 1997, 97-98).[3] This event marks the lower chronological limit for Roman rule within this study. Subsequently, Corinth was almost completely rebuilt in the 1st century AD in the style of Rome; from civic buildings to statues and ceramic wares (Engels 1990; Alcock 1993; Romano 2005; Pettegrew 2007; Millis 2010; Robinson 2013; James 2014; Lepinski 2015; Frey 2015).

In 31 BC, Corinth sided with Octavian in the Roman civil war against Antony and was rewarded for its loyalty when Augustus made Corinth the capital of Achaia, a designation which, in addition to its central ports, allowed the city to prosper. Evidence for the prosperity of Corinth is attested in the archaeological record: for example, large public works projects and the reestablishment of the Isthmian games (Person 2012, 153-154). Corinth's status as capital of Achaia allowed the city to become part of a larger trade network than it had ever been previously. This likely would have benefited the city and provided more resources for individuals of all socioeconomic status. Diet in the ancient world would have been highly dependent on geographic location and social status, so the influx of new goods likely presented more opportunities for the Roman period population to consume a variety of food sources that were not readily available during the pre-Roman period.[4]

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[3] *Colonia* is an emic Latin term, referring to a Roman ruled city outside of Rome itself (Romano 2013, 253). The term also has political and legal implications. Roman law was typically instituted at a *colonia,* whereas other designations, such as a *municipium,* retained more of its own law and governing structure (Purcell 2012). Although the English word colony derives from the Latin *colonia*, modern definitions of a colony lack the political and legal distinctions associated with Roman *colonae*. Therefore, the contemporary term *colonia* will be used in this paper.

[4] Pre-Roman and Roman samples refer to the political and military entity which controlled the region during this time period; it is in no way referring to the cultural, geographic, or political identity of the population.

The trade-based economy of Roman Corinth affected the city demographically, as well. Corinth's population grew during the Roman period, reaching an approximate urban population of 80,000 and a rural population of 20,000 (Engels 1990, 76-84).[5] Settlement density increased around the city, and new villas, gardens, and farmsteads were built in the surrounding area (Alcock 1993, 158-160).

While archaeological and historical records have revealed these important transformations at Corinth, the data do not always elucidate the lived experiences or health of individuals. From the known historical data, two possible hypotheses emerge: (1) if increased population density and trade during the Roman period facilitated the spread of disease, then pathological indicators might be expected to increase as well; (2) if Corinth's economy prospered considerably under Roman rule, providing the local population with better access to resources, then disease frequencies may have decreased. This study addresses these research hypotheses by analyzing osteological evidence from the 7th century BC to the 4th century AD; a time frame that encompasses the rise of ancient Corinth, its conquest by the Macedonians and Romans, the introduction of a Roman settlement on the city's ruins, and its incorporation into the Roman Empire. Doing so will allow us to gain crucial new insight into the embodied experiences of individuals during a time of political and social transformation.

3.0 Materials

Bioarchaeological data were culled from two previous publications from three major cemeteries representative of both the pre-Roman and Roman periods at Corinth: the North cemetery, the Northern cemetery, and Anaploga cemetery (Fox 1997; McIlvaine 2012). Osteological data from 112 adult individuals that belong to the chronological periods of the present study were then reanalyzed. The pre-Roman sample dates to the 7th century BC to 146 BC and contains 55 individuals from three sites: the North cemetery (n=36), Anaploga cemetery (n=12), and skeletons from individual burials discovered in close proximity to these cemeteries (n=7). The Roman period sample dates to the 1st century BC to the 4th century AD, and contains 57 individuals from the Northern cemetery (n=49) and Anaploga cemetery (n=4). Four additional skeletal individuals from a single grave nearby dating to the Roman period were also analyzed.

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[5] Population estimates are based on people per hectare.

3.1 Site descriptions

North Cemetery

Located about one kilometer northwest of the ancient Corinthian Theater is the North cemetery. Relative dating methods based on artifact typologies of associated grave goods have produced dates between the 7th century BC and the 2nd century BC. (Corinth XIII; Angel, n.d.). The majority of skeletal remains recovered at the North cemetery were found in poor to fair condition. Grave typology for only 14 out of the 55 graves were accessible through excavation journals (Figure 2) (ASCSA). All 14 graves examined were sarcophagi and devoid of quality grave goods (ASCSA). Sarcophagi were the most common form of burial at the North cemetery from the 7th century B.C. to the 5th century B.C., though the quality of coffins varied considerably (Corinth XIII, 71-73). Given the lack of luxury goods present in the graves, it is likely that these individuals were not particularly wealthy.

Anaploga Cemetery

Anaploga is approximately one kilometer southwest of the main archaeological site at Corinth. The skeletal remains of 16 individuals from the Anaploga cemetery were analyzed for this case study which consisted of 12 pre-Roman and 4 Roman individuals. The condition of the skeletal remains ranges from poor to good.[6] The pre-Roman burials have been dated to the 7th century BC to the 4th century BC. Grave typology for only 8 out of the 12 graves were accessible through excavation journals; all 8 graves were simple sarcophagi and the excavation notebooks remark on the poor quality of these coffins (Figure 2) (ASCSA). Unfortunately, the majority of graves show signs of disturbance prior to archaeological excavations leaving no grave goods to analyze. However, the poor craftsmanship of the graves indicates that these occupants were likely not individuals of significant means. The four Roman burials are simple inhumations and have been dated to the Late Roman period.

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[6] The terms “poor” and “good” are subjective categorizations. Unfortunately previous publications do not address the criteria of preservation categories.

Northern Cemetery

The Northern cemetery is located approximately half a kilometer north of the forum area, in a line running parallel and south of the Corinth-Patras Highway, beginning approximately half a kilometer east of the forum and extending to one kilometer west of the forum. In total 49 individuals were assessed for pathological indicators. The condition of the Northern cemetery skeletal remains used in the present study varies from poor to good. The majority of the burials from the Northern cemetery were Roman chamber tombs, an indicator of wealth in Roman Greece (Figure 2) (Flamig 2007, 109-110; Corinth XXI, 175-195). However, this assessment is complicated when one considers that the Roman chamber tombs' occupants may have included more than just one nuclear family (Corinth XXI, 6). This could possibly be indicative of a household burial, where people of varying status (head of the household, slaves, etc...) would all be interred together. This makes an analysis of social status based on tomb architecture alone extremely difficult. The rates of functional stress (an indicator of repeated physical labor) developed by individuals in the chamber tombs suggest that these households were not members of the working class, nor were they members of the elite leisure class (Corinth XXI, 236). It should be noted that wealthy Greek males participated in repeated physical exercise at *gymnasia*; however, typical sporting activities, such as running, jumping, wrestling, and discus, are unlikely to produce the same stress markers these individuals showed (Miller 2004, 166-195; Dutch 2005, 105; Newby 2005). Alternatively, individuals within the tomb may have been slaves and household workers who were interred with wealthier families. However, based on the tombs' limited burial spaces and lack of segregation within, these tombs were most likely inter-generationally used by wealthy local families.[7]

4.0 Methods

Demographic information (age and sex) was collected from the samples based on the guidelines established by Buikstra and Ubelaker (1994). Previous investigators estimated sex using the pubis, while age-at-death was estimated using auricular surface changes, cranial suture closure, and dentition (Fox 1997;

[7] At a recent guest lecture at Cornell University, Ceramists Kathleen Slane put forth the argument that tomb reuse may have occurred within the Roman Chamber tombs at the Northern cemetery and therefore the remains could be much younger than previously thought (presentation, April 18, 2018). At present this hypothesis lacks available supporting evidence. Therefore, current dates used by the ASCSA Corinth will be used in this paper. Given Slane's conjecture, however, future work should be done to date the remains, perhaps using radio carbon dating.

