THE EFFECTS OF SOCIOECONOMIC STATUS ON FEMALE HEALTH AT ST. BENET SHEREHOG

by

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DEDICATION

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ABSTRACT

This research investigates the impacts of socioeconomic status on female health at three pre-industrial burial sites in London, England. The analysis compares the female skeletal sample from the parish burial of St. Benet Sherehog (SB), a high-status site, to the cemeteries at the 'New Churchyard' at Broadgate (BG) and St. Thomas Hospital (ST), both representing low-status sites during the 17th century. Data for St. Thomas Hospital was made available by the Museum of London's Wellcome Osteological Research Database and was compared with published data for St. Benet Sherehog and Broadgate to test the hypothesis that women at St. Benet Sherehog exhibited better health outcomes during this period.

Most of the results for the pathologies included in this study did not differ between the high-status and low-status samples; however, two differed significantly ($p < 0.05$) for St. Benet Sherehog (n=57) when compared to the combination of the other two low-status sites, St. Thomas Hospital and Broadgate (n=59). The pathologies that are significantly different are dental caries (SB= 40%, ST/BG= 66%; p= 0.009) and non-specific infections (SB= 61%, ST/BG= 34% frequency; p= 0.005). This suggests that socioeconomic status did not impact most of the pathological conditions examined for the three sites included in the study. Though most of the results were not statistically different, these results and historical records provide insight into what life was like in London during the Stuart period.

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LIST OF ABBREVIATIONS

SES	Socioeconomic Status
SB	St. Benet Sherehog
ST	St. Thomas Hospital
BG	‘New Churchyard’ Broadgate
LEH	Linear Enamel Hypoplasia
NSI	Non-specific infections
TB	Tuberculosis
TREP	Treponematosis

CHAPTER 1: INTRODUCTION

Research Goal

The primary goal of this research is to investigate the lived experiences of high and low-status women living in the 17th century in London during the Stuart period, before industrialization. In this instance, status is associated with sociality and economic stability, which is often referred to as socioeconomic status (heretofore referenced as SES). This research references two levels of socioeconomic status: low and high. The 17th-century London burial site at St. Benet Sherehog, also referenced as Poultry 1 (SB), provides an opportunity to explore the social, cultural, and economic complexities surrounding gender and health in the greater pre-industrial London area. Research is still novel in interpreting these intersections through bioarchaeology (Zuckerman and Crandall, 2019); however, this paper will contribute to this knowledge by observing the possible association between socioeconomic status, gender, and health.

This study examines previously published data presenting skeletal pathology and compares it to historical and archaeological data to test the hypothesis that higher-status females had better health outcomes during this time in London. In order to accomplish this, previously published skeletal pathology data, made available through the Wellcome Osteological Research Database, Hartle (2017) and White et al. (2008), will be examined and compared to historical and archaeological data to test the hypothesis that higher-status females had better health outcomes during this time in London.

It is essential to acknowledge the issue of using sex as a proxy for gender, especially in bioarchaeology. Bioarchaeological researchers are often limited to using biological sex, and it is acknowledged that sex and gender are not the same. Sex is a biological construct, while gender is socially constructed and differs cross-culturally (Marecek et al., 2004). For this research, data will solely reference those individuals presenting as biological females, as designated in the published data sets.

First, the research will compare the female pathological data from the high-status site at SB to two other low-status sites, the New Churchyard at Broadgate (BG) and St. Thomas Hospital (ST). Then the analysis will be compared to the available historical and archaeological data to better understand women's lived experiences during this period. Few bioarchaeology research projects have focused on female health, specifically at the burial site at SB. This site has not been studied as extensively in the literature and is an excellent candidate for comparative purposes to the other two sites: St. Thomas Hospital and the New Churchyard. A map of England is below to understand the area better, pinpointing London.

Map 1.1. A map showing an overview of England, pinpointing London (Office for National Statistics, 2022).

CHAPTER 2: BACKGROUND

The Stuart Period

17th-century London began with the closing of the Elizabethan era in 1603 and the beginning of the Stuart period, which heavily divided society by social class and gender. At this time, England in the 17th century was experiencing social change. The trade of goods, like tobacco, sugar, tea, and coffee, brought people from their homes into the public sphere. However, peoples' private lives were still significant. Women at this time tended to home and family life. Social division by class and gender was still heavily institutionalized, and morality, as defined by the Protestant church, was highly regarded among all the social classes (Arkell, 1987; Drummond & Wilbraham, 1991).

Before the closing of the Elizabethan period, England's government system was a monarchy. The Stuart period turned that monarchy into a parliament, first run by James I of England (also referred to as James VI of Scotland), son of Mary of Scotland, and Henry Stuart (Kenyon, 1967; Coward, 1980; Coward, 2003). The Stuart period in England lasted from 1603 to 1714 and witnessed several momentous events, including, but not limited to, the Great Fire of London in 1666, the Glorious Revolution, which lasted from 1689 to 1690, and the Bubonic plague event occurring in 1665. The following sections discuss how stratification and the gender divide affected men and women of both high and low social status. It also outlines the importance of sugar at this time, the Glorious Revolution, the Bubonic plague, and the Great Fire of 1666.

Stratification and the Gender Divide

Stratification in societies stems from socially constructed ideas; the social construction of the Stuart period society impacted low- and high-status women. There was a clear social divide, regarding class and gender, among both the poor and women in general, during the late 16th and early 17th centuries (Coward, 1980). This divide is evident in early taxation records and wills, which reflected those of high social status in England (*see* Coward, 1980; Slack, 1985; White et al., 2008). The divide was apparent in residential patterns regarding the poor: merchants and the like, who lived in town centers, and the urban poor, who lived in crowded suburbs.

