Occupational Stress and Slavery: Evidence from Bridgetown, Barbados

Sarah Muno
Western Michigan University

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OCCUPATIONAL STRESS AND SLAVERY: EVIDENCE FROM BRIDGETOWN, BARBADOS

by

Sarah Muno

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Master of Arts
Department of Anthropology

Western Michigan University
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2006
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This thesis is dedicated to my family and friends, who provide constant encouragement and motivation. It is also dedicated to the memory of Malonga Casquelourd, who opened my eyes to the profound impact slavery has had on the American past, present and future.

Sarah Muno
OCCUPATIONAL STRESS AND SLAVERY: EVIDENCE FROM BRIDGETOWN, BARBADOS

Sarah Muno, M.A
Western Michigan University, 2006

In 1996 and 2000, construction workers uncovered unmarked burial grounds in the Pierhead and Fontabelle sections of Bridgetown, Barbados. The human remains were removed in salvage excavation and are now housed at the University of the West Indies and the Barbados Museum and Historical Society. The associated grave goods, documentary record, and initial osteological analysis indicate these individuals were part of the enslaved workforce during the early to mid-eighteenth century. This thesis will explore the presence of vertebral osteophytosis, vertebral anterior wedge compression fractures, vertebral apophyseal facet remodeling and musculoskeletal stress markers among the human remains from Pierhead and Fontabelle in order to gain a better understanding of the physical demands of labor placed upon these individuals. By comparing the analyses of occupational stress markers among the individuals from the Pierhead and Fontabelle burial grounds with skeletal remains from other traditional and enslaved populations, this thesis will also attempt to place the slave regime of Bridgetown within historical understandings of slavery and the larger context of human labor.
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CHAPTER I

INTRODUCTION

In 1996, construction workers uncovered an unmarked burial ground in the Pierhead section of Bridgetown, Barbados (Crain et al., 2004). Dr. Karl Watson, Dr. Frederick Smith, and a team of archaeology students from the University of the West Indies investigated the site and excavated the human remains (Crain et al., 2004). In addition to the findings at Pierhead, another unmarked burial ground from the Fontabelle section of Bridgetown was uncovered during the construction of the Barbados Small Business Development Center. In the year 2000, salvage excavation of these human remains was completed under the direction of Mr. Kevin Farmer, Assistant Curator for History and Archaeology at the Barbados Museum and Historical Society.

Osteological analysis confirmed that the individuals from the Pierhead and Fontabelle burial grounds were of African ancestry, and the associated historical materials, grave goods, and burial conditions are consistent with Handler and Lange’s (1999) findings at the Newton Plantation slave cemetery in Barbados (Crain et al., 2004). This evidence suggests that these individuals were part of the enslaved population in Bridgetown during the early to mid 18th century (Crain et al., 2004).

By 1817, 9,254 enslaved Barbadians were documented in Bridgetown (Higman, 1984). While this segment of Bridgetown’s population was no doubt
influential to social and cultural formations, there is little detail pertaining to their lives in the historical literature. In fact, throughout the New World, there is a general lack of detailed references pertaining to urban slavery (Welch, 2003). Whereas plantations commonly kept detailed records of their enslaved populations, such records do not exist for the urban setting. Urban slaveholders were not absenteeees like many plantation owners, their holdings did not usually reach above ten individuals, and therefore detailed records were not necessary (Higman, 1984). The small-scale nature of urban slave holdings also led to its general neglect in Parliamentary inquiries and colonial newspapers (Higman, 1984). Despite the gap in historical documentation of urban slavery in general, and the slave regime in Bridgetown more specifically, these aspects remain important to understanding the full complexity of slave society and Barbadian culture. Rural plantation and urban slavery contrasted with one another in aspects of demographic characteristics, occupational pursuits, and labor enforcement structures. Because these variations created significant differences in the material and living conditions between those enslaved on plantations and in urban settings, they are of great importance (Higman, 1984).

While there may have been significant differences in the quality of life for those enslaved in urban centers and on plantations, the precise nature of these differences are not well known (Higman, 1984; Welch, 2003). The greater range of mobility typically associated with the urban regime may have afforded better opportunities for personal financial gain. However, there is also indication that access to basic needs such as food, clothing, shelter, and medical supplies may have been more difficult to obtain in urban areas (Higman, 1984). Skeletal analysis can
contribute to a greater understanding of these complexities by elaborating on aspects of diet, disease, the demands of physical labor, and trauma. This becomes increasingly relevant in the urban context, where valuable information is not always accessible using conventional historical sources. When bioarchaeological investigations of slavery are contextualized within the framework of history and real lived experience, they can deepen our understandings of the physical consequences of enslavement. Slavery was a fundamental institution to the development and industrialization of the New World. Therefore, the experiences of the enslaved should be central to any historical understandings of the Americas. Because “physical labor is the principle purpose for which Africans were enslaved,” the relationship between bone morphology and activity has remained a central concern in many skeletal analyses of enslaved individuals (Wilczak et al., n.d. pg.404).

The assumption that physical activity and strain can influence bone morphology is based upon aspects of Wolff’s Law. Although Wolff’s Law was originally formulated as a mathematical model that has since been rejected, its general concept of bone functional adaptation can be helpful to bioarchaeological reconstructions of human behavior (Ruff et al., 2006). Bone functional adaptation states that bone will remodel in the direction of mechanical loading, and mass will increase or decrease to reflect these requirements (Kennedy, 1989). In the simplest manifestations, occupational stress markers are thought to occur when a particular force or load exceeds the bone’s elastic limit, so that areas of strain do not return to their original form (Kennedy, 1989).
Correlations between bone morphology and physical labor have been demonstrated in a variety of clinical settings (particularly in relation to sports medicine). However, age, sex, and genetic factors have the potential to influence this relationship in ways that are currently not well understood (Jurmain, 1999; Zumwalt, 2006). Clinical research seems to indicate that bone response to mechanical loading will also vary based upon the load history of the bone cells and the severity and suddenness of the load application (Ruff et al., 2006). Although ongoing research and new technological developments continue to enhance understandings of the interplay between bone morphology and external stimuli, the complexity of these processes necessitates a conservative approach when applied to behavioral reconstructions.

An incredibly wide range of activities can create similar manifestations of joint or muscle trauma within the human skeleton, making it exceedingly difficult to use these characteristics to determine the specific activities individuals were engaged in (Robb, 1998; Jurmain, 1999). Despite this limitation, establishing general patterns of involvement in relation to age, sex, overall body size, and the distribution of characteristics throughout the human skeleton can still be informative. Therefore, this thesis examines six recently excavated skeletons of urban enslaved Barbadians in order to further the understanding of the physical demands of labor placed upon these individuals. By comparing the patterns of osteophytosis, anterior wedge compression fractures of vertebral bodies, vertebral apophyseal facet remodeling, and musculoskeletal stress markers (MSM’s) observed in the remains of these enslaved Barbadians with that described in other bioarchaeological investigations, it will be
possible to place the occupational activities of these individuals within the larger context of human labor.
CHAPTER II

LITERATURE REVIEW

Site Description

The Pierhead section of Bridgetown is located about 40 meters south of the Constitution River, near Fort Willoughby (Crain et al., 2004). The site of the Fontabelle burial ground is just three miles south of the Pierhead site, and both areas had remained mostly undeveloped until the early 19th century (Crain et al., 2004). Neither the Pierhead nor the Fontabelle burial grounds are featured in any historical maps or sketches of Bridgetown (Crain et al., 2004). However, according to descriptions written by European physician Robert Poole in 1748, enslaved Barbadians were buried in an area located on the periphery of Bridgetown near coastal lands (Crain et al., 2004). This description is consistent with the locations of both the Pierhead and Fontabelle burial grounds.

Historical Background

18th Century Bridgetown and Slavery

Barbados was established in 1627 as the second English colony in the Caribbean (Handler and Lange, 1999). The following year, the Earl of Carlisle funded the initial development of a town on some 100 acres near the mouth of the
Constitution River (Welch, 2003). This town was originally referred to as “Indian Bridge”, but soon became known as Bridgetown (Welch, 2003). Bridgetown was seen as ideal for urban settlement and maritime activity because the coast was free from the coral reefs that made ship anchorage difficult and dangerous in other parts of the island, and fresh water was easily accessible (Welch, 2003).

In its early years, the cash economy of Barbados was dependant mainly upon the production of tobacco and cotton (Handler and Lange, 1999). However, in the late 1630’s, production switched to sugar cultivation and Barbados became the first British colony to produce this commodity on a large scale (Handler and Lange, 1999). By the 1650’s, the success of Barbados’ sugar economy made it the wealthiest British colony and transformed the landscape from small-scale farms worked mostly by European indentured servants to large-scale plantations reliant on enslaved African labor (Handler and Lange, 1999). By 1700, some 10,000 tons of sugar were exported from Bridgetown, making Barbados the largest sugar exporter until surpassed by Jamaica and Antigua in 1750-1780 (Welch, 2003). Between the years of 1697-1705, Bridgetown’s port received 40% of all British imports to the Caribbean, and shipped 45% of all Caribbean exports to Britain (Welch, 2003).

The port of Bridgetown also figured prominently in the trans-Atlantic slave trade. As the easternmost island in the Caribbean, it was the first stop for many slaving ships coming through the Middle Passage, and generally offered the best slave prices during the early 18th century (Welch, 2003). Between the years of 1680-1834, 16.5% of all enslaved Africans that remained in Barbados resided in Bridgetown (Welch, 2003).
Unlike those enslaved on plantations, the urban enslaved were often outnumbered by whites and free people, and mingled daily in towns that lacked significant large-scale residential segregation (Higman, 1984). Urban slave populations contained larger proportions of female, African-born, and colored individuals than were present on plantations (Higman, 1984). Additionally, there were much higher percentages of white and freed women slaveholders in the urban centers than there were on plantations (Higman, 1984). In Bridgetown, female slaveholders accounted for 20-40% of all slaveholdings (Welch, 2003). The high percentage of female slaveholders in Bridgetown may have some bearing on the disciplining of the enslaved in an urban context (Welch, 2003). It is possible that the higher female slaveholdings in the towns led to a general breakdown of slave discipline when compared with the strict expectations of male plantation owners (Welch, 2003).

Fifty percent of all enslaved people in Bridgetown were classified as domestics, compared with only 10% for the rural population (Higman, 1984). Within Bridgetown, the most common occupations in descending order were domestics, skilled trades people, transport workers, laborers, fishermen, and sellers (Higman, 1984). Between 1817-1834, 58% of all enslaved peoples in Bridgetown could be classified as skilled laborers (Welch, 2003). By contrast, in the rural setting of St. Andrew, Barbados, the most common occupations in descending order were field laborers, domestics, stock keepers, skilled trades people, drivers, watchmen, and nurses (Higman, 1984).
Female Slave Labor in Bridgetown

Women represented the overwhelming majority of individuals with domestic occupations for both the urban and plantation regimes (Higman, 1984). Of the domestic occupations, females accounted for all the seamstresses, washers, and water-carriers in Bridgetown (Welch, 2003). Domestics serving as maids in the households of urban slaveholders were often responsible for a variety of tasks, due to the small-scale nature of most urban holdings (Higman, 1984). In contrast, the domestics serving plantation great houses were more abundant, and therefore internal differentiation and specialization was more common (Higman, 1984).

Although sellers accounted for less than 0.6% of the enslaved population in Bridgetown, this was several times what was found on plantations (Higman, 1984). Enslaved females maintained the majority of the street stalls selling goods in Bridgetown (Higman, 1984). Enslaved Barbadians in Bridgetown were hawkers, street-stall sellers, hucksters in the public markets, or in the stores of their holders (Higman, 1984). Sellers operated under a variety of different systems, but enjoyed a relatively independent existence (Higman, 1984). Sellers were either given a range of goods and expected to bring the profits back to the slaveholder, or employed through self-hire, where they could choose their own goods and prices while making fixed periodic payments to their holders (Higman, 1984). In either case, the enslaved were permitted a significant distance from their holders and most likely enjoyed freedoms unparalleled in the plantation regimes, where the hiring out system did not exist. In addition to sellers, urban washerwomen were also frequently able to hire themselves out (Higman, 1984). Housemaids and chambermaids were not typically part of this
hiring out system, as they were required to perform constant labor in the homes or commercial establishments of their holders (Higman, 1984). In fact, while the work hours of the urban regime were generally shorter than those in the plantation context, this pattern may not have been true for enslaved housemaids (Higman, 1984).

Many women enslaved in the urban regime also worked as prostitutes in the local hotels and brothels (Welch, 2003). Whereas prostitution was relatively common in Bridgetown, it was extremely rare in the rural plantation contexts (Higman, 1984). As prostitution was considered an illegal trade, it was never officially documented in occupational lists. However, many personal accounts from journals of travelers and Barbadians alike describe the prevalence of this trade within Bridgetown (Welch, 2003).