McIlvaine 2012). For the purposes of this study, the age-at-death estimates of individuals were recategorized per Buikstra and Ubelaker (1994): Young Adult (YA: 20-35 years), Middle Adult (MA: 35-50 years), Old Adult (OA: 50 and older), and Adult (A: specific age indeterminate). Only adult individuals (greater than 20 years of age) were considered in the present study. While subadult remains were excavated and analyzed for pathological indicators, the sample size for the pre-Roman population (N= 2) was too small for statistical analysis; therefore, subadult populations were excluded from this study.[8]

4.1 Paleopathological Indicators

In order to adequately evaluate potential changes in health following the Roman colonization of Corinth, the following pathological conditions were assessed: cribra orbitalia (CO), porotic hyperostosis (PH), linear enamel hypoplasia (LEH), and dental caries. These variables were chosen for analysis due to their scholarly consensus as general health indicators for diachronic comparison (Steckel and Rose, 2002; Roberts and Cox, 2003; Belcastro et al. 2007; Redfern 2007, 2008; Redfern and DeWitte 2011). CO, PH, LEH are thought to register physiological stress during childhood (Larsen 2015, 41; Roberts and Manchester 2005, 75).

The term porotic hyperostosis was first used by Lawrence Angel (1966) to describe lesions of the orbital roof and on the skull vault, sometimes referred to as cribra cranii. Today, lesions of the orbital roof are known as cribra orbitalia (CO), while lesions on the skull vault are considered porotic hyperostosis (PH). There is much debate by paleopathologists as to whether CO and PH have the same etiology (Lewis 2007; Rothschild et al. 2004; Stuart-Macadam 1989). Changes to the orbital and vault bones are macroscopically similar, a loss and overproduction of red blood cells in the bone marrow causes expansion of the inner, diploic tissue of the skull and can result in a thinning of the outer, compact bone matrix (Angel 1966). Previously, CO and PH were commonly thought to be largely caused by iron deficiency anemia (Angel 1966); however, recent research cautions against accepting iron deficiency as the primary cause. Paleopathologists now suggest a variety of mechanisms that could cause these lesions, including hemolytic and megaloblastic

[8] The lack of subadults in the pre-Roman period sample has been attributed to burial practices (Golden 1988, 154; 2004 153-4; Scott 1999, 90; Ingvarsson-Sunstrom 2003, 21; Liston and Rotroff 2013). Child burials are rare in ancient Greek cemeteries, suggesting that during this time period Greek customs did not consider it appropriate to give formal burials to infants and young children. The burial treatment of subadults during the Roman period changes, with child burials at Roman sites becoming common. This likely reflects a change in burial practices and funerary ideology, rather than an increase in subadult mortality (Millet and Gowland 2015; Dasen 2011).

forms of anemia (Walker et al. 2009). Accordingly, CO and PH are classified as non-specific indicators of physiological stress, meaning the etiology cannot always be confirmed (Goodman and Martin 2002).

Similarly, this study uses linear enamel hypoplasia (LEH) as an additional marker for physiological stress during childhood. LEH results from a disturbance in the production of normal enamel (amelogenesis) and presents as macroscopic horizontal lines or pits on adult dentition (Guatelli-Steinburg and Lukacs 1999). Paleopathologists believe the pause in enamel formation is related to prolonged episodes of physiological stress brought on by malnutrition, illness, or even weaning (Guatelli-Steinburg and Lukacs 1999). However, etiologies cannot necessarily be narrowed further, resulting in LEH generally also being considered a non-specific health indicator (Goodman and Rose 1990; King et al 2005).

However, indeterminable etiologies do not reduce the usefulness of CO, PH, and LEH for scientific analysis. These specific pathological indicators reflect the body's experiences and recovery from physiological stress during childhood; therefore, a contextualized analysis of these skeletal pathologies may suggest the biological, cultural, and environmental factors shaping their prevalence. Factors influencing the rates of CO, PH and LEH include biological (disease), cultural, and environmental conditions. The spread of disease is intrinsically linked with cultural factors such as population density, which allows pathogens to spread more easily. Environmental conditions, like droughts and famines, can lead to poor nutritional health and put physiological stress on the body.

Just as CO, PH, and LEH provide valuable insight into the lived experiences of a population, dental caries can also be used to determine the health status and dietary behavior of an individual. Caries, commonly known as cavities, is caused by the breakdown of plaque by bacteria and the subsequent demineralization of tooth enamel (Erdal and Duyar 1999; Lukacs 2012). The prevalence of caries is influenced by a multitude of factors. One prominent factor is diet and subsistence, which impacts the occurrence and intensity of carious lesions (Hillson 2001). The consistency and texture of food sources, as well as the type of food source(s) an individual consumes (i.e. carb/protein, starch/sugar) also contribute to a susceptibility to developing caries. Other factors include the quality and composition of enamel, presence of defects, occlusal variations, and age of tooth eruption (Hillson 2008). Social and cultural behaviors also affect rates of caries, including how food is prepared, how often and how much food is consumed, oral hygiene practices and sexual division of labor (Lukacs 1995). Lastly, an individual's biochemical and physiological makeup will have an effect on the frequency and severity of caries. This can include saliva flow rate and composition, oral ecology or bacterial biofilms (Hillson 1998).

4.2 Methodology

CO and PH were identified by previous researchers macroscopically as confined areas of pitting and porosity on the external surface of the orbital roof or cranial vault (Fox 1997; McIlvaine 2012). LEH and dental caries were also macroscopically diagnosed on adult dentition (Fox 1997; McIlvaine 2012). However, not all excavated skeletons were analyzed for CO, PH, LEH, or caries due to poor preservation of the remains; the total number of individuals or teeth examined is reported in Table 1. While both Fox and McIvaine used the same criteria to identify cases of CO, PH, LEH, and dental caries, the way in which pathologies are reported varies between authors. McIlvaine (2012) scored PH, CO and LEH based on the severity criteria in Steckel et al. (2006). However, Fox (1997) does not score the severity of the pathological conditions, preventing a direct comparison of the severity between populations. In the present study, CO, PH, and LEH are reported according to presence or absence using crude prevalence rates (CPR). CPR% is equal to the number of individuals exhibiting the condition (n) divided by the number of individuals examined (N) X 100. All permanent adult teeth were assessed for evidence of LEH by Fox and McIlvaine. Dental caries is reported as a true prevalence rate (TPR), or the number of teeth affected (n) divided by the number a teeth examined (N) x 100. In all, 993 permanent teeth were examined, 473 from the pre-Roman period and 520 from the Roman period. CPR and TPR help to facilitate a more equal comparison between chronological periods. Two-tailed Fisher's exact tests were used to compare frequencies of all pathological conditions between the two chronological periods. Fisher's exact test was selected due to small sample sizes.