In the late 16th and early 17th century, new professions emerged in significant numbers, especially doctors and teachers; typically, high-status men held these positions. For medical professionals, a critical step was the establishment of the Society of Apothecaries in 1617 and the establishment of the Royal College of Physicians (est. in 1518) and Barber-Surgeons (est. in 1540). Education was only attainable for men and their sons who owned land or for those men who came from other forms of generational wealth. Regarding the gender divide, education was limited for women of high- and low-status (Coward, 1980).

Women of high social status were educated at home at an earlier age because they were trained to perform housework for when they were married. A woman’s education consisted of learning to sew or make needle works; women were advised to stay away from the education men partook in. Instead, women were to look after their husbands and promote their family's welfare. It was uncommon for higher-status women to hold a

professional position; however, the few who did work would have been nurses or midwives, even though they were not provided an educational background in medicine. Even fewer high-status women could have worked in one of the very few positions available to them at the East India Trading or Mercers' Company by recommendation of a man (Clark, 1992 and White et al., 2008). The combination of social opportunity and accessible resources would indicate that fewer sociocultural and behavioral factors would have negatively affected the health of women of higher social status. However, this was not the case for women of low social status during England's Stuart period.

Women of lower social status, or paupers, might have served as servants in the home of someone of middle- or high-status (Coward, 1980). They typically worked in middle- or high-status homes where they were laundering, doing other domestic work, or serving as wet nurses, and all were considered low-paying jobs (Clark, 2013). If a low-status woman was married, they were expected to assist their husband's work unless it was in the public domain. Marriage was a small step away from total impoverishment and societal views concerning witchcraft (Coward, 1980).

Though accusations of witchcraft occurred, very few people in England, especially in London, were alleged to be witches. England's laws on witchcraft can be attributed to the ruling periods of Queen Elizabeth, the last Tudor a century prior, and James I, the first king of the Stuart period. However, it is still important to note the importance of witchcraft during the Stuart period due to the division between men and women. Older women who lived alone or were unmarried were often the victim if accusations were made. There was a negative view of women living alone and those who intended to educate themselves beyond their limits, especially on the uses of medicinal

herbs and remedies (Coward, 1980; 2003). To better understand London's social divide between high- and low-status individuals, examining the relevant laws and events that were in place during the first half of the 17th century is helpful.

Pre-Industrial London: Poor Relief

London's social divide is better understood through the laws created during the first half of the 17th century, during the end of the Elizabethan Period. Poor relief efforts required parishes like the one at SB to care for those considered paupers and provide means of work for those who were able at workhouses in the city and at the parishes of the churches (Kenyon, 1967; Coward, 1980). Parishes in England were communities composed of members of Protestant churches and were split up into counties (Merriam-Webster Dictionary, accessed 2023). Generous aid was provided, per county by year, to those parishes providing work for the poor. Even though it was required and the responsibility of the parishes to provide work and services for the poor, individuals of higher social class still thought of those poorer individuals as an inconvenience socially. This negative view was made worse with the onset of industrialization in the 18th century (*see* Daunton, 1995; Shields Wilford & Gowland, 2019; Coward, 1980).

Poor Laws were created in response to the increasing poverty experienced in the late 16th century. In the early 17th century, members of Parliament criminalized poverty under the direction of the church. The church deemed those in poverty a moral failure, a burden to the parish, and a jeopardy to salvation (Dahlberg, 2012). Despite the passing of Poor legislative laws, parish authorities seemed to direct their attitude and energy toward people experiencing poverty through punishment and resettlement rather than helping

them establish workhouses to create employment opportunities (Coward, 1980). Begging but being able-bodied was punishable by public whipping and being sworn to work (Quigley, 1997). The inability to afford food and inflicted punishment could have contributed to various skeletal lesions due to nutritional stress and trauma. In this sense, wealth and social status were heavily guarded against the poor, and this type of sponsorship was heavily systematized (Daunton, 1995; Shields Wilford & Gowland, 2019). On top of the relief to stabilize those in poverty, England was amidst a few crises of epidemic proportions.

The Glorious Revolution

The Glorious Revolution was a relatively quick war ignited by religious differences between Protestants and Catholics in England, Ireland, and Scotland. By 1688, it was clear that quite a few members of Parliament, who were Protestant, were eager to restore the former political and religious order before James II's "revolutionary" ideas about politics and religion. James II was a Catholic, and despite the support of a few, many Parliament members feared his ideas for change in England. New policies surrounding limiting years of power for particular positions of Parliament were suggested, and most in Parliament did not agree with these decisions (Coward, 1980; Coward, 2003). James II also wanted to enact religious freedoms for practicing Catholics in England, but these ideas were overturned after many French Protestants migrated to England (Bosher, 1994). Despite his efforts to enact new policies in England, James II abdicated his position as King of England and fled before the war's end in 1689, which contributed to the end of the religious and political strife of the Glorious Revolution (Coward, 2003).

Plague and the Great Fire of 1666

England, as a whole, has experienced several surges of bubonic plague throughout the centuries. These events devastated the population and contributed to most of London's earlier burials (White et al., 2008; Slack, 1985). London's population of 460,000 was reduced by 100,000 during the 1665 surge of the plague (Cowie, 1970; Morrill, 2016). The plague event of 1665 made its way through more crowded, poorer London areas, while many parishes like the one at SB were barely affected due to access

to cleaner and less crowded living spaces. The plague affected parishioners at SB in 1625 but only took eight lives, which was very few considering how it affected major crowded areas of London. Parishioners at SB survived this plague event because the Great Fire of 1666 killed off many rodents responsible for carrying the bacteria-infested fleas before reaching more affluent areas (White et al., 2008; Slack, 1985). Unfortunately, the Great Fire destroyed most of London's architecture, including SB's church and surrounding buildings (Cowie, 1970; Slack, 1985).