While plantation owners were quick to introduce children into field labor, adult females were preferred for domestic occupations in the urban setting (Higman, 1984). In Bridgetown, the proportion of females working as domestics increased with age to a maximum of about 35 years (Higman, 1984). In contrast, washerwomen were more specifically in the age range of 25-50 years old, and seamstresses reached an early peak in their teens and then fell to a small proportion of the female population (Higman, 1984).

Enslaved females in urban and rural regimes had very contrasting roles in occupational pursuits. On plantations, females were frequently part of the first gang, which was responsible for the most strenuous agricultural tasks (Higman, 1984). In contrast, females in the urban regime were completely excluded from transport
services, the most strenuous of all urban occupations (Higman, 1984). Aside from seamstresses, females were excluded from all other skilled trades (Higman, 1984).

Male Slave Labor in Bridgetown

Although there were more male domestics in the urban context than on plantations, the majority of enslaved men in Bridgetown were involved in skilled trades. The skilled trades most often filled by enslaved men included carpenters, coopers, masons, tailors, shoemakers, coppersmiths, blacksmiths, printer’s pressmen, watchmakers, bakers, fishermen, ship carpenters, shipwrights, sail makers, and caulkers (Higman, 1984). Of these listed occupations, carpenters were the most frequent in both urban and rural regimes (Higman, 1984). In Bridgetown, carpenters, coopers, and masons together represented 40% of the enslaved population (Higman, 1984). There was a large concentration of tailors and shoemakers in Bridgetown, as much as three to four times as many as in the rural context (Higman, 1984). Whereas plantation tailors produced clothing exclusively for the planter and their immediate family, those in Bridgetown frequently sold their goods in the marketplace (Higman, 1984). Coppersmiths, blacksmiths, bakers, watchmakers, and printer’s pressmen were represented in small percentages for Bridgetown. While smiths, carpenters, coopers and masons were present in similar frequencies among urban and rural settings, ship carpenters, shipwrights, sail makers, and caulkers were found almost exclusively in the urban setting (Higman, 1984). In Bridgetown, these maritime occupations were present in higher frequencies than any other island in the British Caribbean (Higman, 1984).
While transport workers represented about 5% of the urban enslaved population, this percentage is significantly higher than that of plantation settings. Of all transport workers in Bridgetown, 60% of them were sailors or boatmen, and 35% of them were porters (Higman, 1984). Porters, as they were known in the urban context, did not exist in the rural regime (Higman, 1984). The high percentage of porters in Bridgetown is even more interesting in that it is unusual among the rest of the British Caribbean (Higman, 1984).

Other occupations filled by smaller proportions of enslaved men in Bridgetown included fishermen and general laborers (Welch, 2003). Unfortunately, there is no way to determine the specific types of occupations that would be placed under the general heading of ‘laborer.’

Activity-Related Changes in the Human Skeleton

**Vertebral Osteophytosis**

According to bone functional adaptation, osteophytes will form in regions experiencing increased strain (Rogers et al. 1987; Fazzalari et al. 2001). Osteophytes are bony spurs that can form on the anterior or posterior border of vertebral bodies. This additional bone growth serves to dissipate loads over a wider surface area, thereby minimizing the effects of unequal load distribution (Kennedy, 1989).

The vertebral column distributes body weight to the pelvis during movement and loading, protects the spinal cord, and serves as an anchor for muscles and ligaments (White, 1999). Between each vertebral body is an intervertebral disc that
absorbs the shock of axial compression. The outer layer of the disc (annulus fibrosus) is composed of collagen fibers, while the inner layer (nucleus pulposus) is composed of gelatinous material (see figure 1). The high water content of the nucleus pulposus causes it to swell, creating pressure to counteract axial load (Hukins and Meakin, 2000). While swelling also occurs in the annulus fibrosus, this portion of the intervertebral disc mainly acts to reinforce the nucleus.

Figure 1. Vertebral Body and Intervertebral Disc. A- vertebral body. B- intervertebral disc. C-annulus fibrosus of the intervertebral disc. D-nucleus pulposus of the intervertebral disc.

Dehydration of the nucleus pulposus and the breakdown of the annulus fibrous are part of the natural aging process, but may also be influenced by sex, body size, genetics, and mechanical load. Disc degeneration can cause a reduction in the overall height of the intervertebral disc and a non-uniform load distribution across the endplates of vertebral bodies (Fazzalari et al., 2001). The correlation between intervertebral disc degeneration and vertebral osteophytosis has been demonstrated by a number of studies (Nathan, 1962; O’Neill et al., 1999; Fazzalari et al., 2001; Kumaresan et al., 2001 and references therein). However, it is possible that osteophyte formation is initiated by increased stress to the anterior longitudinal ligament, rather than a decrease in disc height (O’Neill et al., 1999). The anterior
longitudinal ligament attaches directly to the anterior portion of the vertebral body. Scmorl and Junghanns suggested that osteophyte formation occurs when small tears in the annulus fibrosus allow more mobility for the nucleus pulposus (O’Neill et al., 1999). As the nucleus presses forward, increased strain is placed upon the anterior longitudinal ligament, initiating periosteal bone growth (O’Neill et al., 1999).

Osteophytosis of the vertebral column appears to be more common where the spinal curvatures are furthest away from the line of gravity (Nathan, 1962; Jurmain, 1999). Therefore, peak involvement for osteophytosis typically occurs at C4-C7 and T7-T9 (Jurmain, 1999). Osteophytosis is also very common throughout the entire lumbar spine, as this area is exposed to increased weight-bearing stresses. While the upper thoracic region is generally the least effected area of the spine, thoracic osteophytes tend to preference the right side. On the left side, osteophytes may be less common because of diminished bone production capabilities resulting from the pulsations of the descending aorta (Resnick, 1985; Jurmain; 1999).

Throughout the entire spine, osteophytes are most commonly observed on the anterior portions of vertebral bodies (Nathan, 1962; Kumaresan et al., 2001). This pattern was recently demonstrated using an anatomically correct and validated finite element model of the lower cervical vertebrae (Kumaresan et al., 2001). When discs in various stages of degeneration were subjected to mechanical stress and strain, bone-remodeling responses were increased in the anterior margins of the adjacent vertebral bodies (Kumaresan et al., 2001).

Osteophyte formation has been demonstrated by a number of different studies to correlate with age. This is not surprising, considering disc degeneration is
also part of the natural aging process. Generally speaking, as age increases, the frequency and severity of osteophytosis also increases. Clinical research has estimated that osteophytosis affects 60-80% of individuals aged 50 years and older (Resnick, 1985). In a study of 400 vertebral columns, Nathan (1962) found some type of osteophyte formation on vertebrae from individuals in their fortieth year, with the earliest expression occurring among individuals in their twenties. The prevalence and severity of vertebral osteophytosis increased with age, so that by the eightieth year, nearly every individual displayed moderate to advanced stages (Nathan, 1962). Examining the vertebrae of 384 individuals from the Terry skeletal collection, Snodgrass (2004) found moderate and severe expressions of osteophytosis only in individuals over the ages of 35 years (for the thoracic vertebrae) and 40 years (for the lumbar vertebrae). The general pattern of increased osteophyte development with increased age has similarly been demonstrated in a number of bioarchaeological studies (see Jurmain, 1999 for review).

As sex hormones are important to bone deposition and resorption processes, they may also contribute to osteophyte development. In a population study of vertebral osteophytosis among 1180 individuals (M=499, F=681) aged 50 years and older (mean age: M=63.7yrs, F= 63.3yrs.), O’Neill et al. (1999) found an increase in the frequency and severity of osteophytosis among males compared to females. However, reports of heavy physical and occupational activities performed between the ages of 25-50 years were more common among men than women. Therefore, the increased frequency and severity found among men may be related to other factors besides sex. Although osteophytes have been observed to be more frequent and
severe in men than women in a number of studies, this pattern has by no means been
demonstrated universally. For example, in Snodgrass’ (2004) study, no statistically
significant differences in the frequency and severity of vertebral osteophytosis were
found between males and females of similar age. However, occupational data was
only known for a small subset of Snodgrass’ (2004) sample. The occupational data
for this sample revealed that both men and women held jobs that could be considered
manual labor intensive (Snodgrass, 2004). While sex hormones are in fact important
to bone deposition and resorption processes, the exact relationship between sex and
osteophyte formation remains unclear.

It has been suggested that the greater frequency and severity of osteophytosis
typically found in males reflects their increased body size compared to females. An
increased body mass index (BMI) to the level of obesity has been shown to increase
the risk of disc degeneration and osteophytes, but it is difficult to determine the
causality of this relationship (O’Neill et al., 1999). In the study by O’Neill et al.
(1999), those in the upper categories of body mass were more likely to have
osteophytes in the vertebral column than those in the lower categories of body mass.
However, Schmitt et al. (2004) demonstrated a rather weak association between BMI
and osteophyte severity among former male athletes. Nevertheless, as weight bearing
stresses influences the development of osteophytes, there must be some relationship
between body size and vertebral osteophytosis.

Recent studies have shown that osteophyte development may be influenced by
genetics (Sambrook et al., 1999). In a study of 172 monozygotic and 154 dizygotic
twins aged 31-80 years, Sambrook et al. (1999) found 74% heritability for disc
degeneration in the lumbar spine and 73% heritability in the cervical spine, after age, height, weight, smoking, occupation, and physical activity were controlled for. When various features of disc degeneration were considered separately, disc height and bulge were predominate factors contributing to the genetic determination, as osteophyte scores did not differ between monozygotic and dizygotic twins (Sambrook et al., 1999). However, in a review of current clinical literature, Battie et al. (2004) found several studies demonstrating an association between a particular polymorphism of the vitamin D receptor gene and osteophyte severity.

Clearly, osteophytosis is a complex process that can be influenced by a number of variables. Of special interest to this research is the correlation between osteophytosis and physical labor. While the complex nature of osteophyte development necessitates caution when creating biomechanical models, associations between physical activity and osteophytosis have been demonstrated. In a radiographic and osteological study of 86 male cadavers under the age of 64 years with known occupational, physical loading, and back pain histories, osteophytosis was associated with heavy physical labor (Videman et al., 1990). Information relating to occupation, physical labor, and history of back pain was derived from death certificates and interviews with family members (Videman et al., 1990). All listed occupations were then classified as sedentary, mixed degree of heaviness, driving, or heavy by occupational health physicians (Videman et al., 1990). In this study, moderate and severe expressions of lumbar osteophytosis were most common among individuals performing heavy manual labor, and least common among drivers (Videman et al., 1990). Moderate and severe expressions were also more common
among individuals whom experienced disabling injuries, exercised for more than 15 years, and performed heavy work before the age of 20 years (Videman et al., 1990).

In a more recent study of elite track and field athletes, Schmitt et al. (2004) found an increase in the frequency and severity of lumbar osteophytes among shot putters and discus throwers compared to long jumpers, pole-vaulters, and endurance athletes (marathon participants). Lundin et al. (2001) found significantly more radiographic anomalies (osteophytes, decreased intervertebral disc height, Schmorl’s nodes, and spondylolysis) in the thoracic and lumbar spines of 134 professional wrestlers, gymnasts, soccer players, or tennis players aged 27-39 years then 28 non-athletes of comparable ages. In contrast, Videman et al. (1997) found no significant difference in the severity of lumbar osteophytosis between monozygotic male twins aged 35 to 69 years with contrasting lifetime exercise histories (endurance versus power sports; Videman et al., 1997). However, a significant difference was found for osteophytosis in thoracic six through twelve, with severity being increased among those individuals engaged in power sports (Videman et al. 1997). These results did not change when occupation and previous back injuries were controlled for (Videman et al., 1997).

While age, sex, body size and genetic factors may influence the manner in which bone responds to mechanical stress, the demonstrated relationship between osteophyte formation and physical load generally conforms to the concept of bone functional adaptation. In order to understand the potential influence of physical strain to vertebral osteophytosis observed among the Pierhead and Fontabelle individuals, these influences must be taken into consideration. Therefore, osteophyte
development will be considered in relation to the age, body size, and sex of the individual. These systematic factors will affect the entire organism in a symmetrical pattern, rather than acting asymmetrically on isolated parts (Jurmain, 1999; Battie et al., 2004). Therefore, it is important to pay close attention to the distribution of osteophytes throughout the vertebral column. Because of the potential for genetic influences, any comparisons between individuals must remain tentative until the relationship between genetics and osteophyte development is better understood.