5.0 Results

5.1 Demographics

The demographic profile for the two chronological periods, as well as for each site, can be seen in Tables 2 and 3. McIlvaine was able to estimate the sex of 48 skeletons from the pre-Roman period. Of those

48 sexed individuals 40% were female and 60% were male. The Roman period had a similar sex distribution; out of the 36 securely sexed skeletons 44% were female and 56% were male. The age-at-death profile revealed significantly fewer Middle Adults in the Roman period than the pre-Roman period (p= 0.0001). However, 63% (36/57) of individuals in the Roman period were unable to be accurately aged more specifically than adult (Fox 1999). The small percentage of Middle Adults in the Roman period and the discovery of only two subadults in the pre-Roman period could indicate that the samples are not representative of a living population.

Another important component of analysis is the socioeconomic means of an individual, which can affect an individual's susceptibility to and severity of certain diseases. Potential wealth disparities may be reflected in grave style, therefore burial type was evaluated (Figure 2). Grave typology for 24 out of 55 Pre-Roman period graves was accessible through excavation notes; 100% (24/24) of those graves were sarcophagi. The Roman period showed slightly more diversity; 2% (1/57) were rock-cut tombs, 2% (1/57) were tile graves, 12% (7/57) were simple inhumations, and 84% (48/57) were Roman chamber tombs.

5.2 Physiological Stress Indicators

CO prevalence decreases from 29% (11/38) in the pre-Roman period to 7% (4/57) in the Roman period, a difference that is statistically significant (Fisher's exact, two tailed, p= 0.0080). The difference in rates of PH between time periods is also statistically significant (p= 0.0237), decreasing from 13% (3/24) in the pre-Roman period to 0% (0/57) in the Roman period. LEH has the largest difference between chronological periods with a decrease from 89% (25/28) in the pre-Roman period to 21% (12/57) in the Roman period, which is statistically significant (p= 0.0001). Dental caries frequency also declines in the Roman period, dropping down to 5% (28/520) from 11% (54/473) in the pre-Roman period, a result that is statistically significant at a high threshold (p= 0.0007). Figure 1 presents the comparative data for CO, PH, LEH, and dental caries for both chronological periods. In order to continue a precedent in classical bioarchaeology set by Kristina Killgrove (2017), all raw data used in this study is available in Table 5. Additionally, each chronological period listed in Table 5 was compared for the pre-Roman and Roman periods. Although sample sizes are small, the distribution of frequencies during the pre-Roman period does not suggest significant changes throughout the centuries, though the sample is notably biased toward the

Archaic period. Like the pre-Roman period, the Roman period sample size representing each century is small; however, the rates of pathologies appear relatively stable throughout the four centuries.

6.0 Discussion

This study found a statistically significant decrease in disease indicators between pre-Roman and Roman period skeletal samples at Corinth suggesting an improvement in overall health. In this section, I will explore three possible explanations for the decrease in disease indicators: (1) Roman rule had an overall positive impact on population health at Corinth; (2) prior Greco-Macedonian occupation of Corinth may be influencing the results seen during the Roman period; and (3) an unequal distribution of wealthy individuals within the pre-Roman and Roman samples may be skewing the results. The current evidence points to an improvement in overall health as a result of Roman rule, although social status differences between pre-Roman and Roman samples cannot be ruled out as a factor. Ultimately, I argue that a modification in lifestyle, diet, and/or disease ecology generated by Roman occupation of the site may have been responsible for the marked decrease in physiological stress indicators and the improvement in oral health.

6.1 Roman Rule Had an Overall Positive Impact on Health

CO, PH, and LEH are physiological stress indicators that can be the consequence of infectious pathogens or malnutrition. The decrease in CO, PH, and LEH frequencies at Corinth therefore suggest that individuals sustained less childhood stress during the Roman period compared to the pre-Roman period.[9] It is possible that changes in infrastructure or food security during the Roman period altered disease ecology, resulting in an improvement in overall health. We must look to the archaeological record for evidence of infrastructural changes that could have altered the previous patterns and processes of disease at Corinth.

While many modifications to Corinth's infrastructure occurred during the Roman period, changes to water transportation, storage, and distribution have the strongest connection to CO, PH, and LEH etiologies. Hemolytic and megaloblastic anemias, two of the most prominent etiologies for CO and PH have been linked

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[9] Although subadult frequencies are not discussed in this paper, juvenile frequencies for both the pre-Roman and Roman periods show low rates of CO, PH, and LEH (Table 5). During the Roman period, 7% of subadults (2/29) showed evidence of CO. 0% (0/29) of subadults presented with PH and 0% (0/29) of juveniles had LEH. This indicates that rates of childhood stress were quite low during the Roman period.

to malaria and waterborne pathogens (Walker et al. 2009; Zuckerman et al. 2016; 44).[10] Possible etiologies for LEH also include consequences of waterborne pathogens, such as dysentery. Given Corinth's water rich environment, the cultural importance water held for Ancient Corinthians, and the significant changes to water systems during the Roman period, it is possible that infrastructural changes to water management reduced waterborne pathogens and ultimately decreased the frequencies of CO, PH, and LEH. This section will briefly review relevant modifications to water management and discuss the potential implications they had on health.

The standard procedure during the pre-Roman period at Corinth was to construct fountain houses at natural springs to pool and protect water (Robinson 2013). This design prevented water from flowing and rendered it stagnant, thereby attracting insects which would increase rates of malaria and create unsterile drinking water that was likely full of contaminants. During the Roman period engineers began to focus on maintaining higher quality (smell, sight, taste) water and providing greater access to clean water sources for people of all socioeconomic statuses (Robinson 2013). Roman technology improved water pressure throughout the city's fountains and supplied running water to pre-existing sources (Landon 2003; Robinson 2013). With new Roman designs, stagnant water became running water and new spouts increased the circulation of springhouses.

The priority placed on constant water flow and regular cleaning of the distribution channels may have decreased the rates of malaria and waterborne pathogens by disturbing insect breeding grounds and the incubation of parasites and bacteria, which can provoke dysentery and can lead to nutrient loss, both of which could lead to anemia and subsequent marrow hypertrophy. By improving the city's water management, Roman rule may have subsequently contributed to the 76% decrease in rates of CO and 100% decrease in PH.

Changes to the infrastructural design of water management at Corinth were not simultaneous, but occurred throughout the four centuries of Roman rule in the region. Although the Roman sample in this study has been analyzed as one chronological period, in the course of four centuries historical, cultural, and

[10] Malaria was endemic at Corinth until after World War I (Corinth XXI, 236)

environmental circumstances would have evolved. It is therefore important to note that individuals' experiences may have differed greatly throughout the Roman period. However, the paleopathological data suggests that childhood health during the formative years of Roman rule (44 BC to the end of the 1st century AD) was not appreciably better or worse, compared to the later stages of Roman occupation (Table 5). It stands to reason then that infrastructural designs instituted in the early Roman period contributed to improvements in health, with later contributions building upon the healthier foundations previously established. In the 1st century BC, the early Roman period, already there is evidence of substantial changes to water management. The example of the Peirene fountain at Corinth shows that substantial changes were made during the 1st century to limit human contamination of the water basin and increase circulation of the standing water (Robinson 2011, 182; Robinson 2013, 347). From what we know of the historical record, there is no evidence suggesting that there was a downturn in water management capabilities at Corinth during the course of Roman rule. In fact, water management seems to remain a priority at Corinth; for instance, in the 2nd century AD Emperor Hadrian commissioned an aqueduct which supplied fresh water from Lake Stymphalos to the city center (Landon 2003, 55-57). As demonstrated by archaeological and literary sources, an amalgamation of changes in water transportation, storage, and distribution throughout the Roman Period may have led to a decrease in CO and PH frequencies.