The Importance of Trade Goods

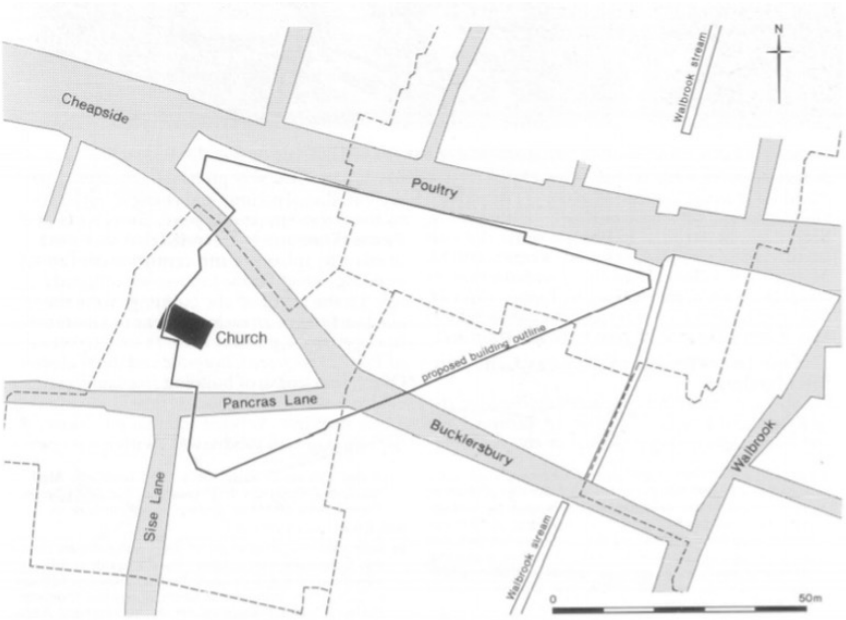
The sugar trade started in the 16th century, increasing the cost of this good until about the middle of the 17th century. By 1650, the cost of sugar significantly decreased and became more accessible to individuals of all circumstances. Sugar was used in many foods and beverages like tea and coffee, especially with the new popularity of tea and coffee shops. High- and middle-status individuals were no longer limited to entertaining and providing food and drink in the home. High- and middle-status individuals had the opportunity to meet various new people at coffee and tea shops and be more involved in community affairs. In the early days of the sugar trade, sugar was used in high-priced confectionaries like pastries and jams, which were commonly consumed by high-status individuals. The eventual low cost of sugar also allowed low-status people to consume higher quantities of high-carbohydrate foods and other low-value confectionaries (Drummond & Wilbraham, 1991; Hartle, 2017).

The Parish at St. Benet Sherehog

The church at SB dates back to the 12th century and was one of 86 parishes destroyed in the Great Fire of 1666. In 1634, twenty-nine homes existed in the area; this grew to thirty-six homes by 1666 before the Great Fire (White et al., 2008). Further archaeological and archival analysis reveals that the sample is mixed with individuals of mostly high SES and very few individuals of low SES (White et al., 2008). As evident by the parish records, those higher-status families could afford apprentices and servants working for them in their homes and had a few of their servants buried with them. Since the burial site contains primarily wealthy individuals and some poor individuals, this could bias the data due to the diverse representation of mixed-status individuals, which decreases the number of higher-status females in the overall sample (White et al., 2008; Hartle, 2017).

During the beginning of the 17th century, most parish residents at SB were considered higher in socioeconomic status based on archival records described in the monograph from the Museum of London Archaeology Service by White et al. (2008) and Paul Slack's (1985) account of the parish. A family renting a home here at the time would expect to pay approximately £ 21, which was well above the average in London. After the Fire of 1666, very few inhabitants returned to the area, and once new buildings were built, rent values plummeted from approximately £ 21 to approximately £2. Historical records, like Wills, indicated that the majority of individuals at SB were of high status, and many of the inhabitants here were known to contribute to poor relief efforts in the city (White et al., 2008).

The primary industries at SB, where men typically worked, were grocery and apothecary. A grocer would have sold goods ranging from tobacco to tea, while a druggist or pharmacist would provide medicine at an apothecary. Men could also be merchants for the Mercers' and East India Trading Companies (White et al., 2008). While there were more employment opportunities and other social advantages for men, being a woman of a higher social class allowed for some limited employment opportunities. After the parish had left the church at SB due to the Great Fire of 1666, it became a burial ground for newer surrounding parishes until it officially closed in 1853. The devastating nature of the fire made it impossible for the families of SB to return to the homes they had built there, some of which had been built centuries prior (White et al., 2008). Below is a map depicting the general excavation area at St. Benet Sherehog, which also reveals where the Church was located.



Map 2.1. An overview of the general excavation area at St. Benet Sherehog or Poultry1 (White et al., 2008).

CHAPTER 3: MATERIALS AND METHODS

Materials

To test the hypothesis that higher-status females at SB had better health outcomes during the pre-industrial period in London, this research utilizes secondary data from the Wellcome Osteological Research Database. St. Benet Sherehog and The New Churchyard data were provided via published monographs in connection with the Museum of London Archaeology Service (White et al., 2008; Hartle, 2017). This section briefly discusses the Wellcome Osteological Research database, the particulars of each burial site, and the variables collected for this study.