In addition to sports and clinical literature, vertebral osteophytosis has been discussed in a number of bioarchaeological investigations. In Lovell’s (1994) study of prehistoric human remains excavated from Bronze Age Harappa (an urban center of the Indus Valley civilization), osteophytosis was present in 34% of the 159 vertebrae from individuals between the ages of 21-40+ years examined. In this study, slight osteophytosis was observed most frequently (55%), and severe expressions were evident in only 15% of all vertebrae examined (Lovell, 1994). The cervical vertebrae of these individuals had the most severe expression of osteophytosis, while the thoracic and lumbar regions were affected to a slight or moderate degree (Lovell, 1994). Interestingly, the only individuals displaying ankylosis (fusion of vertebral bodies), the most severe stage of osteophytosis, were two males aged between 21-35 years. This may be surprising, given that osteophytosis is an age-progressive condition. Despite the early appearance of ankylosis in these two individuals, none of the eight individuals under the age of 21 years displayed any signs of osteophytosis. Osteophytosis was most common among individuals between the ages of 31-40 years (Lovell, 1994).
Peripheral osteoarthritis was rare in this sample, and no indications of nutritional deficiency were observed (Lovell, 1994). In combination with the assemblage of grave goods, these characteristics led Lovell (1994) to interpret these individuals as non-elite urban dwellers, rather than agricultural or industrial laborers of low socioeconomic status.

The severity and frequency of osteophytosis observed in the Harappa individuals is less marked when compared to some studies of prehistoric agriculturalists. For example, in Chapman’s (1972) study of human remains from prehistoric sites in Central and Southern Mexico, moderate to severe stages of osteophytosis were found in a little over half of the individuals between the ages of 30-40 years (57% of 47 individuals). Nine of the total 148 individuals examined were under the age of 20 years at the time of their death, and slight osteophytosis was observed in five of them (Chapman, 1972). Eleven individuals between the ages of 30-50 years displayed the most severe stages of osteophytosis in the form of ankylosis (Chapman, 1972). The individuals with ankylosis represent seven percent of the entire sample, or 30% of all individuals aged between 30-50 years. Chapman (1972) does not provide information as to the frequency and severity of osteophytosis for the different regions of the spine. Generally, it appears that these agriculturalists experienced osteophytosis at a younger age and also experienced severe stages more commonly than the individuals from Harappa.

Analysis of skeletal remains of 34 Native American foragers with a mean age of 33 years from the Stillwater Marsh site in western Nevada indicate that cervical and lumbar osteophytosis was only present in individuals over the age of 25-30 years,
and thoracic osteophytosis was present only in individuals over the age of 30-35 years (Larsen et al. 1995). Lumbar osteophytosis was most common, affecting 66.7% of the entire sample (Larsen et al. 1995). This was followed by cervical osteophytosis, which affected 52% of all individuals analyzed (Larsen et al. 1995). Thoracic osteophytosis was rare, affecting only nine of the 34 individuals analyzed. Because this study limited descriptions of osteophytosis to either present or absent, there is no way to compare the severity of expression in these individuals with that found in the human remains from the Harappan and Mexican samples. However, it does seem that these foragers were more like the urban Harappan individuals than the Mexican agriculturalists in that osteophytosis was not frequent in individuals under the age of 30 years.

These studies of traditional populations indicate that osteophytosis was most common in the cervical and lumbar regions, and individuals between the ages of 30-50 years were affected most frequently. While it was uncommon for individuals under the age of 21 years to be affected by osteophytosis, this condition was present in a few young adults from both the urban Harappan and the Mexican agricultural samples. The frequency of osteophytosis in these traditional populations contrasts with historical agriculturalists from the Wharram Percy and Ensay sites in the United Kingdom. In these skeletal populations, osteophytosis was present most frequently in the lower thoracic and lumbar spine (Derevenski, 2000). Unfortunately, Derevenski (2000) does not give information relating to the prevalence of osteophytosis among different age categories.
Anterior Wedge Compression Fractures of the Vertebrae

Compression fractures of vertebral bodies are typically associated with osteoporosis, and therefore common among elderly individuals (Old and Calvert, 2004). Some risks for osteoporosis include advanced age, female gender, estrogen deficiency, low body weight, and dietary deficiencies in calcium and/or vitamin D (Old and Calvert, 2004). Wedging of the vertebral bodies is characterized by a reduction in the anterior body height of four or more millimeters compared to the posterior body height (Hurxthal, 1968; Driscoll et al. 1993). By calculating the percent reduction of anterior body height relative to the posterior vertebral body height, it is possible to determine the severity of anterior wedge fractures (Genant et al. 1993). The percent reduction in anterior height is calculated by PH-AH / PH x 100, where PH is posterior height and AH is anterior height (Fazzalari et al. 2001).

Anterior reduction percentages between 20-25% are classified as mild wedge fractures, those between 25-40% are moderate, and anything over 40% is considered a severe wedge fracture (Genant et al., 1993).

In individuals with low bone mass and microarchitectural deterioration (as in osteoporosis), anterior wedge fractures can result from repetitive loading below ultimate levels (Rapillard et al., 2005). Wedge compression fractures in a healthy spine, on the other hand, are usually the result of traumatic compression or flexion injuries, such as an automobile crash or a hard fall (Vives et al., 2001; Old and Calvert, 2004). However, a healthy spine can also experience wedge compression fractures when subjected to cumulative non-traumatic compression fatigue (Rapillard et al., 2005). In Levy’s (1968) study of Rhodesian porters, cervical wedge fractures
were associated with carrying heavy loads on the head. According to Levy (1968), axial loading of the head straightens the cervical curvature, which can ultimately result in compressive fractures. Although anterior wedge fractures are most frequently associated with osteoporosis or axial loading, they can also be the result of remodeling associated with osteoarthritis (Osman et al., 1994).

Compression fractures of the vertebrae were present in human remains of prehistoric Native American foragers from the Stillwater Marsh site in western Nevada (Larsen et al., 1995). The mean age of the 34 adults analyzed for evidence of occupational stress was 33 years, and three individuals over the age of 35 years had anterior wedge compression fractures in the lower thoracic and lumbar regions of the spine (Larsen et al., 1995). One individual (also over 35 years of age) had severe anterior wedge compression fractures of the fourth and fifth cervical vertebrae, which the authors attributed to some type of severe neck injury (Larsen et al., 1995).

Vertebral Apophyseal Facet Remodeling

The apophyseal facets of the vertebral column are synovial joints that link the vertebrae together and give them flexibility to move against each other. Apophyseal facet remodeling occurs when one or more vertebral facets become enlarged, or when facet margins become indistinct (Derevenski, 2000). Among the human remains from the Pierhead and Fontabelle burial grounds, facet remodeling was observed in most frequently in the cervical spine, but also present in the thoracic and lumbar regions. The facet joints of the lower cervical vertebrae (C4-C6) typically share physical load with the intervertebral disc equally, except in large axial loading, when
they are increasingly responsible for maintaining the stability of the spine (Teo and Ng, 2001). Cervical facet joints also play a dominant role in resisting large flexion and extension movements (Teo and Ng, 2001). Thoracic facet joints play a major role in resisting flexion and extension, but they are less involved in axial loading. These facets can become damaged with excessive amounts of rotation and extension. Lumbar facets become increasingly responsible for carrying compressive axial loads during prolonged periods of standing and can also be damaged with excessive torsional and extension movements.

Apophyseal facet remodeling and subsequent degeneration in the form of articular surface pitting and lipped margins is less common than vertebral osteophytosis, and seems to occurs most frequently in the mid cervical and upper to mid thoracic vertebrae (Jurmain and Kilgore, 1995). Degeneration occurs most frequently in these areas, and especially between the seventh cervical and the first thoracic, because these areas are most subject to stress movements reducing or accentuating the vertebral curvatures (Derevenski, 2000).

Derevenski (2000) evaluated the presence of apophyseal facet remodeling, osteoarthritis of the apophyseal facets, and osteophytosis of the vertebral bodies among 51 individuals from the 16-19th century archaeological site of Ensay and 59 individuals from the medieval site of Warram Percy in the United Kingdom. According to this study, the presence of apophyseal facet remodeling seemed to coincide with particular activities documented in historical and ethnographic literature (Derevenski, 2000).
At Ensay, historical and ethnographic data indicate that there was a strict sexual division of labor. Women were responsible for domestic tasks, and performed the majority of heavy-lifting activities while men were responsible for most of the outdoor agricultural work (Derevenski, 2000). As the terrain of this area was rocky and steep, most agricultural and heavy lifting activities were done manually, rather than with the help of draft animals (Derevenski, 2000). The women at Ensay carried heavy loads (as much as 80 lbs.) of peat and seaweed for fuel and fertilizer in baskets known as creels (Derevenski, 2000). These creels were “large baskets supported by a woven strap across the breastbone and around the shoulders, with the weight resting on a “dronnag”, or creel pad just above the pelvis” (Derevenski, 2000: 335).

In contrast to Ensay, ethnographical and historical sources do not document a strong sexual division of labor for Wharram Percy (Derevenski, 2000). Although the men here were more likely to perform heavy lifting tasks and women dominated in domestic work, both sexes were involved in agricultural labor and heavy lifting activities (Derevenski, 2000). The women from Wharram Percy were not known to have used the creels used by the Ensay women. Furthermore, the steep and rocky terrain of the Ensay site did not characterize the environment of this area, and draft animals were therefore used more frequently (Derevenski, 2000).

Derevenski (2000) found that while 23 of the 28 females analyzed from the Ensay site displayed facet remodeling, this remodeling only took place in 16 of the 28 females from the Wharram Percy site. This difference is statistically significant and may be related to the Ensay women’s role in heavy lifting and use of the creel (Derevenski, 2000). Among those individuals affected by facet remodeling at
Wharram Percy, the males showed more involvement than the females, which may be related to the male role in heavy lifting and agricultural work (Derevenski, 2000). Facet remodeling in these skeletal samples was most common in the thoracic region of the spine (Derevenski, 2000). This contrasts with the apophyseal facet remodeling observed in the urban Harappan individuals, which occurred most frequently in the cervical region (Lovell, 1994).

**Musculoskeletal Stress Markers**

Entheses are the attachment points between bone and muscles. While many bioarchaeologists use the term ‘enthesopathy’ to describe bone hypertrophy or lesions at attachment sites resulting from physical activity, ‘pathy’ specifically refers to inflammatory or infectious processes. It has been suggested that the term ‘musculoskeletal stress marker’ (often abbreviated as MSM) be used instead of enthesisopathy when discussing the relationship between attachment site morphology and activity, as a means to distinguish normal adaptive responses from pathological conditions (Nangy, 2000; Molnar, 2006). Therefore, this thesis will use the term ‘musculoskeletal stress markers’ to denote bone hypertrophy or lesions at attachment sites.

Using musculoskeletal stress markers as evidence of physical activity also relies on the idea of bone functional adaptation. There is some indirect evidence that external force to bone will induce periosteal bone cell proliferation, and that abnormally strong and frequent muscle contractions may increase blood flow to periosteal bone (Zumwalt, 2006). However, it is not clear as to whether MSM’s
reflects activity occurring shortly before death or throughout the individual’s lifetime
and if it is dependant upon the type of muscle activity or the individual’s skeletal
maturity status (Zumwalt, 2006). The degree to which muscle site attachments
respond to external load and the influences of sex, age, genetics, and diet are poorly
understood (Zumwalt, 2006). However, there is some indication that physical activity
occurring in subadult individuals will have important influences on lifelong skeletal
health (Warden et al., 2004). This may explain the correlation between bone
hypertrophy and physical activity found in clinical studies of elite athletes, who
typically begin activity before full maturation (Jurmain, 1999; Calbert et al., 2001).
Although muscle markings do increase with age (Weiss, 2004), they are probably
largely influenced by the age of onset of strenuous physical activity.

In terms of sex, males tend to have a higher frequency of musculoskeletal
stress markers than females (Weiss, 2003). While this has often been assumed to
represent sexual division of labor, Weiss (2003) has found that when males and
females are controlled for body size, there is no real difference in male and female
muscle insertion morphology. Therefore, the increased prevalence of MSM’s in men
may simply be a product of their overall larger body size (Weiss, 2003).

MSM’s cannot be used to determine the specific activities an individual was
engaged in (Robb, 1998). Correlation with a specific activity is difficult because
muscle insertion sites are morphologically complex and difficult to observe
consistently, most muscle groups respond to a mosaic of biomechanical stress, and
the skeleton registers many different activities performed at different times in an
individual’s life (Robb, 1998). Rather than try to pinpoint specific activities using
musculoskeletal stress markers, it is more appropriate to focus on the general patterns of involvement within a particular skeletal population (Robb, 1998). Musculoskeletal stress markers can be used to demonstrate that an individual had engaged in some form of strenuous labor and will indicate the particular anatomical regions experiencing increased stress (Kennedy, 1989).