Progress in water technology and sanitation may have also lowered the rates of LEH, as disease can be an influencing factor; however, malnutrition is among the most common causes of LEH and should not be ignored as a potential factor. It is possible that inhabitants of pre-Roman Corinth experienced greater nutritional stress than their Roman-era counterparts. The archaeological and geological record show strong evidence of severe incident of drought and grain shortages in pre-Roman Corinth (Camp 1982; Garnsey 1998, 150-164; Montgomery 1986, 463-61; Tracey 1995, 30-36; Dixon 2014 33-36). New policies surrounding grain acquisition and distribution implemented during the Roman period may have contributed to the 76% decrease in frequency of LEH in conjunction with improved water management. For instance, the institution of the *curator annonae*—a prestigious municipal office responsible for procuring adequate food supplies for the city at a reasonable price— likely helped reduce famine and nutritional deficiencies in Roman Corinth (Engels

1990). Unlike Pre-Roman Corinth, Roman Corinth had an elected official to raise funds for grain, procure grain supplies for the city, and oversee the distribution of the cities stores (Garnsey and Saller 2014, 214). This official designation may have reduced malnutrition within the Roman population. However, the effectiveness of the *curator annonae* is highly debated (Engels 1990). Although few epitaphs have been recovered from Corinth, a number of them commemorate *curator annonae* for their contributions to the city (Ibita 2016, 36). Although epitaphs can exaggerate an individual's importance, the repeated reference to the appointment makes it unlikely that the position of *curator annonae* was completely ineffective.

The economic conditions of a city can also impact health, particularly nutritional health; for that reason, another possible factor to consider is the increased prosperity of the Roman city. Corinth was not only a strategic stronghold for the Romans, but connected Italy, Greece, Macedonia, and Asia Minor, making it a large trading center in antiquity with both land and sea routes. The increased trade brought by Corinth's status as a Roman *colonia*, and eventually its position as capital of Achaia, likely provided an abundance of goods that would have traveled through their ports and trading stations into the region (Alcock 1993, 160). Increase in trade and access to new resources may have been beneficial for the population at Corinth during the Roman Period. Although the inflow of goods would have also brought an increase of merchants and perhaps diseases, the data suggest that the affluence and stability of the city did not negatively impact health; rather, it may have contributed to its improvement.

Additionally, a rise in imported food sources most likely resulted in a more varied diet at Corinth. Not only could a more well-balanced nutrition decrease rates of LEH within the population, but it would also account for the decrease in dental caries.[11] Less reliance on more cariogenic foods, such as grain, would decrease the frequency and severity of carious lesions. Furthermore, studies have also shown a link between meat consumption and rates of PH; the more meat an individual consumes, the less susceptible they are to PH (Stuart-Macadam and Kent 1992). The Roman diet relied more heavily on meat than the traditional

[11] LEH may also form on teeth developed prior to weaning. It is possible then, that more varied imports did not *directly* improve childhood diet at Roman Corinth, but perhaps *indirectly* impacted childhood health through the diet of the breastfeeding mother.

Greek diet, and Roman expansion resulted in a considerable increase in the meat and livestock trade (Kron 2002; 2008a; 2008b). It is possible that the influence of Roman dietary customs encouraged Corinthians to consume more meat resulting in a lower frequency of PH. Although it is conceivable that trade benefited individuals of all social spheres and strata, the degree to which individuals profited was likely unequally distributed within the population.

6.2 Multiple Instances of Colonial Rule at Corinth

While aspects of the built landscape under Roman rule may account for changes in CO, PH, LEH, and dental caries, we also need to consider the longer term colonial history at Corinth. Immediately preceding Roman control of the city, Corinth was under Greco-Macedonian rule which calls into question whether the changes in water management and diet associated with Roman rule *directly* caused the decrease in disease indicators. It is possible that Antigonid occupation during the Hellenistic period at Corinth caused a considerable increase in disease.[12] The precise relationship between Macedonia and Corinth during the Hellenistic period is obscured by minimal archeological evidence. Nonetheless, the fight for power after Alexander the Great's death (323 BC) is likely to have negatively affected the city. Perhaps Roman rule was simply less oppressive than Antigonid rule and improved health was not a *direct* effect of Roman rule, but rather a *byproduct* of the removal of Greco-Macadeonian control over Corinth. Yet, the struggle for control lasted only twenty years, ending in 303 BC when Demetrios Poliorketes seized power in Corinth. Although the pathological data employed in this study lack the ability to securely separate out Greco-Madcedonian remains from those of the late Classical period, the available data do not point toward a uniform increase in disease indicators during the Hellenistic period (Table 5). However, observations for childhood stress indicators are limited to three individuals during this time period, underscoring the need for larger, temporally-specific samples. Additionally, Michael Dixon's (2014) historical account of Hellenistic Corinth has called into question the degree of oppression Corinthians suffered during Antigonid rule. According to Dixon, there is no evidence that Corinthians were taxed or compelled to finance the garrison's presence on

[12] The Hellenistic period in Corinth is referring to the time between Alexander's death in 323 BC and end of Antigonid occupation of Corinth in 196 BC.

Acrocorinth, or that Macedonian rule infringed greatly upon Corinthian autonomy and freedom (21-22). In fact, he argues that Greco-Macedonian rule provided Corinth with protection, stability, and security. However, there has been limited work published on Hellenistic Corinth; more evidence may be needed to shed light on the experiences of individuals during the Antigonid occupation. Future bioarchaeological studies should make use of radiocarbon dating, which will grant greater chronological control and allow researchers to investigate the effects of multiple colonial processes at Corinth.

6.3 Social Variability within the Sample

One alternative explanation for the changes in disease frequencies found at Corinth is the potentially unequal distribution of "elite" individuals between the pre-Roman and Roman samples. Though there is evidence that some wealth discrepancies are manifested in these burials, there are problematic assumptions with classifying individuals as elite or non-elite, as these categories elide variation in wealth and status that is known to have existed in the Roman world.[13] Likewise, a definition of wealth that is archaeologically measurable is not without limitations. Grave goods cannot inform us of the amount of land an individual possessed or how many fine statues decorated their home. What is more, we cannot assume that modern notions of wealth map neatly onto ancient ones or that burial ideology is synonymous with wealth as accumulated capital.

Despite the limitations inherent to inferring social status from burial assemblages, on balance there is reason to believe that some tomb types were more expensive than others. For example, the Roman period shows some degree of wealth disparities between tomb types. In a hierarchal society, it is plausible that in order to afford certain types of tombs, for instance a Roman chamber tomb, one would need to possess a minimal amount of wealth. Presumably, one's kin would not elect a simple inhumation if they had the means to commission a chamber tomb. To test if "wealth" disparities may be driving patterns in the data,

[13] The character of Trimalchio in the Satyricon, a Roman freedman with considerable wealth who is mocked by those of higher social standing, provides an excellent example of the distinction between wealth and status in the Roman world.

pathological frequencies were compared by burial type for a subset of the sample where burial architecture could be identified in excavation notes (Table 4).