The Wellcome Osteological Research Database

The Wellcome Osteological Research database records dental and skeletal pathological frequencies from burial sites from pre-Roman to the post-medieval period of England. For this analysis, the previously collected data from the post-medieval period, specifically the 17th century, will be useful for comparing the osteological data to the historical and archaeological accounts of London described in the literature thus far. In the past, combined historical, archaeological, and skeletal data have provided evidence for social division amongst varying classes of individuals in 17th-century London. The results of the analysis will help connect patterns of inequalities affecting female health at SB.

St. Benet Sherehog Burial

The location of SB burial site was initially the place where 18 individual buildings stood and were going to be redeveloped. Three phases of excavations of the burials at SB occurred between 1994 and 1996; phase one of the excavation includes the skeletal remains of this research. Of the 235 post-medieval individuals recovered during the excavation, researchers retained 230 for analysis. Only 106 of the total 230 individuals (46%) were well-preserved and believed to date primarily from the 16th and 17th centuries (*see* Discussion for further facts on preservation for all sites). Of the 230 individuals, 46 were considered adult females, and 11 were probable females. All three sites included a high quantity of subadults, which were not included in this analysis. All individuals were buried in coffins aligned east to west. Researchers recovered several copper alloy shroud pins and coffin handles during excavation. Alongside parish records, it was indicated that the wealthy and a few lower-status individuals, from this period, shared the burial ground. It was assumed that the level of decoration, type of metal used on coffin handle pieces, and coffin wood type indicated each individual's social status. When compared to BG (low status) and ST (low status), this high-status site reveals a better understanding of the relationship between biological sex and health and how various social and economic factors impacted 17th-century London females (White et al., 2008; Wellcome Osteological Research Database, accessed 2021).

The ‘New Churchyard’: Broadgate Burial

The New Churchyard Broadgate burial (BG) excavation began in 1984, partly due to the 19th-century construction of Broadgate and Liverpool Street Stations. The ‘New Churchyard’ cemetery was established in 1596 at Broadgate. The prior epidemics of the plague in 1563 and influenza from 1557 to 1559 contributed to many deceased individuals and a lack of land on which to bury them. Lord Mayor Sir Thomas Rowe issued orders to use the ground at the ‘New Churchyard’ site to bury the dead from those events and any epidemic after that until its closure in 1739 (Hartle, 2017). The burials from the 16th and 17th centuries were associated with low-status individuals. Due to the extensive excavation of BG over a lengthy period, the individuals used in this analysis come from excavation phase 2 (category B), as Robert Hartle (2017) indicated in the Crossrail Archaeology Monograph. Of the 137 post-medieval individuals recovered, researchers retained 105 for analysis. Only 105 of the 137 total individuals (77%) were well-preserved and believed to date primarily from the late 16th and 17th centuries (*See* discussion for further facts on preservation for all sites). Of the total sample size, n= 105, 30 were determined to be adult females. Most of the excavated burials were uncoffined, indicating that those individuals were poorer than the few higher-status individuals buried in lead coffins from the latter half of the 17th century (Wellcome Osteological Research Database, accessed 2022; Hartle, 2017). Skeletal and dental materials are still being analyzed, and as new information emerges, more pathological conditions will be added to the Wellcome Osteological Research database (2022).

St. Thomas Hospital Burial

St. Thomas Hospital's burial site is located at Bridge House, Southwark, in London. St. Thomas Hospital was established in 1173 and was named after St. Thomas Becket of Canterbury. The hospital initially provided shelter and treatment for the poor, sick, and homeless and was run free of charge at the time of its establishment (Agha & Agha, 2011). The individuals at the site at St. Thomas Hospital were mainly of low-status during the post-medieval period and were highly susceptible to infectious diseases. The 1991 excavations of St. Thomas Hospital revealed a mass grave of three pits, and the pottery found at the site dates the area to the 17th century, during the post-medieval period. A total of 227 individuals were recovered for analysis; of those skeletal remains, 133 (70%) were fully articulated and well-preserved. Researchers retained and analyzed 160 sets of skeletal remains and associated artifacts and found that the burial site consisted of pauper or poor SES individuals. Of the 227 remains, 29 were determined to be females from the post-medieval period (Wellcome Osteological Research Database, accessed 2021). The combined sample size and socioeconomic circumstances of the people living in the areas at the time make this an excellent site to compare to SB.

Sex Estimation

The authors of the monographs and the Wellcome Osteological Research Database reported the analysis of sex estimation. All individuals reported as female or probable female were included in this analysis.

Dental Pathology

Dental pathology is a crucial line of inquiry regarding health due to its connection to dietary patterns, which are heavily influenced by living conditions, cultural practices, resource availability, and social status (Goodman and Rose, 1991). Data for selected dental pathologies were included for all three female samples. The dental pathology data comes from the Wellcome Osteological Research Database and monographs for SB and ST burial sites (*see* White et al., 2008; Hartle, 2017; Wellcome Osteological Research Database, 2021). Some dental pathologies were linked to the high use of refined sugars, high-value meats at SB, which would have been sold at the grocer's and obtained through the trade of both the Mercers Company and East India Trading Company. The availability of high-carbohydrate foods for those of low-status has contributed to increasing dental diseases caused by bacteria and other underlying conditions (Mant and Roberts, 2015).