It is possible that since the lower limbs experience more weight bearing than the upper limbs, attachment site morphology in these regions may be more reflective of body size than physical loading (Weiss, 2004). In a study of lower limb muscle insertion morphology, Weiss (2004) analyzed the femoral attachments of the *gluteus maximus* and *gluteus medius*, *adductor magnus*, *vastus intermedius*, *vastus medialis*, *piriformis*, *gluteus minimus*, *obturator externus*, *quadrate femoris*, *popliteus*, *vastus lateralis*, *gastrocnemius*, *iliacus*, and *pectineus*. For tibial insertions, the *soleus*, *popliteus*, *semimembranosus*, *tibialis posterior*, *flexor digitorum*, and *tibialis anterior* were considered (Weiss, 2004). These particular insertion sites were designated because they are clearly identifiable and have been used in previous literature regarding lifestyle reconstruction (Weiss, 2004). This study included skeletal remains from 57 males and 20 females from Native British Columbians (3,500-1,500 years BP) and 18th century Quebec prisoners ranging from 18-69 years old (Weiss, 2004). Weiss (2004) scored these muscle insertion sites according to the standards formulated by Hawkey and Merbs (1995). In this study, it was shown that while age was the greatest predictor of musculoskeletal stress markers, body size only correlated with MSM’s in males (Weiss, 2004). The difference between males and
females show that about half this difference was related to body size, and half to activity patterns (Weiss, 2004).

Hawkey and colleagues (Hawkey 1988; Hawkey and Merbs, 1995) have formulated ordinal scales to score MSM’s. While this scoring system has been used in a number of other studies and is useful for describing complex morphologies, age, sex, and body size should be considered in comparative analyses (Wilczak and Kennedy, 1998). Rather than using MSM scores to compare the activity levels of different individuals or skeletal populations, it may be more accurate to compare these scores for different muscle attachment sites in the same individual (Wilczak and Kennedy, 1998). This type of comparison will indicate what region of an individuals’ body was placed under increased stress, which may aid in behavioral interpretations.

Hawkey and Merbs’ classification scheme was based upon human remains from a Thule Eskimo population located in the northwest Hudson Bay region of Canada. This population was relatively genetically homogenous, and subject to unusual environmental conditions which may have influenced muscle insertion morphology (Hawkey and Merbs, 1995). In light of the different environmental conditions experienced by the individuals from the Pierhead and Fontabelle burial grounds and the Thule Eskimos, it can be expected that the severity of muscle insertion site changes will not be as marked among the individuals from Bridgetown.

In scoring musculoskeletal stress markers, Hawkey and associates (Hawkey, 1988; Hawkey and Merbs, 1995) distinguished between robusticity (rough uneven cortical surfaces and distinct ridges or crests), osseous growths (spicules), and stress lesions (lytic-like lesions) and score them separately. Scores range from one (faint) to
three (strong) (Hawkey, 1988; Hawkey and Merbs, 1995). A faint robusticity score entails a slight rounding of the cortical surface without any distinct crests or ridges (Hawkey, 1988; Hawkey and Merbs, 1995). Strong robusticity is classified as distinct crests and ridges, often accompanied by a slight depression (not extending into the cortex) between ridges (Hawkey, 1988; Hawkey and Merbs, 1995). A faint stress lesion is characterized by shallow lytic-like furrows into the cortex that measures less than one millimeter deep (Hawkey, 1988; Hawkey and Merbs, 1995). Strong stress lesions are characterized by a lytic-like lesion more than three millimeters deep, and more than five millimeters in length (Hawkey, 1988; Hawkey and Merbs, 1995). A faint ossification score indicates a slight exostosis that is usually round in appearance and extends less than two millimeters from the surface of the cortex (Hawkey, 1988). A strong ossification score indicates an exostosis that extends more than five millimeters from the cortical surface, or covers an extensive amount of the cortical surface (Hawkey, 1988).

Previous Biocultural Studies of Slavery

In order to place the analysis of the Pierhead and Fontabelle individuals within the larger context of human labor, comparative studies will be useful. By comparing patterns of occupational stress markers between individuals and skeletal populations, it may be possible to enhance our understandings of the diversity of past activities and labor practices. While evaluating the severity of occupational stress markers to discuss variations in physical strain may be difficult to verify in light of potential
systemic influences (age, sex, body size, and genetics), these kinds of analyses are still widely used by bioarchaeologists. Tentative conclusions drawn from comparative analyses are acceptable because the exact relationship between systemic factors and occupational stress markers remains unknown, and many factors such as age, sex, and body size can be controlled for. Furthermore, comparative studies provide the only means of placing skeletal analyses within the larger context of history.

In order to place the Pierhead and Fontabelle individuals within the larger framework of slave labor, comparisons with human remains of enslaved Africans in other contexts are necessary. While bioarchaeological investigations of slavery are not plentiful, the following studies provide a starting point in which to generate hypotheses about the relationship between the Bridgetown regime and other slave regimes throughout the Americas.

**African Burial Ground Manhattan, New York**

The African Burial Ground Project excavated 419 burials representing enslaved as well as free African Americans from 18th century Manhattan, New York. Of these 419 individuals, 187 were suitable for analysis of occupational stress (Wilczak et al., n.d.). Only adults older than 15 years were analyzed for stress markers, ensuring the influence of normal bone growth remodeling would not affect results and stress markers would be given adequate time to form within the skeleton (Wilczak et al., n.d.). In total, 98 males and 78 females were represented, with the largest age bracket for both sexes being the 35-49 year old range. A fairly large
proportion of the youngest age group had moderate to severe degenerative changes throughout the entire skeleton (Wilczak et al., n.d.). This led the authors to feel confident that the bony changes observed were the result of occupational stress, rather than the natural aging process.

Thirty-four males and twenty-nine females between the ages of 25-49 years from this sample displayed evidence of degeneration in the vertebral apophyseal facets in at least one region of their spine (Wilczak et al., n.d.). In terms of vertebral osteophytosis, this was present in at least one vertebral region for 23 males and 21 females (Wilczak et al., n.d.). The cervical region was the most commonly affected by osteophytosis for all age brackets (Wilczak et al., n.d.). For both vertebral osteoarthritis and osteophytosis, there were no sex differences in distribution. Additionally, 60% of those individuals with cervical osteophytosis also displayed at least moderate cervical osteoarthritis (Wilczak et al., n.d.). These authors assert that osteoarthritis of the apophyseal joints is most closely associated with bending and rotation stress, while osteophytosis of the vertebral bodies is most commonly associated with compressive stress (Wilczak et al., n.d.). The correlation between these two conditions may indicate these individuals were involved in the rotation and bending of the neck, as well as compressive loading. This could potentially be indicative of carrying heavy loads upon the head and or shoulders (Wilczak et al., n.d.). As there were no sex differences in frequency of these conditions, both males and females were equally subject to repetitive and severe stress of the neck (Wilczak et al., n.d.).
In the upper limb, 22 females and 43 males had osteoarthritis in at least one of the joints or joint complexes (Wilczak et al., n.d.). While females had the highest incidence of wrist osteoarthritis for the 25-49 year old age bracket, males had the highest incidence of elbow involvement (Wilczak et al., n.d.). The shoulder joint was least affected for both sexes, and the greatest frequency difference between males and females occurred at the elbow (Wilczak et al., n.d.). In the lower limb, evidence of osteoarthritis in at least one joint or joint complex was observed in 40 females and 58 males. There was a higher frequency of osteoarthritis in the lower limbs than in the upper limbs for both males and females, and the ankle represents the most affected lower region for both sexes (Wilczak et al., n.d.).

There were significant differences in musculoskeletal stress markers between males and females (Wilczak et al., n.d.). Males had a greater average of MSM’s per individual than females. There was also evidence of early onset, as MSM’s were present in individuals as young as 15-24 years (Wilczak et al., n.d.).

In the lower limb, musculoskeletal stress markers were most frequent and severe at the linea aspera and gluteus maximus (Wilczak et al., n.d.). In the upper limb, MSM’s were most frequent and severe at the attachment points for the deltoideus, pectoralis major, latissimus dorsi, supinator, finger flexors, lateral scapula, and costoclavicular ligament (Wilczak et al., n.d.).

Although sex differences in occupational stress are not common for this sample, they did occur. The slightly higher frequencies of elbow osteoarthritis and musculoskeletal stress markers at the biceps brachii, pectoralis major, latissimus dorsi, and teres minor attachments in males are associated with carrying and lifting
heavy loads (Wilczak et al., n.d.). The higher incidence of knee osteoarthritis and the higher frequency of musculoskeletal stress markers at the costoclavicular ligament, supinator and brachialis insertions in the females has been associated with repetitive kneeling and bending, as well as the back and forth motions and forearm supination (Wilczak et al., n.d.). It is possible that these patterns suggest increased heavy lifting tasks among the males, and increased household tasks (involving bending and kneeling) among the females (Wilczak et al., n.d.).

South Carolina Plantation

Human remains excavated near Charleston South Carolina provide a means of comparison between urban and rural regimes. These human remains were associated with a plantation population of enslaved individuals from the years between 1840-1870 (Rathbun, 1987). Occupational stress markers were measured for the entire adult skeletal population. There were a total of 28 individuals analyzed, 13 of them being males, and 15 of them being females (Rathbun, 1987). The average age at death of these individuals was 35 years for males, and 40 years for females (Rathbun, 1987). Due to the relative young age of this sample, degenerative joint changes were assumed to represent occupational stress, rather than the natural aging process (Rathbun, 1987).

Evidence of degenerative joint changes was noted for every adult individual in this sample. Of particular frequency were changes associated with the shoulders, hips, and lower vertebrae (Rathbun, 1987). Unlike the African Burial Ground
individuals from New York, the majority of vertebral degenerative changes occurred in the lumbar region, and was associated with heavy lifting and carrying.

The New York and South Carolina individuals were similar in that degenerative changes of the elbow were more common in males, and knee degeneration more common in females. Despite these similarities, the extent of sexual variation is much higher among the South Carolina plantation individuals. In addition to the higher frequency of elbow degeneration among South Carolina males, there was also a greater frequency of hip degeneration, and double the occurrence of Schmorl’s nodes or herniation of the intervertebral disks in the lumbar region (Rathbun, 1987). Males were also twice as likely to display musculoskeletal stress markers at the insertion site for the supinator on the ulna (Rathbun, 1987). The presence of this type of occupational stress is related to the marked medial rotation of the forearm, and can occur in many agricultural pursuits including hoeing and wood chopping (Rathbun, 1987). In addition to the knee, females had a higher rate of shoulder degeneration than males (Rathbun, 1987).

When the presence of degenerative changes is compared between the urban New York individuals and the rural South Carolina individuals, some important differences can be highlighted. Whereas degenerative changes of the shoulder and hip were lowest among the New York individuals, this represented the highest frequency of degeneration in the South Carolina individuals. Possibly the greatest variation between these two samples is the difference in the sexual distribution of degenerative changes. While the frequency of degenerative changes in the cervical and lumbar vertebrae did not differ in males from the South Carolina plantation,
degenerative changes among the females from this group were twice as common in the cervical region as they were in the lumbar region (Wilczak et al., n.d.). As the New York individuals did not vary by sex in vertebral degenerative changes, this may reflect a greater variation in heavy load carrying between the males and females among the South Carolina individuals (Wilczak et al., n.d.). Additionally, the patterns of degenerative changes are more varied among the New York individuals than they are among the South Carolina individuals. While this could be related to the differences in sample size, it is also possible that it is a reflection of the different slave regimes. Whereas urban regimes tended to encompass a variety of different tasks, the labor associated with plantations revolves almost entirely around agricultural pursuits of a specific crop (Wilczak et al., n.d).

Cactocin Furnace, Maryland

Excavations at the Cactocin Furnace ironworks factory in Frederick County, Maryland uncovered the human remains of 31 enslaved individuals working during the late 18th and early 19th century (Kelley and Angel, 1983). The majority of occupations at the Cactocin Furnace were those involving skilled labor (Kelley and Angel, 1983). Some possible occupations performed here included coaling ground colliers, ore bank excavators, furnace and forge operators, wagoners, carpenters, smiths, watermen, woodchoppers, coopers, farm hands, and cooks (Kelley and Angel, 1983). The presence of musculoskeletal stress markers was more common among the adult males than the adult females, which led the authors to conclude that the heaviest, most demanding labor was reserved for enslaved men (Kelley and Angel,
Musculoskeletal stress markers were observed in both the youngest male (aged 19 years) and the youngest female (aged 18-19 years) (Kelley and Angel, 1983). There were eight adult females ranging in age from 18-54 years, and four displayed clear evidence of occupational stress (Kelley and Angel, 1983). The occupational stress present among these four females included osteoarthritis of the shoulder, hip, ankle, and the thumb, as well as musculoskeletal stress markers of the supinator crests and scapula (Kelley and Angel, 1983).