While it remains possible that the changes in disease frequencies at Corinth are the result of sample bias, the data are not unambiguous in this regard. A statistically significant difference in dental caries was found between sarcophagi burials and Roman chamber tomb burials ($p= 0.0194$); individuals buried in sarcophagi were more likely to develop carious lesions than those in chamber tombs. There was also a statistical difference in rates of dental caries between Roman chamber tombs and simple inhumations ($p= 0.0003$). Additionally, LEH was higher among individuals buried in sarcophagi (85%, 11/13), compared to Roman chamber tombs (23%, 11/48), the difference was statistically significant (Fisher's exact, $p= 0.0001$). Lower frequencies of LEH and dental caries in more costly tombs can be explained by the greater access to food sources that the individual's wealth may have allowed. While wealth could account for changes in caries and LEH, it is less likely to account for changes in CO or PH. The distribution of CO and PH does not appear to be biased by tomb type. From an epidemiological perspective, possible correlates of physiological response to infectious disease stressors, such as CO and PH, may bear no relationship to political, legal, social, or economic standing (Robb et al. 2001; Paine et al. 2007). As Robb et al. (2001: 220) note, "wealth in the ancient world may not have brought isolation or relief from endemic or epidemic diseases," and this may especially have been the case for infants and young children with immature immune systems. To put this more plainly, the child of a high-ranking government official may have had the same chance of contracting dysentery as did the child of a slave.

The finding of status differentiation in LEH and caries rates requires some discussion of dietary practices in the Greek and Roman world, albeit a comprehensive account is beyond the scope of this thesis. In a society dominated by social hierarchy, food was an important index of wealth, status, and power (Garnsey 1999, 3; Corbier 1999; Dalby 1996, 24-29). It is likely that those of higher social or economic standing had greater means to procure a more diverse and protein-rich diet, which can reduce the frequency of dental caries and LEH. It is also possible that wealthy individuals were able to purchase higher quantities of less cariogenic foods, such as meat. Even though rates of carious lesions and hypoplastic lines do differ between individuals of socioeconomic status, given that CO and PH are comparable between social strata it is unlikely that wealth alone is driving the results. However, these results should be reviewed with some caution. The absence of a statistically significant difference in physiological stress indicators between tomb types does not necessarily assure that there is no meaningful difference in health outcomes between individuals of varying social strata. For that reason, this potential explanation cannot be discounted. Future work should reassess the status of skeletal samples in partnership with the Corinth Excavation team and reevaluate how we classify individuals as elite and non-elite. This would provide more opportunities for future scholars to evaluate the plausibility that the unequal distribution of elaborate tombs within the pre-Roman and Roman samples may be driving the decrease in pathological frequencies seen in the Roman period.

6.4 Chronological Representation within the Sample

Another factor related to sample composition that may be driving the observed results concerns uneven chronological representation. The pre-Roman period sample consists of 55 skeletal individuals, and of those, 63% (33/55) date to the Archaic period. This bias towards the Archaic period in the sample could be affecting the comparative results between the pre-Roman and Roman periods. Although sample sizes in this study are small in the Classical and Hellenistic periods, the paleopathological data do not suggest that childhood health during the Archaic period (7th century-6th century BC) was appreciably better or worse, compared to the Classical and Hellenistic periods at Corinth (Table 5). In fact, from an epidemiological perspective, we might expect childhood health during the Archaic period to have been better than the later Classical era. The majority of local citizens in Archaic Corinth remained subsistence agriculturalists and pastoralists, rather than city dwellers (Gwynn 1918, 89, 93; Angel 1972; Pomeroy et al. 2004); less densely populated areas would lessen and slow the spread of disease and living conditions may have been more sanitary in less populated spaces.

With regard to dental health, 67% (315/473) of the teeth analyzed in the pre-Roman sample belong to individuals who dated to the Archaic period. There is no statistically significant difference between the rates of carious lesions between the Archaic period and the Classical or Late Classical/ Early Hellenistic periods (Table 5). There is however, a significant difference between the Archaic period (12%, 39/315) and the Hellenistic period (38%, 8/21) (Fisher's exact, two tailed, p= 0.0041), which might suggest the later adoption of more cariogenic foods. There is also a significant difference between the Late Classical/ Early Hellenistic periods (2%, 1/43) and the Hellenistic period (38%, 8/21). Ultimately, these results are based on relatively few individuals recovered from the post-Archaic, pre-Roman period, cautioning against the over-interpretation of these changes as broader social shifts in diet and underscoring the need for larger samples with which to address these questions.

6.5 Inter-site Variability

As this study gives us one piece of the diverse portrait of Roman colonization, it is valuable to compare the results from Corinth in relation to previous studies from other Roman provincial sites. Relatively few studies have analyzed diachronic changes in the CO, PH, LEH, and carious lesion frequencies of pre-Roman and Roman period populations. Peck (2009) analyzed skeletons from Rudston, Burton Fleming, Garton Station, and Kirkbur, in the Northeast of Britain; Redfern and DeWitte (2011) published an overall health analysis of Roman Dorset. Peck and Redfern and DeWitte examined all four health indicators that the present study considers which allows for the best direct comparison. All three studies produced very distinct results, showcasing the local and regional diversity of colonial experiences and Roman rule.

We can compare the Corinth data with that from the sites of Rudston, Burton Fleming, Garton Station, and Kirkbur (Peck 2009). All four sites are rural and skeletal remains were excavated from large cemeteries. A comparison of the overall health of adult humans buried at Corinth and in the Northeast of Britain shows clear differences between the populations. In his study, Peck (2009) found that health at all four sites declined significantly during the Roman period. His analysis found that individuals were twice as likely to develop CO and LEH during the Roman period as before and 3.73 times more likely to develop carious lesions. Rates of CO increased from 9% in the pre-Roman period to 13% in the Roman period (TPR), and LEH also increased to 13% from 9% (CPR) (Figure 3). Frequencies of dental caries rose from 0.7% in the pre-Roman period to 7% in the Roman period (TPR) (Figure 3). At Corinth, the lowest percent change in a pathological frequency is dental caries (55% decrease); however, in the Northeast of Britain dental caries represents the greatest percent change (900% increase). This could indicate that diet changed more significantly in Britain than in Corinth. Overall, the pattern at Corinth reveals greater changes in CO and LEH than in the Northeast of Britain. The results of Peck's study are quite different from the results seen at Corinth with completely contrasting patterns of health under Roman rule.

Comparisons can also be made between the adult data from Corinth and corresponding data from the Roman provincial site of Dorset. The burial context of the remains in Redfern and DeWitte's (2011) study were from rural areas around Dorchester. The rates of CO, PH, LEH, and carious lesions are relatively consistent between the Iron Age and Romano-British periods at Dorset.[14] In contrast to Corinth, the overall analysis of the frequencies of these skeletal variables did not reveal significant changes in general health status from the late Iron Age to the Romano-British periods, suggesting that the Roman conquest of Dorset had minimal effects on overall health. In both Roman Dorset and Corinth, the greatest percentage change was seen in rates of PH (Figure 3). The lowest percentage change at both sites, although directionally opposite, are frequencies of dental caries. Like the Northeast of Britain, changes in pathological frequencies at Roman Dorset reveals less severe transformations in overall health than at Corinth.