Linear Enamel Hypoplasia (LEH)

Linear enamel hypoplasia (LEH) is a non-specific stress indicator that can be caused by various stressors, including vitamin D deficiency (anemia), nutritional deficiency, and disease in early childhood. LEH are lines or grooves that often indicate a disruption in early childhood development between one and five years of age when dentition is still developing and can often result from weaning stressors, as observed in cultural practices (Aufderheide and Rodriguez-Artin, 1998; Hillson, 2005; Hartle, 2017). Though the reasons for the development of non-specific LEH are unknown, it is suggested that potential causes of LEH can include considerably stressful environments

and cultural practices and may be linked to poverty due to inadequate diet (Nikita, 2017; Goodman and Rose, 1991).

Dental Caries

Dental caries are caused by bacterial overgrowth on the tooth's surface. Damage to the tooth's surface allows bacteria to wreak havoc on and inside the tooth, which causes local demineralization and destruction of the enamel, dentine, and cementum (Mant and Roberts, 2015). There is a link to a diet rich in higher carbohydrates (Ortner, 2003). Though the link between social status and dietary practices is still unknown, individuals of high status could afford to buy food items high in protein and most likely consume fewer carbohydrates (White et al., 2008; Mant and Roberts, 2015).

Periapical Lesions

If left untreated, dental caries or cavities can result in periapical lesions or an infection of the tooth or multiple teeth. The inflammation from caries causes eventual tooth abscesses and can be life-threatening, especially in those with weakened immune systems (Hilson, 2005, as cited in Hartle, 2017). The result of the infection can leave an abscess opening in the maxilla or mandible where the infection occurred. As these are associated with dental caries, the same risk factors apply, including diets high in carbohydrates (White et al., 2008; Mant and Roberts, 2015).

Periodontitis

Periodontitis or periodontal disease is commonly known as gingivitis. Periodontal disease is an inflammatory illness caused by bacterial overgrowth along the gum tissues. If left untreated, the bacterial overgrowth leads to plaque formation and eventually hardened calculus. In the end stages, bone deterioration and tooth loss are inevitable. While there is a positive correlation between aging and tooth decay, several non-age-related risk factors can lead to periodontitis at any age. Some of these could be correlated with diet and lifestyle choices (Nazir, 2017), both of which are commonly associated with social and cultural practices.

Skeletal Pathology

Cribra Orbitalia and Porotic Hyperostosis

Cribra orbitalia and porotic hyperostosis are porous lesions commonly found on the cranial bones of the skeleton. Cribra orbitalia is more commonly visible on the orbits of the frontal bone, while porotic hyperostosis is evident on other cranial elements. Past studies have indicated that cribra orbitalia and porotic hyperostosis often results from iron deficiency anemia or vitamin B deficiency (Walker et al., 2009). However, current studies have indicated that a range of respiratory conditions may also contribute to the likelihood of developing these porous cranial lesions (Waldron, 2009; Walker et al., 2009; O'Donnell et al., 2020).

Treponematosis

Treponematosis (TREP), more commonly known as syphilis, is categorized as a treponemal disease caused by *Treponema pallidum* bacteria and presents differently at four stages: primary, secondary, latent, and tertiary. Treponematosis results in clusters of deep crater-like lesions called caries sicca, often found on the frontal and parietal bones of the skull and the tibia, starting in the secondary stage. If the above skeletal elements are missing, the infection can be detected in the ribs, sternum, and other long bones (Ortner, 2003; Hartle, 2017).

Tuberculosis

Tuberculosis (TB) is an infectious disease caused by two different bacteria: *Mycobacterium tuberculosis* and *Mycobacterium bovis*. It is transmitted between individuals through exhaled droplets. Although both high- and low-status individuals were at risk, TB may have affected those individuals of lower SES due to inadequate or nutrient-deficient diets. Nutrient-deficient diets can lead to scurvy or diabetes, which lowers an individual's immune system, making TB easily passable among individuals living in overcrowded spaces (Roberts, 2012; Hartle, 2017).

Non-specific infections

There are differences between nonspecific skeletal stress indicators (NSIs) and skeletal changes caused by specific diseases like tuberculosis or treponematosis. The specified pattern and appearance left on the bone can diagnose specific illnesses, while nonspecific indicators cannot identify a specific disease or stressor. While a nonspecific

indicator of skeletal stress may have a specific cause, it is not distinguishable from a lesion caused by another stressor and is considered nonspecific from unknown bacterial or viral infections, like periostitis or osteomyelitis. Their causes, though unknown, may be linked to pollution (like pipe smoking, which was common with the trade of tobacco) and associated respiratory health issues, and overcrowding in areas where low-status individuals resided (Ortner, 2003; Hartle, 2017).

Methods

To test the hypothesis that higher-status females had better health outcomes during this time, this research focused on the following skeletal and dental pathologies: non-specific infection, cribra orbitalia combined with porotic hyperostosis, LEH, caries, periodontitis, periapical lesions, TREP, and TB. These conditions were selected as they have been shown to vary with SES in previous studies and may provide insight into the different lived experiences of the women at these three sites (Hobdell et al., 2003).

For this study, the following variables were identified: Frequency of pathological condition (dependent) and burial site (independent). In order to perform the analysis, *RStudio statistical software* was utilized to run chi-square tests of independence to evaluate the association or independence between pathological frequencies of the three burial sites. The chi-square test assumes that the expected frequencies are less than or equal to five. Secondly, it assumes that the variables' levels (or categories) are mutually exclusive; for this study, the burial site is mutually exclusive with pathological frequency. This chi-square analysis compares the prevalence of these health conditions between the three sites: St. Benet Sherehog (high status) (n= 57), ‘New Churchyard’ at Broadgate (low status) (n= 30), and St. Thomas Hospital (low status) (n= 29). Due to the reduced number of samples at the two low SES sites, this analysis combined the data from Broadgate and St. Thomas Hospital for a total sample size of n= 59. This was done to maximize sample sizes.