Eight adult males were represented in the Cactocin Furnace human remains, and they ranged in age from 19-65 years (Kelley and Angel, 1983). Unlike the female adults, every single male displayed MSM’s (Kelley and Angel, 1983). These lesions were visible for the deltoideus, supinator, and gluteal crests, as well as the pectoralis major, teres major and teres minor muscle insertions (Kelley and Angel, 1983). Osteoarthritic conditions were noted for the knee, elbow, thumb, as well as the cervical and lumbar vertebrae (Kelley and Angel, 1983).

The upper extremities of the Cactocin individuals displayed the most frequent signs of occupational stress, which is more similar to the rural plantation population than the urban individuals from New York. Patterns of sexual division of labor were also similar between the South Carolina and Maryland individuals. The preponderance of upper limb and vertebral involvement may be related to the heavy lifting, carrying and holding necessary in iron extraction and processing (Kelley and Angel, 1983).
CHAPTER III

MATERIALS AND METHODS

Skeletal Remains

Pierhead Sample

The human skeletal remains from the Pierhead individuals are housed at the University of the West Indies, under the charge of Dr. Karl Watson. The only complete skeleton from the Pierhead burial ground is Individual PH1, a female aged between 22-30 years. This individual was previously sexed and aged by Crain et al. (2004), using the guidelines outlined in Buikstra and Ubelaker (1994). For Individual PH1, C1-L5 was present, as well as the right and left clavicles, scapulae, humeri, radii, ulnae, femora and tibiae. The sex of this individual was determined using the greater sciatic notch, cranial features, and measurements of glenoid cavity of the scapula, the humeral head, and the femoral head (Crain et al., 2004). While the measurements of the glenoid cavity, humeral head and femoral head fell into the indeterminate range, all other features indicated a female. The age of Individual PH1 was determined by tooth eruption, suture closures of the cranium, features of the sternal rib end, features of the auricular surface, and epiphyseal fusion (Crain et al., 2004). All of these characteristics, when taken together, indicated that Individual PH1 died between the ages of 22-30 years.
Fontabelle Sample

The individuals from the Fontabelle section are housed at the Barbados Museum and Historical Society and under the charge of Mr. Kevin Farmer. From the Fontabelle burial ground, a female aged between 20-30 years, two females aged between 30-50 years, a female between the ages of 35-44 years, and a male aged 40-50+ years are complete enough for occupational stress analysis. These individuals were previously aged and sexed by Crain et al. (2004) using the standards outlined by Buikstra and Ubelaker (1994).

Individual 30bu72 is a male aged 40-50+ years. The skull, the left and right humerii, the left femur, and the left tibia represented this individual. The sex of Individual 30bu72 was determined using cranial features including the nuchal crest, mastoid process, supra-orbital margin, glabella, and a zygomatic root extending past the auditory meatus (Crain and Smith, 2004). The endocranial and ectocranial sutures were used to estimate the age at death of this individual. These sutures ranged from significant closure to complete fusion, indicating that this man was older than 45 years at the time of his death (Crain and Smith, 2004).

Individual 30bu89 is a female aged between 30-50 years at the time of death (Crain and Smith, 2004). The skull, ribs, five cervical vertebrae, nine thoracic vertebrae, and four lumbar vertebrae represented this woman. The sex of Individual 30bu89 was estimated using the nuchal crest, mastoid process, supra-orbital margin and supra-orbital ridge of the cranium (Crain and Smith, 2004). In addition, the small mental eminence and sloping ascending ramus of the mandible, the non-sloping forehead and overall gracility of the skull are also features associated with females.
Most of the sutures of this female’s skull were fused, indicating an individual over the age of 40 years (Crain and Smith, 2004). The third molar was completely erupted and displayed moderate wear (Crain and Smith, 2004). There was also moderate wear present on the second molar, and significant wear of the first molar (Crain and Smith, 2004). These dental characteristics indicate an individual in their late 20’s to early 30’s, if not older (Crain and Smith, 2004). The sternal rib ends display features characteristic of an individual between their mid 30’s to mid 50’s (Crain and Smith, 2004). Taking all of these variables into account, the estimated age at death for this female was between the ages of 35-50 years (Crain and Smith, 2004).

Individual 30bu85 is a female who was aged between 25-40 years at the time of her death. The skull, ribs, right clavicle, five cervical vertebrae, seven thoracic vertebrae, and five lumbar vertebrae represented this woman. The sex of Individual 30bu85 was estimated using the nuchal crest, mastoid process, supra-orbital margin, and supra-orbital ridge of the cranium (Crain and Smith, 2004). The overall gracility of the skull, along with the above mentioned features all displayed characteristics associated with females. In addition, the os coxae displayed wide sciatic notches and well defined and developed prearicular sulci, which are also characteristic of the female sex (Crain and Smith, 2004). The age of this woman was determined using dental eruption and wear, rib end morphology, suture closure, fusion of epiphyses, and features of the auricular surface of the os coxae (Crain and Smith, 2004). Both the upper and lower third molars of this woman were erupted, indicating an individual over the age of 21 years (Crain and Smith, 2004). Moderate wear was also observed for most of the teeth present for this individual (Crain and Smith, 2004). This woman
displayed completely fused medial clavicle epiphyses indicating an individual of 24 or more years. However, her ectocranial sutures were not fused, which is often associated with younger adults (Crain and Smith, 2004). Taking these characteristics together, the age at death for Individual 30bu85 was estimated between 25 and 40 years (Crain and Smith, 2004).

Individual 30bu61 is a female who was aged between 35-44 years at the time of her death, although the associated skeletal remains represented at least two individuals (Crain and Smith, 2004). Two sets of vertebral bodies could be separated as belonging to two different individuals because of the marked difference in size. The larger set of vertebrae was consistent in size with the left and right os coxae, a large humeral head and robust diaphysis, the proximal end of a right radius, a left radius fragmented into two portions, a right mastoid process, and a portion of a right mandible. Therefore, these skeletal elements are assumed to belong to a single individual. The very small adult vertebrae are consistent with a very gracile right radius, indicating these skeletal elements most likely belonged to another single individual.

The greater sciatic notches of both the left and right os coxae and the small size of the mastoid process in relation to the corresponding auditory meatus are suggestive of the female sex (Crain and Smith, 2004). The portion of the right mandible includes an erupted third molar, indicating an individual over the age of 21 (Crain and Smith, 2004). The auricular surfaces of both the left and right os coxae display features characteristic of individuals between the ages of 35-44 years (Crain and Smith, 2004). The smaller vertebrae and gracile right radius could not be used to
determine the age or sex of the second individual represented in these human remains. Therefore, Individual 30bu61 will be used to denote the larger individual, and the smaller remains will not be examined for markers of occupational stress.

Individual 30bu94 is a female who was aged in her mid 20's to mid 30's. The cranium, a left humerus, and both the left and right radii, ulnae, femora and tibiae represent this individual. The sex of this woman was estimated using the supra-orbital margin, supra-orbital ridge, nuchal crest, mastoid process, and mental eminence of the cranium. Overall, the skull of this individual was gracile and the ascending ramus of the mandible was sloping (Crain and Smith, 2004). All of the cranial features observed displayed characteristics most commonly associated with the female sex. The age of death for Individual 30bu94 was estimated using epiphyseal fusion, tooth eruption, and cranial sutures (Crain and Smith, 2004). The overall fusion of the long bones suggests that this female was older than 18 years (Crain and Smith, 2004). The eruption of the left third molar and the missing right molar with alveolar resorption suggests an individual in their mid 20’s (Crain and Smith, 2004). The observable sutures displayed the beginnings of some fusion, indicating an individual most likely in their young to mid adult years (late 20’s to mid 30’s) (Crain and Smith, 2004). When these features are considered together, it is likely that this woman died sometime in her 20-30th year (Crain and Smith, 2004).
Vertebral Osteophytosis

Each vertebral body was evaluated macroscopically under strong light according to the ordinal scale outlined by Buikstra and Ubelaker (1994). In this scale, osteophytosis is scored based upon the level of development of osteophytes and the circumference affected (Buikstra and Ubelaker, 1994). These categories include marginal lipping that is barely discernable, an elevated ring, curved spicules, or fusion (Buikstra and Ubelaker, 1994). For examples of osteophyte development, see figure 2. The circumference effected by the greatest expression of osteophyte development is classified as either 1/3 of the total circumference or less, between 1/3 –2/3, or greater than 2/3 (Buikstra and Ubelaker, 1994).

![Figure 2. Vertebral Osteophyte Scoring Gradient](image)

Figure 2. Vertebral Osteophyte Scoring Gradient (severe stage of fusion is not shown). A- normal vertebral body. B-elevated ring representing faint or slight expression. C- curved spicules representing moderate expression (upward curve). D-curved spicules representing moderate expression (downward curve).

Anterior Wedge Compression Fractures of the Vertebrae

Among the Pierhead and Fontabelle human remains, wedge compression fractures were present only in the cervical vertebrae. Using digital calipers, wedge
compression was determined by measuring the anterior and posterior vertebral body heights at the midpoints. To determine the severity of anterior wedge compression, Genant et al. (1993) suggests adding the posterior and anterior heights and then dividing this sum by the posterior height to calculate the percentage of anterior height reduction. This scoring classification is outlined in figure 3.

![Figure 3](image_url)


**Vertebral Apophyseal Facet Remodeling**

Apophyseal facet remodeling in the Pierhead and Fontabelle human remains was examined under strong light and scored using an ordinal scale developed by Derevenski (2000). This scale ranges from zero to three, with zero indicating no remodeling and three indicating extensive remodeling (Derevenski, 2000). Derevenski’s (2000) scoring method is illustrated in figure 4. A zero score indicates no remodeling, where the superior facet has sharply defined margins, the laminal groove is clearly visible, and the articular process is separated from the transverse process (Derevenski, 2000). A score of zero for the inferior articular facet indicates distinct margins that do not rest on the lamina of the succeeding vertebra (Derevenski, 2000). Stage One indicates an indistinct inferior margin of the superior facet with
increased surface area extending onto the lamina or into the laminal groove (Derevenski, 2000). A Stage One classification for the inferior facets occur when the margin rests on the lamina of the succeeding vertebra, has a rounded appearance, and may be eburnated (Derevenski, 2000). Stage Two remodeling is the same as Stage One, except a bony shelf on the lamina of the succeeding vertebra accompanies the extension of the inferior facet of the proceeding vertebra (Derevenski, 2000). Stage Three remodeling indicates a superior facet margin that is bent over and rounded in an anterior direction, and the bony shelf characteristic of Stage Two extends further down the lamina and outwards onto the transverse process of the succeeding vertebra (Derevenski, 2000). In extensive remodeling, the superior facet margin is bent over and rounded in an anterior direction (Derevenski, 2000). Additionally, a bony shelf on the lamina of a succeeding vertebra is present, extends outward to the transverse process, and accompanies the extension of the inferior facet of the proceeding vertebra (Derevenski, 2000).

Figure 4. Vertebral Apophyseal Facet Remodeling Scoring Gradient. A- normal facets. B- Stage One remodeling. C- Stage Two remodeling. D- Stage Three remodeling. (See text for details). Redrawn after Derevenski (2000).
Musculoskeletal Stress Markers

The anatomical sites of muscle insertions in the Peirhead and Fontabelle individuals were viewed macroscopically under strong light. All necessary measurements were taken in millimeters using digital calipers. The sites scored included the trapezoid and conoid ligament insertions on the clavicle (see fig. 5), the deltoideus, coracobraclhalis, teres major and pectoralis major insertions on the humerus (see fig. 6), the biceps brachii (see fig. 7 I), supinato (see fig. 7 II), and pronator teres (see fig. 7 II) insertions on the radius, the triceps brachii (see fig. 8) insertion on the ulna, the linea aspera (see fig. 9) of the femur (insertion site for the adductor muscles), the insertion site for the popliteus (see fig. 10 II) on the tibia, and the origins of the soleus (see fig. 10 II) and tibialis anterior (see fig. 10 I) muscles on the tibia.

Due to differential preservation, not all of these features were scored for every individual analyzed from the Pierhead and Fontabelle burial grounds.

![Figure 5. Muscle Insertions on the Clavicle (Inferior aspect of the left clavicle, anterior is up). A- conoid ligament insertion. B- trapezoid ligament insertion. Redrawn after Gray (1985).](image-url)


Figure 8. Muscle Insertions on the Ulna (Left ulna, posterior aspect). A- insertion for the triceps brachii muscle. Redrawn after Gray (1985).
A faint robusticity score entails a slight rounding of the cortical surface without any distinct crests or ridges (Hawkey, 1988; Hawkey and Merbs, 1995).