These comparisons of physiological stress indicators and oral health before and after Roman conquest at three different sites from across the Roman Empire showcase the variability in health response that exists in situations of colonial rule. The diversity of experiences raises the question, *who benefits from colonialism*? It is plausible to posit that some stakeholders may have benefited or suffered more than others. In the instance of Corinth, the province of Achaia was viewed quite differently than, for example, Britannia (Woolf 1994). The special treatment Greece received from Rome may explain why health improved in Corinth as opposed to the decline in health we see in Northeast Britain. Studies of other sites within the Roman Empire, such as Athens, Egypt, Gaul, and Hispania would contribute to a more holistic understanding of health under Roman rule. Furthermore, where pre-Roman Corinth was already a densely populated city with large trading ports, Roman Dorset and the Northeast of Britain were more rural

[14] Redfern and DeWitte (2011) do not reveal whether frequencies are calculated as crude prevalence rates or true prevalence rates.

settlements with limited connectivity. Perhaps the substantial conversion to a more densely populated area had a more negative effect on health. The different results produced by each study emphasize our need to better understand the biological effects of long-term contact situations.

7.0 Avenues of Future Scholarship

The results of this study suggest that there was an improvement in overall health at Roman Corinth. The historical record provides support for this assertion, with circumstantial evidence suggesting that changes in water infrastructure, economy, and diet contributed to the decrease in the rates of CO, PH, LEH, and carious lesions at Roman Corinth. However, questions remain open about the exact historical mechanisms at play; the wide chronological breadth of this preliminary study make it difficult to link precise historical changes to disease frequencies. Future research can be utilized to build upon the results and arguments of this preliminary study.

7.1 *Intra-site Variability at Corinth*

Differing geographic origins may result in a variety of diets and exposure to toxins and pathogens. Early colonists, believed to be freedman, veterans, and Roman poor, could have originated from anywhere in the Mediterranean (Walbank 1997, 107).[15] Additionally, Corinth's status as capitol of Achaia, busy ports and trading stations, and rapid economic growth likely attracted many new residents; including merchants, craftsmen, skilled laborers, and entrepreneurs (Engels 1990, 66-84). Emigration to Corinth would have introduced many variables that may affect the health responses of an individual, which cannot be reduced to simple 'Roman' or 'Greek' binaries. These differences likely affected individuals' susceptibility and response to infectious diseases and their overall health outcomes. Bioarchaeology can utilize strontium isotopic analysis to determine not only the geographic origins and migration patterns of the individuals being analyzed (for an overview of strontium isotopic analysis, see Faure 1986). This approach allows future researchers to interrogate questions of origins without encouraging a Roman/native binary, provides greater understanding

[15] Many epitaphs and duoviri from the formative period at Roman Corinth suggest the individuals were freedman; most can be connected with powerful Roman families from across the Mediterranean (Corinth VIII; Walbank 1997, 107; Millis 2010).

of the true extent of networks and emigration within the Roman Empire, and presents a framework to investigate links between geographic origins and expressions of identity.

7.2 'Nesting Doll' Imperialism

In addition to showcasing the potential of bioarchaeology within Classical studies and the Romanization debate, Corinth's history of colonial experiences also raises new questions: how do we approach regions which have experienced a sort of "nesting doll imperialism"? That is to say, how might several occurrences of colonial rule, particularly one immediately following the previous, affect how we interpret changes in health? By simplifying regional studies to one colonial process, we ignore how past histories mold the future. Antigonid control over Corinth prior to Roman rule may alter how people were affected by and reacted to the next colonial experience. Resistance may manifest itself differently after repeated experiences of colonial rule, identities may be negotiated unconventionally given the influence of multiple cultural and political systems, and health may be uniquely embodied under the changing social and physical conditions; therefore, we cannot simply examine these colonial rules in isolation, as they did not occur in isolation from one another.[16] We must consider the impact previous imperialist events have had on the experiences of the people we seek to understand.

Unfortunately, as previously mentioned, this study lacks the chronological control to investigate the Classical period, Antigonid occupation, and Roman imperialism at Corinth in isolation. This is due to the dating techniques employed by previous researchers, which rely solely on associated grave goods. While this technique can be useful, it does not always allow for a precise chronology as many artifact types found in graves, such as pottery, were in use for long periods of time. Future research would benefit from collecting samples from the skeletal remains at Corinth to test using radiocarbon dating. Applying the Bayesian Model to compare absolute and relative chronologies would likely result in the most accurate chronology. Future scholars could then compare graves of the last centuries of Corinth as an independent *polis*, the Antigonid period, the years between Mummius' sack and Caesar's establishment of the colonia, the Augustan period,

[16] The effects long-term, repeated colonization have on a population have not received the scholarly attention the topic deserves.

and the late Roman period. Temporal resolution of this kind would make tracking changes chronologically at Corinth possible. Understanding the data within the context of Corinth's entire history will improve interpretations and allow for a more nuanced discussion of the potential impact colonial processes have on a site and its people.

7.3 *Future Directions for Bioarchaeological Research in Roman Studies*

The bioarchaeology of colonialism only developed in the 1980s. This field of study is relatively new and as such has not reached its full potential to inform on long asked historical questions or dismantle paradigms that have emerged within studies of colonialism. In order to do so, a more robust temporal and geographical breadth on situations of colonial contact is required. Future bioarchaeological research in Roman studies should focus on diachronic changes of health under the Roman Empire, honing in on the expansion and replication of bioarchaeological data at the site-specific or regional level. It is my hope that a database of the biological impact of Roman rule will eventually be established and a more holistic picture of health across the Empire will emerge. Once this research phase is complete, studies should aim for cross-regional synthesis and the eventual understanding of the global experience of colonialism (Stojanowski 2017).

8.0 Broader implications for Studies of Colonial Contact

As the above discussions have suggested, this case study, although examining a bioarchaeological approach to Romanization, has wider implications for studies of colonialization. Bioarchaeological research on colonial processes has predominantly shown an increase in physiological stress indicators and worsening oral health in colonized populations (Verano & Ubelaker 1992; Larsen 1994a; Larsen 1994b; Larsen and Milner 1994; Larsen et al. 2001; Littleton 2005; Buzon & Richman 2007; Klaus & Tam 2009; Spielmann et al. 2009). These results have often unintentionally reinforced the notion of a dominant 'colonizer' and a passive or submissive 'native' population. These findings inadvertently reduce individuals to cultural and political label of either/or, limiting academic interpretations to one over-simplified perspective.

In contrast to previous studies examining health in colonial contexts, disease frequencies at Corinth declined. The results of this study demonstrate that health does not respond uniformly to instances of colonial rule. In fact, the low rates of disease indicators at Roman period Corinth suggest that the effects and form of even one colonial regime appear to have varied widely across the empire (see Peck 2009; Redfern and DeWitte 2011). The emerging portrait of health under Roman rule is a mosaic, demonstrating that one model or theory cannot be applied to all Roman sites. The inter-regional comparison between Corinth and other sites of Roman colonization serves as a reminder that colonial experiences are unique to each site and do not conform to previously constructed ideals of colonizer/native binaries. This paper therefore provides opportunities for future researchers to ask more nuanced questions regarding the diversity of colonial experiences and to rethink problematic assumptions associated with the colonizer and native paradigms used across regional disciplines.