CHAPTER 4: RESULTS

This analysis observed the following pathologies: nonspecific infection, cribra orbitalia, porotic hyperostosis, LEH, caries, periodontitis, periapical lesions, TREP, and TB. *Figure 4.1* and *Table 4.2* display the pathology frequencies of the eight conditions selected for this analysis. Though they were not statistically different, there are higher frequencies of the following conditions at the combined sites of ST and BG: TREP, TB, periodontitis, and periapical lesions. However, the results of the chi-square tests of independence showed that two of the eight conditions differed significantly ($p < 0.05$) for SB (n= 57) when compared to the other sites at ST and BG combined (n=59). The significantly different pathologies were NSIs (p-value: 0.005) and dental caries (p-value: 0.009). The frequency of NSIs was higher at SB, while the frequency of caries was higher at ST and BG. The results for the other pathology frequencies showed no statistical significance or association between pathological condition (dependent) and burial site (independent). Fisher's exact test was used to test for differences in the proportions of skeletons with evidence of tuberculosis. The results of the Chi-square tests of independence show no statistical significance or association between females at SB exhibiting lower levels of disease due to their socioeconomic status except dental caries, while they had a higher frequency of NSIs. For pathological conditions and their associated p-values from the Chi-square tests of independence, see *Table 4.3*.

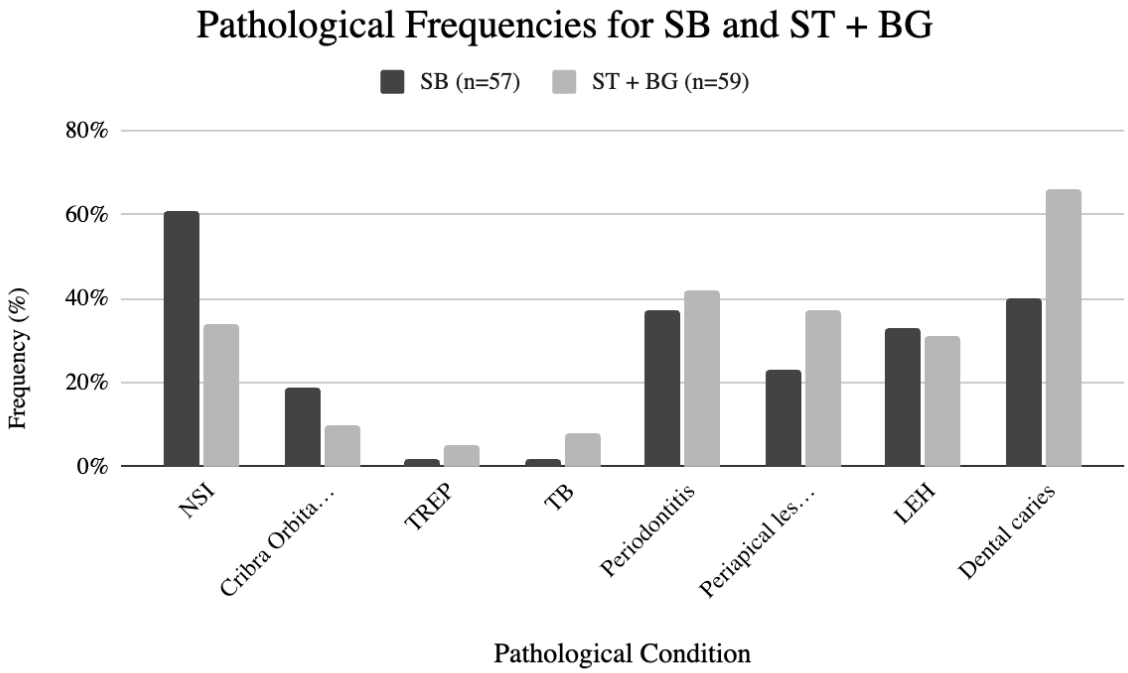


Figure 4.1. Bar chart displaying the dental and skeletal pathology frequencies at St. Benet Sherehog, Broadgate, and St. Thomas Hospital burial sites: NSI (non-specific infection), TREP (treponematosis), TB (tuberculosis), and LEH (linear enamel hypoplasia).

Table 4.2. Table displaying the dental and skeletal frequency of pathological conditions at St. Benet Sherehog, Broadgate, and St. Thomas Hospital burial sites: NSI (non-specific infection), CRIB/PH (cribra orbitalia and porotic hyperostosis), LEH (linear enamel hypoplasia's), TREP (treponematosis), TB (tuberculosis).

Pathological Frequency table	SB (n=57)	ST + BG (n=59)
NSI	35/57 (61%)	20/59 (34%)
CRIB/ PH	11/57 (19%)	6/59 (10%)
LEH	19/57 (33%)	18/59 (31%)
Dental caries	23/57 (40%)	39/59 (66%)
Periodontitis	21/57 (37%)	25/59 (42%)
Periapical lesions	13/57 (23%)	22/59 (37%)
TREP	1/57 (2%)	3/59 (5%)
TB	1/57 (2%)	5/59 (8%)

Table 4.3. Table displaying the p-values of the chi-square tests of independence for each pathology: NSI (non-specific infection), LEH (linear enamel hypoplasia), PERIO. (Periodontal disease), TREP (treponematosis), TB (tuberculosis), CRIB/PH (cribra orbitalia and porotic hyperostosis), and PERIA. L. (periapical lesions). NSIs and caries are bolded due to significance.