Moderate robusticity score includes not only a rounded, uneven cortical surface, but also the formation of distinct ridges (Hawkey, 1988; Hawkey and Merbs, 1995).

Strong robusticity is classified as distinct crests and ridges, often accompanied by a
A faint stress lesion is characterized by shallow lytic-like furrows into the cortex that measures less than one millimeter deep (Hawkey, 1988; Hawkey and Merbs, 1995). A moderate stress lesion includes lytic-like lesions between one and three millimeters in depth, and usually less than five millimeters in length (Hawkey, 1988; Hawkey and Merbs, 1995). Strong stress lesions are characterized by a lytic-like lesion more than three millimeters deep, and more than five millimeters in length (Hawkey, 1988; Hawkey and Merbs, 1995). Stress lesions gradients are illustrated in figure 12.
A faint ossification score indicates a slight exostosis that is usually round in appearance and extends less than two millimeters from the surface of the cortex (Hawkey, 1988). A moderate ossification score is characterized by a distinct exostosis that is varied in shape and extends between two and five millimeters from the surface of the cortex (Hawkey, 1988). A strong ossification score indicates an exostosis that extends more than five millimeters from the cortical surface, or covers an extensive amount of the cortical surface (Hawkey, 1988). Ossification gradients are illustrated in figure 13.

CHAPTER IV

RESULTS

Pierhead Results

**Individual PH1**

Moderate apophyseal facet remodeling (Stage One) was present on the right facets of both the atlas (C1) and axis (C2) of Individual PH1. The right facets had an increased surface area, and the margins of C2 were indistinct. An extended bony protrusion was present on the right superior facet of C3, representing moderate remodeling (Stage One). Moderate facet remodeling was present in the form of increased surface area at the right superior and inferior facets of C4. There was no facet remodeling observed at C5. Increased surface area and indistinguishable margins for the superior right articular facet of C6 indicated moderate remodeling. The right articular facet of C7 had indistinguishable margins, indicating moderate remodeling. Anterior wedge compression was observed at C3-C7, and these results are presented in table 1.

The facet remodeling of Individual PH1’s cervical vertebrae in combination with the presence of anterior wedge fractures may be an indication that she frequently carried loads upon her head. Jurmain (1999) has asserted that asymmetrical facet remodeling most likely results from trauma rather than chronic wear and tear.
Carrying heavy burdens upon the head would require an equal load distribution in order to avoid injury, and therefore, changes from chronic wear and tear would be expected to follow a symmetrical pattern. Therefore, the asymmetry of facet remodeling in Individual PH1 may indicate that she experienced some type of trauma while carrying loads upon the head.

<table>
<thead>
<tr>
<th>Vertebrae</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
</tr>
</thead>
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<td>10</td>
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<td>12</td>
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<tr>
<td>Posterior Height (mm)</td>
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<td>14</td>
<td>14</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Percent Reduction in anterior height</td>
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<td>36%</td>
<td>29%</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Grade</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Mild</td>
<td>Mild</td>
</tr>
</tbody>
</table>

Table 1- Cervical Wedge Compression Fractures, Individual Ph1.

In Levy (1968) and Schers’ (1978) study of cervical injuries in African porters who carried heavy loads upon the head, injury most frequently resulted from a slip or fall which resulted in unequal load distribution. Although many of the individuals studied by Levy (1968) and Scher (1978) experienced neurological damage, the loads they carried frequently exceeded 200 pounds. While the anterior compression fractures and asymmetrical facet remodeling in Ph1’s cervical spine likely indicate she carried loads upon her head approaching her body weight and experienced some type of trauma while carrying a load, the probability of neurological damage is low. The
lesions observed in Individual PHI's cervical spine were moderate, and one would expect severe lesions had neurological damage occurred.

Moderate facet remodeling was present at T1 for all facets on the left side. Osteophytosis was present at T1 in the form of bony growths extending from the right anteriolateral margin. These bony projections covered less than 1/3 of the circumference. Due to preservation, all articular facets of T2 could not be measured. Therefore, it was not possible to determine if remodeling had taken place. There were no indications of facet remodeling or osteophytosis at T3-T5. T6 displayed osteophytosis in the form of slightly curved spicules extending from the right anteriolateral margin. This lipped curving extended over less than 1/3 of the vertebral body circumference. T7-T9 displayed osteophytosis on the right anteriolateral sides in the form of lipping with slightly curved spicules (see figure 14). At T8, osteophytosis was also present at the inferior margin on the right anteriolateral aspect. This expression was more marked than on the superior margin, with more pronounced lipping and curved spicules. For T7-T9, osteophytes extended over about 1/3 of the circumference. T10 displayed osteophytes in the form of an elevated ring, with minimal curving. These osteophytes were found on both the lateral sides and extended from 1/3 to 2/3 the circumference. T11 was fragmentary, but displayed osteophytes in the form of an elevated ring extending about 2/3 of the circumference. T12, also fragmentary, did not display any signs of osteophytosis.

The thoracic region of the spine is largely responsible for rotational movements and supporting the shoulder girdle. Therefore, the observation of
osteophytosis in this region of PH1’s spine would be consistent with activities requiring extensive use of the upper extremities.

As to be expected, the most severe expression of osteophytosis in PH1 occurred in the lower thoracic region, where the spinal curvature is furthest from the line of gravity. However, several features suggest that the osteophytosis observed in this woman may reflect activity, rather than the normal aging process and typical stresses of bipedal locomotion. First, she died before her fortieth year, when osteophytosis becomes increasingly common. Second, osteophytosis was more common in the thoracic spine, rather than the lumbar spine where age is believed to exert the most influence. As osteophytosis was not apparent throughout the spine, it is unlikely that systematic factors such as age, genetics, diet, or sex were solely responsible.

Of this woman’s lumbar vertebrae, osteophytes were observed at L1, L3 and L4. The osteophytes at L1 were located at the right anteriolateral aspect in the form of an elevated ring covering less than 1/3 of the circumference. The osteophytes observed at L3 was also an elevated ring extending over less than 1/3 of the
circumference. At L4, the osteophytes were located at the lateral right aspect, and resembled an elevated ring with minimal curved lipping. These osteophytes extended over less than 1/3 the circumference.

The right clavicle of PH1 displayed a hypertrophic crest at the insertion for the conoid ligament and pitting surrounded by bony crest formations at the trapezoid ligament insertion (see figure 15). Although the coracoclavicular ligament complex is not part of Hawkey and associates' (Hawkey, 1988; Hawkey and Merbs, 1995) scoring classification for musculoskeletal stress markers, the well-defined crests and ridges would most likely indicate moderate to strong expression. The attachment for the trapezoid ligament of the left clavicle also displayed hypertrophic formation, although this was more marked than on the right side. Therefore, the robusticity of the left trapezoid insertion was considered strong.

Figure 15. Robusticity of the Coracoclavicular Ligament Complex Insertions (arrows), Individual PH1 (inferior aspect of right clavicle). Anterior is up, proximal towards the left. Scale in centimeters. (Photograph courtesy of Chris Crain).

The coracoclavicular ligament complex is associated with up-and-down motions of the shoulder against resistance. The conoid ligament provides the primary restraint during superior elevation of the clavicle, and the trapezoid ligament acts as a restraint to compression along the axis of the clavicle (Harris et al, 2000).
The right humerus of PH1 displayed slight lipping and bone spur formation at the humeral head near the crest of the lesser tubercle. In addition to this characteristic, the inferior aspect of the glenoid fossa of the scapula displayed porosity. Although this might indicate the beginnings of degeneration of the humeroglenoid joint, this characteristic may instead be indicative of moderate robusticity at the teres major insertion. Following the suggestion of Jurmain (1999), this feature was not used to classify osteoarthritis of the humeroglenoid joint because there was no observed eburnation, and it remains uncertain as to whether it was associated with the joint or the teres major insertion. Using Hawkey (1988) and Hawkey and Merbs (1995) classification, the deltoideus insertion of the right humerus displayed moderate robusticity (a score of 2; see figure 16). This insertion site was marked with roughness and two ridges separated by a depression. The pectoralis major insertion also displayed moderate robusticity in the form of a roughened, uneven and elevated surface, although no distinct crests were observed.

The left humerus of PH1 displayed only slight robusticity (score of 1) at the deltoideus insertion. A slight ridge and a rounded, rough appearance characterized
this insertion, but no distinct crests or depressions were observed. The *pectoralis major* insertion displayed moderate robusticity in the form of an uneven, roughened surface accompanied by a mound-shaped elevation, although there were no distinct crests or ridges. The *teres major* insertion for the left humerus displayed moderate robusticity, as there was a roughened mound formation giving the insertion an uneven appearance. No ridges or crests accompanied these characteristics.

The right radius of PH1 displayed spicule development at the *supinator* muscle insertion (see figure 17), which is not included in the scoring method of Hawkey and associates (Hawkey, 1988; Hawkey and Merbs, 1995). This spicule development extended about one millimeter from the insertion site. This most likely indicates faint expression.

![Figure 17. Spicule Development at the Supinator Insertion of the Right Radius (arrow), Individual PH1. Anteriomedial aspect, medial is to the right. Scale in centimeters. (Photograph courtesy of Chris Crain).](image-url)
The *biceps brachii* insertion of the right radius displayed moderate robusticity in the form of a slight indentation and a roughened rounded appearance. The *pronator teres* insertion displayed faint robusticity in the form of a roughened, uneven surface with slight indentation.

The *biceps brachii* and *pronator teres* insertions of the left radius displayed faint robusticity. The *biceps brachii* insertion displayed a roughened, uneven appearance. The accompanying indentation was only slight, and not surrounded by well-defined margins of bone. The *pronator teres* insertion also had a rough uneven surface with a slight indentation lacking a surrounding crest or well-defined ridges.

The insertion site for the *triceps brachii* on the right ulna displayed a roughened uneven surface accompanied by a clear and well-defined ridge. Therefore, moderate robusticity was observed at this insertion site. The insertion for the *triceps brachii* on the left ulna also displayed moderate robusticity in the form of a roughened uneven surface and well-defined ridge.

The *pectoralis major, deltoideus*, and *biceps brachii* muscles are involved in the flexion of the arm (as in anterior lifting). The *pectoralis major* and *deltoides* are also involved in arm adduction and medial rotation, as is the *teres major*.

The *supinator* and *biceps brachii* are involved in the forced supination of the forearm (as in the combination of twisting and pulling motions), and the *triceps brachii* extends the forearm against resistance.

The femur and tibia of PH1 was very gracile, and no evidence of musculoskeletal stress markers was observed.
There are a number of occupational activities that would potentially result in the patterning of skeletal changes observed in Individual PH1. Extensive use of the upper limbs would occur during a variety of cleaning tasks associated with domestic occupations. However, of the domestic tasks available to women in Bridgetown, the roles of a washerwoman or water carrier might be more consistent with the patterning of involvement for PH1 than occupations such as housemaid or chambermaid. While the transportation of heavy loads would not necessarily be part of the daily requirements of chambermaids or housemaids, it would be consistent with water carrying and washing. Carrying heavy loads of laundry or water containers on the head could potentially result in the cervical changes observed in PH1. Whereas cleaning house would presumably involve frequent bending and kneeling that could potentially result in skeletal changes to the lower limb, washing and water carrying would place a much higher demand on the upper as opposed to the lower extremities. Although impossible to verify, the potential correlation between the skeletal changes of PH1 and the role of a washerwoman or water carrier remains intriguing.

**Individual PH1 Summary**

Individual PH1 was a female aged between 22-30 years at the time of her death. Moderate expressions of occupational related strain were observed throughout her skeleton, excluding the rather gracile lower extremities. The anterior wedge compression fractures of PH1’s cervical vertebrae indicate that she most likely carried heavy loads upon her head. Although anterior wedge compression fractures can result from osteoporosis in young females with estrogen imbalance or calcium
deficiency, it would be unlikely for these systematic factors to result in localized lesions. The asymmetrical apophyseal facet remodeling indicates Individual PH1 may have experienced some type of injury to her neck, possibly from losing her balance and tripping or falling while carrying a load upon her head.

The moderate robusticity of Individual PH1’s upper extremities compared to the gracility of her lower extremities, and the presence of osteophytosis in the thoracic spine, may be consistent with occupations specifically stressful to the upper body. Although washing involves the up and down movements of the arms against resistance and twisting and pulling motions that would be consistent with musculoskeletal stress markers of the coracoclavicular ligament complex and robusticity of the deltoideus, biceps brachii, triceps brachii and supinator muscles, extensive use of the upper limbs is by no means exclusive to this occupation. Furthermore, although both water carrying and washing would require the transportation of heavy loads (possibly upon the head), loads were carried in this manner by enslaved Barbadians performing a wide variety of occupational activities. The occupational activities of a washerwoman or water carrier do seem more conducive to the skeletal lesions observed in Individual PH1 than other common activities among enslaved women in Bridgetown. However, this assertion is impossible to verify and remains speculative.