9.0 Conclusion

Bioarchaeological data from Corinth indicate that the frequencies of disease indicators decreased in the centuries following Roman colonization of the city. The Roman sample exhibited lower rates of cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia, and dental caries, suggesting a marked change in disease ecology. The overall decrease in physiological stress indicators during the Roman Period may be explained by advancements in water storage and distribution, better sanitation, government positions specifically designed to reduce famine, and increased economic opportunities that came with the Roman colonization of Corinth. However, the possibility remains that the large quantity of chamber tombs in the Roman period, a possible indicator of higher socioeconomic standing, may be a factor influencing the frequencies of pathological indicators. By revealing an improvement in overall health after a colonial event, this study exposes the diversity of colonial experiences and invites future research to examine the unique nature of colonial processes.

FIGURES AND TABLES

Table 1. Total number of individuals or teeth examined at Corinth, Greece for each pathological condition[1]

Pre-Roman	**Condition Analyzed**	**Total number of individuals or teeth examined**	**Method of Reporting**
	CO	38	CPR
	PH	24	CPR
	LEH	28	CPR
	Caries	473	TPR
Roman			
	CO	57	CPR
	PH	57	CPR
	LEH	57	CPR
	Caries	520	TPR

[1] Adult population only

Table 2. Sex Distribution for Corinth, Greece

		Female % (n)	***Male % (n)***	***Indeterminate % (n)***
Pre Roman				
	North Cemetery	36 (13)	64 (23)	0 (0)
	Anaploga	33 (4)	33 (4)	34 (4)
	Individual Burial	29 (2)	28 (2)	43 (3)
	Total	34 (19)	53 (29)	13 (7)
Roman				
	Northern Cemetery	24 (12)	39 (19)	37 (18)
	Anaploga	50 (2)	0 (0)	50 (2)
	Individual Burial	50 (2)	25 (1)	25 (1)
	Total	28 (16)	35 (20)	37 (21)

Table 3. Age at Death Distribution for Corinth, Greece

		YA (20-35)% (n)	*MA (35-50)% (n)*	*OA (> 50)% (n)*	*A age indeterminate % (n)*
Pre-Roman					
	North Cemetery	28 (10)	42 (15)	30 (11)	0 (0)
	Anaploga	25 (3)	58 (7)	17 (2)	0 (0)
	Individual Burial	29 (2)	57 (4)	14 (1)	0 (0)
	Total	27 (15)	48 (26)	25 (14)	0 (0)
Roman					
	Northern Cemetery	10 (5)	10 (5)	10 (5)	70 (34)
	Anaploga	50 (2)	25 (1)	0 (0)	25 (1)
	Individual Burial	50 (2)	25 (1)	0 (0)	25 (1)
	Total	16 (9)	12 (7)	9 (5)	63 (36)

Table 4. Pathological Condition by Grave Type

Tomb type	**Pathological Condition**			
	CO% (n/N)	**PH% (n/N)**	**LEH% (n/N)**	**Dental Caries% (n/N)**
Sarcophagi	5 (1/19)	11 (1/9)	85 (11/13)	8 (23/284)
Roman Chamber Tomb	6 (3/48)	0 (0/48)	23 (11/48)	4 (16/412)
Tile Grave	100 (1/1)	0 (0/1)	0 (0/1)	10 (1/10)
Simple Inhumation	14 (1/7)	0 (0/7)	14 (1/7)	17 (11/66)
Rock-cut Tomb	0 (0/1)	0 (0/1)	0 (0/1)	0 (0/32)

Table 5. Raw Data Corinth, Greece

Sample	Assigned Chronological Period	Caries % (n/N)	LEH % (n/N)	CO% (n/N)	PH % (n/N)
Pre-Roman Adults					
	Archaic (7th-6th Centuries)	12 (39/315)	95 (20/21)	36 (9/25)	13 (2/16)
	Classical (5th-324 BC)	6 (6/94)	100 (2/2)	0 (0/8)	0 (0/3)
	Late Classical/ Early Hellenistic (400-300 BC Century)	2 (1/43)	50 (1/2)	50 (2/4)	0 (0/4)
	Hellenistic (323 BC-146 BC)	38 (8/21)	67 (2/3)	0 (0/1)	100 (1/1)
Total:		11 (54/473)	89 (25/28)	29 (11/38)	13 (3/24)
Pre-Roman Subadults					
	Archaic (7th-6th Centuries)		50 (1/2)	50 (1/2)	0 (0/2)
	Classical (5th-324 BC)		0 (0/0)	0 (0/0)	0 (0/0)
	Late Classical/ Early Hellenistic (400-300 BC Century)		0 (0/0)	0 (0/0)	0 (0/0)
	Hellenistic (323 BC-146 BC)		0 (0/0)	0 (0/0)	0 (0/0)
Total:			50 (1/2)	50 (1/2)	0 (0/2)
Roman Adults					
	1 AD	4 (9/217)	25 (6/24)	13 (3/24)	0 (0/24)
	1-2 AD	8 (4/52)	20 (1/5)	0 (0/5)	0 (0/5)
	2 AD	0 (0/2)	25 (1/4)	0 (0/4)	0 (0/4)
	3AD	4 (1/22)	33 (1/3)	0 (0/3)	0 (0/3)
	4 AD	1 (2/130)	22 (2/9)	0 (0/9)	0 (0/9)
	3-4 AD	15 (4/26)	50 (1/2)	0 (0/2)	0 (0/2)
	Late Roman	12 (7/57)	0 (0/5)	20 (1/5)	0 (0/5)
	Roman	7 (1/14)	0 (0/5)	0 (0/5)	0 (0/5)
Total:		5 (28/520)	21 (12/57)	7 (4/57)	0 (0/57)
Roman Subadults					
	1 AD		0 (0/9)	11 (1/9)	0 (0/9)
	1-2 AD		0 (0/7)	0 (0/7)	0 (0/7)
	2 AD		0 (0/1)	0 (0/1)	0 (0/1)
	3AD		0 (0/0)	0 (0/0)	0 (0/0)
	4 AD		0 (0/7)	0 (0/7)	0 (0/7)
	3-4 AD		0 (0/0)	0 (0/0)	0 (0/0)
	Late Roman		0 (0/1)	100 (1/1)	0 (0/1)
	Roman		0 (0/4)	0 (0/4)	0 (0/4)
Total:			0 (0/29)	7 (2/29)	0 (0/29)