	NSI	LEH	CARIES	PERIO.
P-values	**0.005**	0.899	**0.009**	0.675
	TREP	TB	CRIB/PH	PERIA.L.
P- values	0.636	0.102	0.259	0.135

CHAPTER 5: DISCUSSION

Overview

The chi-square tests of independence demonstrated a relationship between cemetery sample and pathology in only two of eight variables. This section discusses each pathological condition separately and collectively to understand the health patterns observed and their potential relationship with SES.

Dental Pathology

Linear Enamel Hypoplasia

LEH was present among the high- and low-status samples: SB (n= 57; 33% frequency); ST and BG (n= 59; 31% frequency) but was not significantly different with a p-value of 0.899. Even though higher-status individuals had access to better resources, low- and high-status individuals were at risk for linear enamel hypoplasia. This result may reflect social practices concerning the early weaning of children, which can lead to nutritional disruption early on, regardless of one's social status (Hartle, 2017). Early weaning practices started affecting children as early as the 16th century; this reflected a cultural shift over socioeconomic factors, partly because breastfeeding was seen as inconvenient and unfashionable across all levels of status (K. Britton et al., 2018).

Dental caries

Dental caries were present among both the high- and low-status samples: SB (n= 57; 40% frequency); ST and BG (n= 59; 66% frequency) and were significantly different with a p-value of 0.009. Dental caries were much more common among the individuals at ST and BG compared to the high-status site at SB. This finding may reflect access to different food resources. In addition to sugar, the general diet for high-status individuals included protein-rich sources of foods like meats. Fruits and vegetables were popular due to trade and available agricultural products. In contrast, their low-status counterparts generally subsisted on foods rich in carbohydrates, like bread, and some lower-valued fat sources, like bacon and butter. They generally lacked proteins and had a diet with fewer vitamins, less variety, and lower overall food quality (Dhaliwal et al., 2019; Wohl, 1983; Drummond and Wilbraham, 1991; Clayton & Rowbotham, 2009; Mant & Roberts, 2015; Hartle, 2017).

Periapical lesions

Periapical lesions were present among both the high- and low-status samples: SB (n= 57; 29% frequency); ST and BG (n= 59; 37% frequency) but were not significantly different with a p-value of 0.899. Periapical lesions were slightly more prevalent at the two low-status sites. The high prevalence of periapical lesions at the low-status sites is likely attributed to the high frequency of dental caries found at both ST and BG. As previously stated, diet may have played an important role in the presence of dental caries.

Periodontitis

Periodontitis was present among both the high- and low-status samples: SB (n= 57; 37% frequency); ST and BG (n= 59; 42% frequency) but was not significantly different with a p-value of 0.675. Periodontitis was slightly more prevalent at the two low-status sites. Even though periodontitis affects individuals of older ages, this analysis could not take into consideration the age of each female included in the skeletal data. While there is a positive correlation between aging and tooth decay, several non-age-related risk factors can lead to periodontitis. These non-age-related factors can be attributed to diet and lifestyle choices (Nazir, 2017).

Skeletal Pathology

Nonspecific Infection

NSIs were present among both the high- and low-status samples: SB (n= 57; 61% frequency); ST/BG (n= 59; 34% frequency) and was significantly different with a p-value of 0.005, which was contrary to the hypothesis that high-status females at SB would have better health outcomes. NSIs were quite common among the individuals at SB compared to the low-status sites at ST and BG (Ortner, 2003; Hartle, 2017). The direct cause of these nonspecific infections is unknown, and though there may be no direct correlation between an individual's SES and the likelihood of contracting an infection with unknown origins, there may be some connection regarding the osteological paradox.

Cribra Orbitalia and Porotic hyperostosis

Cribra orbitalia and porotic hyperostosis was present among the high- and low-status samples: SB (n= 57; 19% frequency); ST and BG (n= 59; 10% frequency) but was not significantly different with a p-value of 0.259. Similarities in frequencies of cribra orbitalia and porotic hyperostosis at SB, ST, and BG may be due to respiratory illnesses in response to overcrowding in urban spaces and the trade of tobacco, which was commonly used among individuals of all statuses by the time prices dropped in the latter half of the 17th century (Clark, 1992 and Hartle, 2017). However, it is also possible this is due to iron deficiency or vitamin B deficiency anemia as these are also commonly associated with cribra orbitalia and porotic hyperostosis (Walker et al., 2009).

Treponematosis

Treponematosis or syphilis was present among the high- and low-status samples: SB (n= 57; 2% frequency); ST/BG (n= 59; 5% frequency) but was not significantly different with a p-value of 0.636. Syphilis was slightly more prevalent at the low-status sites, ST, and BG. Since syphilis is a sexually transmitted disease, tracking its spread among the population may be problematic.

Tuberculosis

Tuberculosis was present among both the high- and low-status samples: SB (n= 57; 2% frequency); ST/BG (n= 59; 8% frequency) but was not significantly different with a p-value of 0.102 (<0.05). It was slightly more prevalent at the two low-status sites, ST and BG. Both high and low-status individuals were at risk due to the nature of the

disease; TB is often spread through coughing. However, it may have affected more individuals of lower SES due to inadequate or nutrient-deficient diets with lowered immune systems and living in overcrowded spaces (Roberts, 2012; Hartle, 2017).