Although associated with labor carried out in Bridgetown, it is also possible that the skeletal lesions of Individual PH1 are not reflective of her work in the urban regime at all. Given the young age-at-death of this woman and the urban slaveholders preference for female domestics in their twenties through their fifties,
these lesions either developed relatively rapidly (in a span of five to ten years), this woman began work earlier than what has been described in historical sources, or these lesions reflect previous activities not associated with the urban slave regime.

Whether or not skeletal changes are a reflection of childhood stresses, those occurring throughout the course of an individual’s life, or close to the time of death continue to be a subject of much debate (Jurmain, 1999; Zumwalt, 2006). What is clear is that this woman was involved in activities at some point in her life that placed physical strain upon her upper body.

Fontabelle Results

**Individual 30bu72**

The proximal regions of the right and left humeri of Individual 30bu72 were missing, and therefore only the *deltoides* and *coracobrachialis* insertion sites were scored. The *deltoides* insertion of the right humerus displayed moderate robusticity in the form of uneven roughness with distinct tactile ridges. In addition to the robusticity score, strong stress lesions were also observed (a score of three; see figure 18). There were two lytic-like lesions associated with the *deltoides* insertion. One measured 12.34 mm in length, and the other measured 9.06 mm in length. The depth of both these lesions were between two and three millimeters.
The coracobrachialis insertion site is not part of Hawkey (1988) and Hawkey and Merbs (1995) scoring classification. However, this insertion on the right humerus was characterized by roughness and a visible mound shaped elevation, although there were no distinct crests or ridges. Therefore, faint to moderate robusticity was observed at this insertion.

Strong robusticity was observed at the deltoideus insertion of the left humerus (see fig. 19). This insertion site displayed well-developed and distinct ridges with an indentation between them. A stress lesion was beginning to form in this individual, and was scored as faint. This lesion was characterized by pitted furrowing and measured 13.25 mm in length. The lesion was less than one millimeter in depth. Hawkey and Merbs (1995) postulate that stress lesions are the result of abrupt macrotrauma rather than normal wear and tear. These authors hypothesize that stress lesions can result from muscle ruptures (as in an abrupt fall; Hawkey and Merbs, 1995).

The coracobrachialis insertion of the left humerus was scored as moderately robust. There was a roughened, uneven mound-shaped elevation, although no distinct
crests are ridges were present. Both this muscle and the deltoideus are involved in the abduction, medial rotation, and flexion of the arm.

Figure 19. Robusticity at the Deltoideus Insertion of the Left Humerus, Individual 30bu72 (arrow). Lateral aspect is up, proximal aspect is towards the left. Scale in centimeters. (Photograph courtesy of Chris Crain).

The left femur of this male was without the proximal and distal ends. Although Hawkey (1988) and Hawkey and Merbs (1995) do not provide classification schemes specific to the lower limbs, the description of their robusticity and stress lesion scores were applied to these remains. The linea aspera, the insertion site for the adductor muscles, displayed strong robusticity in the form of an elevated ridge with indentation. There was also the beginning of a lytic-like lesion forming at the superior aspect of the linea aspera. This lesion measured 29.60 mm and was not more than one to two millimeters in depth. Therefore, this lesion was classified as moderate. The adductor muscles are involved in pressing the thighs together, and fixing the hip when the knee is flexed and the foot is off the ground.

Strong robusticity was observed at the popliteal line of the left tibia, which is both the insertion for the popliteus and the origin for the soleus. The beginning of a lytic-like stress lesion was also apparent. This lesion measured 38.48 mm in length and was between one and three millimeters in depth. Therefore, this stress lesion was
scored as strong. The *popliteus* muscle flexes and medially rotates the leg, and laterally rotates the thigh while the *soleus* muscle plantar flexes the foot and is important to locomotion. In addition to the popliteal line, the *tibialis anterior* origin, located under the lateral condyle, displayed faint robusticity in the form of a rough, pitted appearance. The *tibialis anterior* is the prime mover of dorsiflexion. Some possible degenerative changes were also noted above the tibial tuberosity in the form of pitting and slight spicule development. Below the tibial tuberosity there is grooving and more spicule development. While these features may be indicative of knee degeneration, the absence of eburnation and the advanced age of this individual indicate that activity-related interpretations may not be possible.

All of the attachment sites of the lower limbs displaying robusticity and stress lesions in Individual 30bu72 are important to walking and running. Therefore, this individual may have been involved in occupational activities that required a great deal of mobility. The fact that this man experienced stress lesions in both the upper and lower limbs may indicate that his occupational activities were very labor intensive, and resulted in trauma experienced while walking and carrying heavy loads in the arms. According to Higman (1984), transport work was the most labor-intensive occupation of enslaved individuals in Bridgetown. While this man may have indeed been a transport worker, his advanced age and increased body size, rather than the intensity of his labor requirements, may be responsible for the increased expression of musculoskeletal stress markers compared to the other individuals.
Individual 30bu72 Summary

Individual 30bu72 is a male who was aged between 40-50+ years at the time of his death. A mixture of moderate and strong robusticity and stress lesions were observed throughout this man’s skeleton, affecting both the upper and lower extremities. While strong expressions were exclusive to the left upper and lower extremities, the absence of the right femur and tibia make it difficult to determine if this pattern is the result of increased use or handedness. This individual is the only person in this analysis displaying evidence of occupational related strain in the lower extremities, and is also the only individual with stress lesions. While this may be indicative of increased labor demands (possibly in transport work) it could equally result from his increased age and body size in relation to the other individuals.

Individual 30bu89

Although the vertebrae of Individual 30bu89 are fragmentary, evidence of facet remodeling and osteophytosis was observed. The atlas (C1) was broken into two pieces, and both superior facets display Stage One (moderate) remodeling in the form of slight lipping and flaring of the facet margins. The fragmentary nature of the rest of the cervical vertebrae made it difficult or impossible to determine the specific location of the spine in which they came from. Three of the five cervical vertebrae present display slight lipping of the posterior superior body margins. Lipping of the inferior posterior body margin was observed at one of these cervical vertebrae in addition to the posterior superior lipping. The remodeling of cervical facets in combination with slight osteophytosis might be indicative of burden carrying upon
the head, although these characteristics are extremely mild when compared with those of Individual PH1. It is quite possible that this lipping and facet remodeling is indicative of age, rather than occupational activities, as this woman was most likely near or past the age of 40 years. The fact that C1 displayed symmetrical facet remodeling excludes the possibility of any distinguishable neck trauma.

Osteophytosis was present in only one of the nine thoracic vertebrae present. This vertebrae is most likely a lower thoracic, but the fragmentary nature made it impossible to distinguish the specific region of the thoracic spine it came from. The osteophytes were curved spicules located at the anteriolateral right side, and extended over about 2/3 of the total circumference (see figure 20).

![Figure 20. Thoracic Osteophytosis (arrow), Individual 30bu89 (Lower thoracic). (Photograph courtesy of Chris Crain)](image)

All of the four lumbar vertebrae present displayed osteophytosis in the form of curved spicules. These osteophytes were located at the anteriolateral right aspect of the superior vertebral body margins, and extended between 1/3-2/3 of the total body circumference. The fact that osteophytosis was most common in the lumbar region
and this woman was an older adult makes any occupational interpretations difficult. However, the relative lack of severe or marked osteophytosis and facet remodeling may indicate that this woman was not involved in occupational activities that produced a high level of physical strain.

**Individual 30bu89 Summary**

Individual 30bu89 is a female who was aged between 30-50 years at the time of her death. The presence of slight to moderate facet remodeling in the cervical vertebrae and osteophytosis throughout the spine, in combination with the increased age of this individual, may be more reflective of her advanced age than occupational activities.

**Individual 30bu85**

The superior facets of Individual 30bu85's atlas (C1) were characterized by lipping, and the left facet displayed Stage One remodeling with increased surface area (see figure 21).

![Figure 21. Cervical Apophyseal Facet Remodeling (arrows), Individual 30bu85. Atlas is on the left, axis on the right. Scale in centimeters. (Photograph courtesy of Chris Crain)](image-url)
The left superior facet of the axis also displayed Stage One remodeling with increased surface area. The rest of the cervical vertebrae were too fragmentary to number. Two cervical vertebrae also displayed Stage One remodeling because the anterior left facets had an increased surface area, and no distinct margins. Due to the fragmentary nature of this woman's vertebrae, it is difficult to determine if the asymmetrical patterning observed in four of her cervical vertebrae was consistent throughout the rest of her cervical spine. Similar to Individual PH1, this patterning (if consistent) may have resulted in some type of neck trauma induced by an unequal load distribution while carrying burdens upon the head (possibly from a slip of the foot or a fall). The moderate expression indicates that this trauma most likely did not result in neurological damage.

Two of the seven thoracic vertebrae could not be examined for facet remodeling or osteophytosis because of their fragmentary nature. One of the lower thoracic vertebrae displayed some remodeling of the facets in the form of pitting, grooving, and crest formations. These characteristics would be consistent with rubbing and shearing stresses resulting from both weight bearing and movement. There were no other indications of facet remodeling or osteophytosis in the other thoracic vertebrae present.

A great deal of facet remodeling was present in the five lumbar vertebrae of this individual. The border of the right superior facet of L1 was marked by an indentation, and it was a great deal larger than the left superior facet, indicating Stage One remodeling (see figure 22). Grooving at the borders also marked the inferior left facet of L2, and it was somewhat smaller than the right inferior facet. The right
superior facet of L3 displayed Stage One remodeling, as it was a great deal larger than the left superior facet. The left inferior facet of L4 also displayed Stage One remodeling, and was larger than the right inferior facet. The superiolateral margin of the right superior facet of L5 had a roughened, bumpy appearance and slight porosity. Lumbar facets are responsible for protecting against excessive tosional and flexion stresses, and are also increasingly responsible for carrying axial compression loads during prolonged periods of standing.

Figure 22. Lumbar Apophyseal Facet Remodeling (arrow), Individual 30bu85. Scale in centimeters. (Photograph courtesy of Chris Crain).

It is possible that this woman was involved in occupational activities that required her to stand for long periods of time while carrying or holding burdens. While this may be consistent with the practices of a huckster or street stall seller, there is no way to verify this interpretation.
Individual 30bu85 Summary

Individual 30bu85 is a female who was aged between 24-34 years at the time of her death. This individual is the only person in this analysis with facet remodeling in the lumbar spine, although remodeling also occurred in the cervical and thoracic regions. Because the lumbar facets become increasingly responsible for resisting axial loading during long periods of standing, it is possible that this woman was engaging in activities that required her to stand for extended amounts of time while carrying or holding loads. Of the female occupations listed in the literature review, this practice would be consistent with selling goods in the marketplace, but could also easily be related to serving in households or a number of other occupations. The relative absence of osteophytosis may be a reflection of reduced physical strain experienced by this individual, but could also equally be the result of her young age.

Individual 30bu61

While human remains of at least two individuals are associated with the catalogue number 30bu61, it has been assumed that the cranium, ilium, left and right radii, left humerus, three cervical vertebrae, 14 portions of the thoracic spine, and five lumbar vertebrae represent one individual. This assumption is based upon the distinct size differences between the human remains associated with this catalogue number. The remains associated with Individual 30bu61 were significantly larger than the other remains, and the size of individual bones corresponded with one another. The other human remains included with this individual are an extremely gracile right radius and seven very small adult thoracic vertebrae. Due to the gracility of this radii
and the small size of the thoracic vertebrae, it is assumed that these human remains are representative of a separate person.

Facet remodeling and osteophytosis was not observed for any of the vertebrae assumed to belong to Individual 30bu61. Therefore, unlike the other females in this sample, this woman probably did not habitually carry heavy loads upon her head, shoulders or back.

The right radius consists of just the proximal region. The left radius is broken into two pieces that can be fitted together, ensuring they are two features of the same bone. The deltoideus insertion of the left humerus is roughened with slight ridges (figure 23). Therefore, this insertion received a moderate robusticity score. As stated earlier, the deltoideus muscle is involved in the abduction, flexion, extension, lateral rotation, and medial rotation of the arm.

![Figure 23. Robusticity at the Deltoideus Insertion of the Left humerus (arrows), Individual 30bu61. Lateral aspect is facing front, the proximal region is towards the left. Scale in centimeters. (Photograph courtesy of Chris Crain).](image)

The biceps brachii insertion of the right radius has a roughened, flattened appearance with a bony ridge margin. This insertion received a moderate robusticity score. The biceps brachii insertion of the left radius also received a moderate
robusticity score, although it appears somewhat more pronounced than the right insertion. The *biceps brachii* is engaged when the elbow is flexed and the forearm is supinated, usually at the same time (as in pulling and twisting motions). The distal region of the left radius had pinpoint porosity and osteophyte formation in the form of a small, lipped ridge. The pinpoint porosity extended over less than 1/3 of the area.