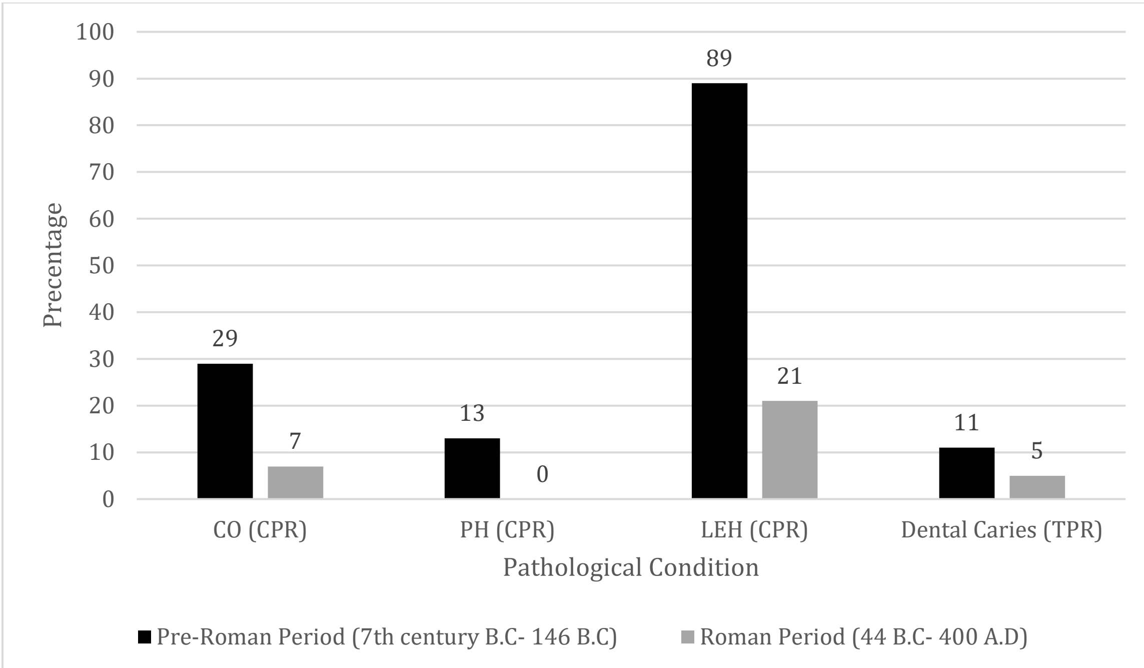

Figure 1. Frequencies of pathological conditions in adult burial population from Corinth, Greece

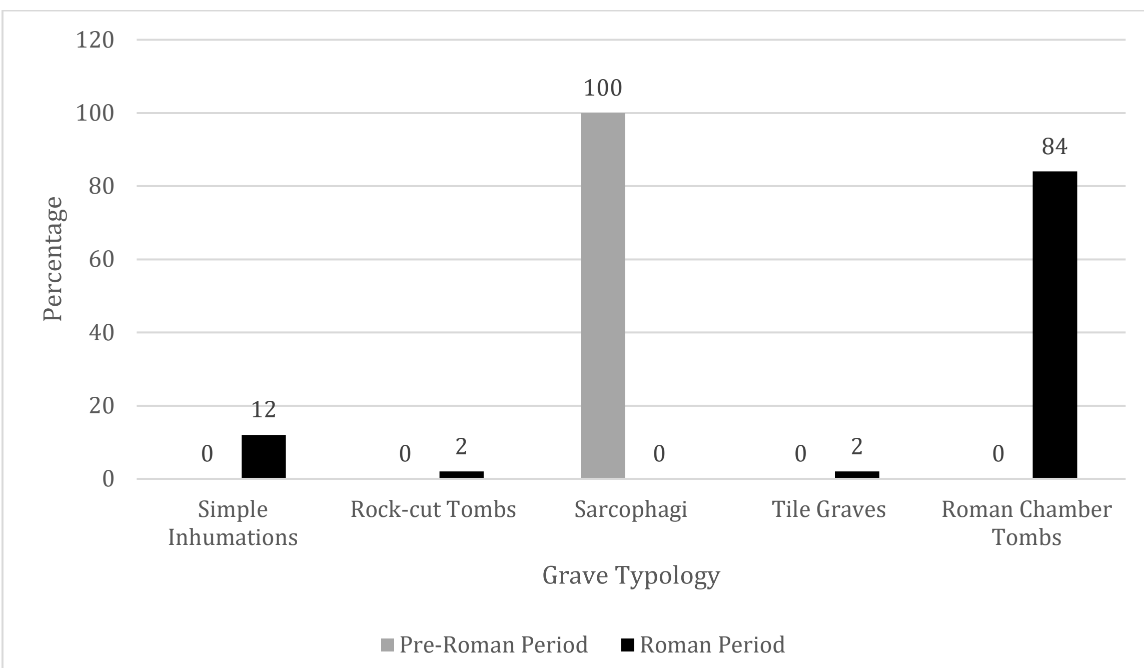

Figure 2. Frequencies of grave types in excavated samples from Corinth, Greece

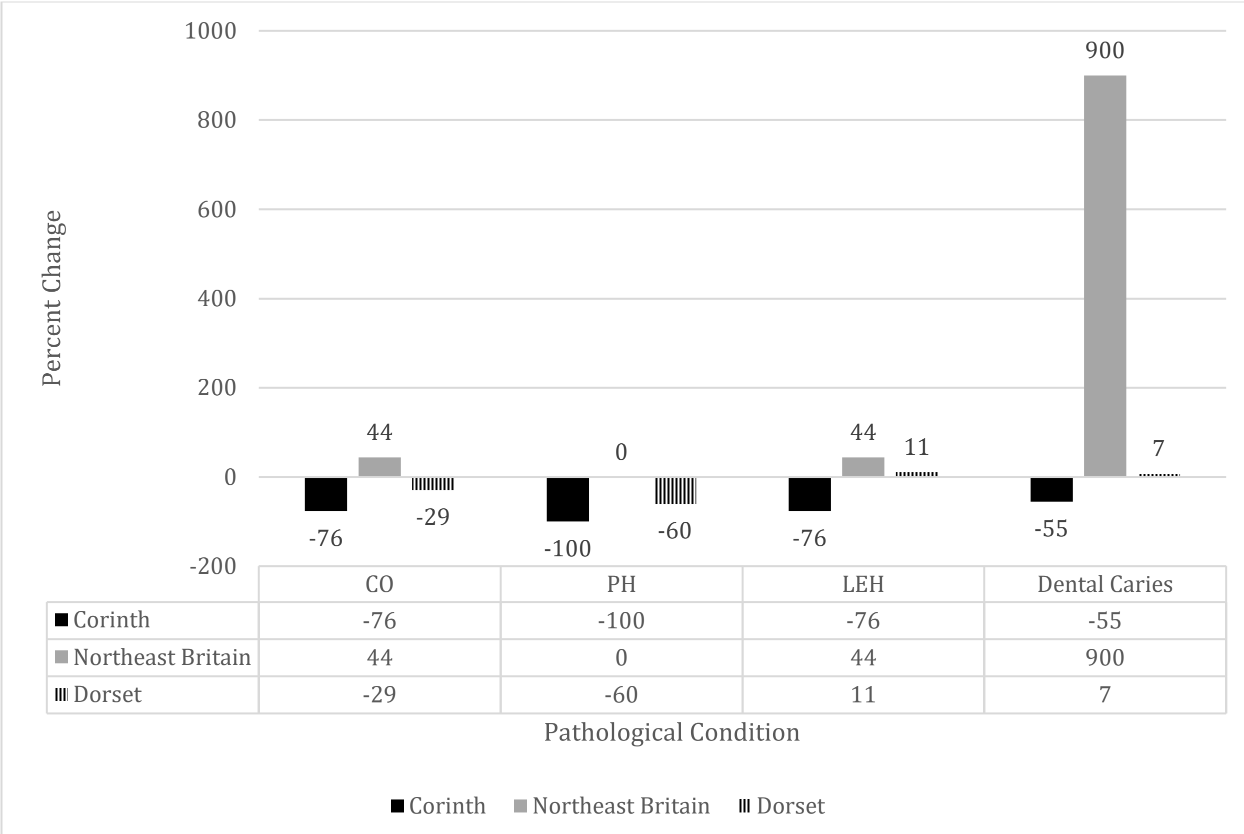

Figure 3. Percent change in pathological frequencies at three sites, following Roman colonization; Corinth, Northeast of Britain (Rudston, Burton Fleming, Garton Station, and Kirkbur), and Dorset.

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