Summary

Based on the Chi-square tests of independence for cribra orbitalia, porotic hyperostosis, LEH, periodontitis, periapical lesions, TREP, and TB, social factors of inequality did not appear to influence those pathological frequencies at SB, BG, and ST. In other words, being a woman of high- or low-status did not affect the likelihood of contracting these illnesses in most instances. However, the lower rate of caries could suggest that the high-status females from SB may have differed in their diet compared to lower-status females. Higher status did not appear to lower the risk of infection, as SB had a significantly higher frequency of NSIs.

CHAPTER 6: CONCLUSIONS

This research aimed to reconstruct women's experiences in the 17th century in London. The analysis predicted that higher-status females at SB would have better health outcomes due to access to better resources and living conditions. The results of the chi-square tests of independence demonstrate no statistically significant differences for most pathological conditions examined; therefore, the hypothesis is not supported.

The historical record indicates that 17th-century London's stratified society impacted the lives of all living there, including women. The results of this analysis indicated that the lower-status females exhibited higher rates of dental pathologies compared to women of high status at the parish of SB, potentially due to their high-carbohydrate diet. Secondly, the rate of NSIs was higher at SB when compared to BG and ST, which could be due to the nature of NSIs. In many cases, it would not have mattered what one's SES was when contracting a disease with unknown origins. Overall, it is concluded that it did not matter if a woman was of high or low status; the likelihood of contracting these illnesses in most instances was the same across the sites, at least for these samples. After considering the skeletal data and the impact of specific historical events throughout the 17th century, there are limitations concerning sample size, historic recording bias, preservation, and the osteological paradox that should be addressed for future research.

Limitations

Sample Size

One of the main limitations of bioarchaeological research and data collection is the small sample sizes from these cemeteries, which limits the ability to draw meaningful conclusions about the period and may not accurately represent the larger population at that time as a whole. The data represented in this research is only representative of females buried at these sites and may not be reflected the same in future studies. For this study specifically, small sample sizes also may not accurately represent most high-status or low-status individuals. One way the sample sizes could be increased is by including additional skeletal data sets from this time period.

Historic Recording Bias

One of the issues identified through examining the parish records from this time is historic recording bias. This refers to discrepancies between what is written in the records and what actually occurred (*see* Hartle, 2017). The bias referred to the inaccuracy of reported burial records when an individual died, and two key issues arose with historic recording bias in the 17th century. First, there was no standard procedure for burial register entries. This period lacked standard procedures due to the high death rate from the plague and the Glorious Revolution. Second, parish clerks may have neglected to compile accurate burial records due to the deceased's social views about religion, which may have impacted the deceased in life. It is estimated that 20 to 40 percent of burials went unregistered across all sites in London (Boulton, 2014; Hartle, 2017).

While some of this may have been because of the vast number of poorer individuals that died during the events of the Plague, and the Glorious Revolution from 1688 to 1689, it does create an issue for the bioarchaeological record. Many individuals buried in the cemeteries were not recorded properly, which is problematic since those records are used to categorize these cemeteries as high-, middle-, or low-status for comparative purposes (Boulton, 2014; Hartle, 2017).

Preservation

Many of the remains discussed in this analysis were uncoffined, which can affect their preservation. In general, the lack of preservation of skeletal remains can impact bioarchaeological research's ability to draw meaningful conclusions about the overall population. For many reasons, skeletal remains are susceptible to various kinds of damage, making it challenging to assess trauma and pathology in some instances. The researchers recorded the preservation at the sites included in this analysis with the assumed correlation between social status and coffined versus uncoffined remains. Preservation of the overall skeletal sample sizes includes males, females, subadults, and those of undetermined sex. The loss of material due to preservation issues for SB was 54%, ST was 30%, and BG was 23% (White et al., 2008; Hartle, 2017). This analysis was limited to the data provided in the monographs connected to SB and BG and the Wellcome Osteological Research Database for ST.

Osteological Paradox

The skeletal remains discussed in this research can only tell us so much information about the lives of the females living at SB, BG, and ST because the health data is limited to primarily non-specific stress markers that are present on the skeleton. The osteological paradox examines the complications of using these markers to make inferences about whole populations. This includes the issue that individuals with signs of disease may not necessarily be "unhealthy" but rather those that survived for at least a while. Healthy individuals may have been more likely to display stress markers because they survived longer, while less healthy individuals may perish before markers appear on the bone (Wood et al., 1992; DeWitte & Stojanowski, 2015). Essentially, it's important to recognize that the disease prevalence in a cemetery sample may be skewed and not representative of the living population. This means that the skeletal samples from the three burial sites do not necessarily accurately reflect the health of the overall population of London at that time.

Future Directions

With the growing availability of skeletal data on the Wellcome Osteological Research Database, there are a few future directions to consider. Including more samples from different high-, middle-, and low-status sites would help decrease the bias regarding SB's mixed status and the issue with small sample sizes. Secondly, the issue of historic recording bias could be resolved through a more in-depth analysis of archival records in connection with the skeletal data. With the possibility of falsifying historical archival records, a more in-depth skeletal analysis regarding pathology and trauma could help

match the individual's record at the time of death. These future analyses could reveal a more accurate picture of each individual's lived experience and address similar concerns regarding the osteological paradox. Lastly, while this analysis focused solely on the females at each burial site, it might be interesting to conduct a comprehensive comparative analysis that observes the differences in health and SES before or after the Stuart period, which introduced trade items through Mercers and East Trading companies. The addition of sugar, tobacco, tea, and coffee to the English diet during this time may have impacted individuals' dental health.

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