While it is not advisable to classify osteoarthritis without the presence of eburnation, it is possible that this spicule development represents an early stage of this condition and indicates extensive use of the elbow.

Individual 30bu61 did not have osteophytosis or apophyseal facet remodeling, although there is some indication that she was involved in occupational activities that placed physical strain on her upper body. Without her lower limbs, it is not possible to determine if her labor was exclusive to the use of her upper limbs. The absence of osteophytosis, in light of this woman’s age, may indicate that she did not habitually carry heavy loads. It is possible that she was employed as a house or chambermaid, although, again, a number of occupational interpretations are equally plausible. When taken together, the skeletal remains of Individual 30bu61 do not clearly indicate a high level of physical strain.

**Individual 30bu61 Summary**

Individual 30bu61 is a female aged between 35-45 years at the time of her death. Given her age, it is interesting that no evidence of osteophytosis or apophyseal facet remodeling was present, although this could be related to the fragmentary nature of her vertebrae. Moderate expressions of musculoskeletal stress markers were
observed and did not display an obvious preference for one side, although the absence of the right humerus makes it difficult to draw any conclusions from this pattern. Although it is not possible to determine the exact nature of her occupational activities, it would appear that they did not require a great deal of physical strain.

**Individual 30bu94**

The left humerus of Individual 30bu94 does not show any signs of robusticity, stress lesions, or osseous growths. The *pronator teres* insertion site of the right radius also did not display enough robusticity to score. However, the *biceps brachii* insertion displayed faint robusticity in the form of a roughened appearance accompanied by indentation without distinct ridging.

Faint robusticity was observed for the *pronator teres* insertion of the left radius. This insertion site displayed roughness and slight indentation, but was not accompanied by any distinct ridges or crests. The *pronator teres* muscle is involved in pronating the forearm and flexing the elbow. The *biceps brachii* insertion had a roughened appearance and indentation accompanied by slight ridging.

Moderate robusticity was observed for the *brachialis* insertion of the right ulna. This robusticity was characterized by roughness and indentation accompanied by well-defined ridges. The *brachialis* muscle is a major forearm flexor.

The *brachialis* insertion of the left ulna displayed strong robusticity in the form of an indentation surrounded by distinct, well-defined ridges. The presence of strong robusticity at this muscle insertion site may indicate that this woman was
involved in occupational activities that placed more strain on her forearm than the rest of her upper limbs.

The lower limbs of this individual were very gracile, and no robusticity, stress lesions, or osseous growths were observed.

30bu94 Summary

Individual 30bu94 is a female aged between 20-30 years at the time of her death. Unlike the other females in this analysis, the majority of her musculoskeletal stress markers were faint, except for strong robusticity at the insertion of the left brachialis. This woman is the only individual in this analysis with a robust brachialis insertion. However, although this woman was of a similar age to Individual PH1, the robusticity of her upper extremities was decreased in comparison. While it may appear that this individual was involved in occupational activities requiring extensive use of the forearm, the fragmentary nature of her remains makes it difficult to generate a list of possible occupations.
CHAPTER V

DISCUSSION AND CONCLUSION

Discussion

By comparing the patterning and frequency of occupational related skeletal lesions in the Barbadian human remains with those of traditional peoples such as foragers and agriculturalists, as well as other enslaved populations from urban and rural contexts, it is possible to place the Barbadians within the larger framework of human labor. The assertion made by both Higman (1984) and Welch (2003) that enslaved Barbadians in the urban context may have had a better overall quality of life than those enslaved on plantations is somewhat supported by my skeletal analyses of the Pierhead and Fontabelle human remains. Although overarching conclusions about the slave regime in Bridgetown are not possible in light of the small sample size, tentative conclusions about the physical strain experienced by these individuals can provide insight into their experiences as enslaved laborers and highlight future research issues and questions.

Of all the individuals analyzed from the Bridgetown burial grounds, the woman from the Pierhead burial ground displayed the most severe expressions of occupational stress markers in light of her young age (between 22-30 years). While none of the vertebral apophyseal facet remodeling, anterior wedge compression
fractures, osteophytosis or musculoskeletal stress markers scores (except the coracoclavicular ligament complex insertions) assigned to this individual advanced beyond moderate expression, this patterning is most likely the result of her age rather than an indication of little physical strain.

Apophyseal facet remodeling of the vertebrae was present in three (PH1, 30bu89, and 30bu85) of the four individuals whose vertebrae were available for analysis. Both Individual PH1 and Individual 30bu85 were relatively young, aged between 22-34 years at the time of their death. The asymmetrical patterning of facet remodeling in Individual PH1 suggests that she experienced some type of injury while carrying loads upon her head. Compared with the historical agriculturalists from the Ensay and Wharram Percy sites in the United Kingdom, facet remodeling in the Barbadian individuals was predominantly located in the cervical and lumbar region, rather than the upper thoracic spine. Derevenski (2000) attributed the remodeling of the thoracic spine among the individuals from the United Kingdom to carrying heavy loads on the back with a creel basket. Creel baskets were fastened to the back by a strap placed across the breastbone and around the shoulders, and the weight of the basket rested just above the pelvis (Derevenski, 2000).

The patterning of apophyseal facet remodeling in the cervical region observed for the Barbadian individuals more closely resembles that found among the human remains from the urban Harappan sample and the African Burial Ground in New York. Both Lovell (1994) and Wilczak et al. (n.d.) attribute cervical remodeling to carrying loads upon the head, which would be consistent with historical depictions of enslaved Barbadian women in Bridgetown. However, in terms of the age of
individuals with facet remodeling, both the individuals from the African Burial Ground and Bridgetown seem to show earlier expression than the individuals from the Harappan sample. Apophyseal facet remodeling was most common among individuals aged between 31-40 years from the Harappan sample, while individuals as young as 22-25 years old experienced cervical remodeling in the Barbadian and New York samples. Although all of these individuals were derived from urban contexts and may have experienced similar types of stresses to the head and neck, it appears that the enslaved individuals were exposed to these stresses at an earlier age.

The anterior wedge compression fractures in the cervical vertebrae of Individual PH1 suggests she may have carried loads on her head heavier than those carried by the other females from Bridgetown, although genetic and other environmental factors may have also played a role. Although Larsen et al. (1995) attributed the severe anterior compression fractures of the lower cervical vertebrae in an individual from the Stillwater Marsh site to some type of traumatic injury to the neck, it is unlikely that Individual PH1’s moderate compression fractures were the result of injury. Given the presence of cervical apophyseal facet remodeling, the moderate expression of anterior wedge fractures, and the young age of Individual PH1, her compression fractures were most likely the result of chronic wear and tear from carrying loads upon the head.

Osteophytosis was present in two (Individual PH1 and Individual 30bu89) of the four individuals from the Bridgetown sample whose vertebrae could be analyzed. The thoracic and lumbar regions were most commonly affected, although Individual 30bu89 also experienced slight osteophytosis of the cervical vertebrae. This is not
surprising, given that Individual 30bu89 was one of the oldest women in the Barbadian sample (aged between 30-50 years). The presence of osteophytosis in the thoracic region of the Barbadian individuals is unique from the prehistoric foragers from the Stillwater Marsh site, the prehistoric and historic agriculturalists from Mexico and the United Kingdom, and the enslaved individuals from the African Burial Ground, the South Carolina Plantation and the Cactocin Furnace in Maryland. In all of these comparative samples, osteophytosis is most common in the cervical and lumbar regions. This may be indicative of increased stress on the upper limbs of the Barbadian individuals, as the thoracic spine is responsible for stabilizing the shoulders. In terms of age, the Barbadian sample, although small, seems to indicate that osteophytosis occurred at a younger age than the prehistoric foragers from the Stillwater Marsh site and the urban individuals from the Harappan site, where individuals between the ages of 30-50 years were most commonly affected. The presence of osteophytosis in a Barbadian individual (PH1) aged between 22-30 years is similar to the distribution of osteophytosis among the prehistoric agriculturalists from Mexico, and the enslaved individuals from both the African Burial Ground in New York and the South Carolina Plantation, where individuals in their twenties were frequently affected. The age distribution of osteophytosis among these skeletal samples may indicate that the enslaved Barbadians in Bridgetown, the prehistoric agriculturalists from the Mexican sites, and enslaved individuals in the United States from both an urban and rural context were exposed to occupations placing increased stress on the spine at an earlier age than prehistoric foragers from the Stillwater
Marsh site or non-elite urban dwellers from the Harappan site. However, the small sample size of Barbadian individuals requires this assertion remain tentative.

In terms of severity, osteophytosis in the Barbadian individuals is similar to that found in the historic agriculturalists from the United Kingdom (Ensay and Wharram Percy) and the prehistoric urban dwellers from the Harappan site. In all of these skeletal samples, faint and moderate expressions were more common than severe expressions. As Larsen et al. (1995) did not provide information relating to the severity of osteophytosis among the prehistoric foragers from the Stillwater Marsh site, this sample cannot be used for comparison.

The severity of osteophytosis among the Barbadian individuals is not as marked as that of the enslaved individuals from the African Burial Ground in New York, where even individuals in their early to mid twenties displayed severe stages (Wilczak et al., n.d.). This discrepancy is most likely the result of the small sample size of the Barbadian human remains, but may suggest that the urban slave regime in New York involved carrying heavier loads more frequently than the slave regime in Bridgetown. More bioarchaeological data is needed from Barbados to confirm this assumption. Furthermore, until a greater understanding of the potential genetic and environmental influences on activity-related skeletal changes is achieved, comparisons of severity should remain tentative.

The individuals from the Pierhead and Fontabelle burial grounds in Bridgetown, Barbados display more musculoskeletal stress markers in the upper as opposed to the lower extremities. In fact, the only individual displaying musculoskeletal stress markers in the lower extremities is the male from the
The localization of musculoskeletal stress markers in the upper extremities is similar to that found among the enslaved individuals from the Cactocin Furnace involved in skilled labor, and those performing agricultural tasks at the South Carolina plantation. Enslaved individuals from the African Burial Ground in New York show a varied distribution of musculoskeletal stress markers, which Wilczak et al. (n.d.) attributed to the wide range of activities performed by these urban laborers. As mentioned in the literature review, individuals enslaved in urban contexts performing domestic duties were often responsible for a wide variety of tasks and were not typically involved in the type of specialization common to plantations, where slaveholdings were much larger (Higman, 1984). Although the size of the Barbadian sample may limit the conclusions that can be made, the localization of musculoskeletal stress markers in the upper limbs may suggest these individuals were involved in more specialized labor than expected of females in an urban slave regime.

Stress lesions and strong robusticity are much more rare in the Pierhead and Fontabelle individuals than in the Thule Eskimos used in the scoring classifications developed by Hawkey and associates (Hawkey, 1988; Hawkey and Merbs, 1995). This is not surprising, as the Thule hunter-gatherers are generally believed to have been highly physically active, given their unique environmental circumstances. The
discrepancies between the expressions of musculoskeletal stress markers in the Thule Eskimos and those of the Pierhead and Fontabelle individuals may suggest the Barbadians did not engage in the type of physically demanding activities often associated with recent traditional hunter-gatherers. However, the great differences in environment and genetics between these two groups may also play a large role in these differences. Additionally, the faint and moderate expressions observed in the Barbadian sample may be a result of the relatively young age-at-death of this sample.

While the individuals from the Bridgetown burial grounds were relatively young, enslaved individuals from the Cactocin Furnace, the South Carolina plantation, and the African Burial Ground display moderate and severe musculoskeletal stress markers as young as 18-20 years of age (Wilczak et al. n.d., Rathbun, 1987; Kelley and Angel, 1983). It is possible that the severe expressions in these enslaved individuals indicate that the slave regime in the United States involved more strenuous labor, or the introduction of younger individuals into the labor pool than occurred in Bridgetown.

The most marked difference between the Pierhead and Fontabelle individuals and the comparative samples is the lack of degenerative joint disease in the Barbadian individuals. From the African Burial Ground, the Cactocin Furnace, and the South Carolina plantation, degenerative joint disease was present in at least some of the individuals aged as young as 18-25 years (Wilczak et al. n.d.) Although these differences may suggest that slave labor in the United States was more strenuous than the Bridgetown slave regime experienced by the Pierhead and Fontabelle individuals, it could just as likely be the result of the age preferences operating in Bridgetown.
noted in the literature review, adults at least in their late teens and early twenties were preferred for many of the domestic occupations available in Bridgetown (Higman, 1984). Since most of the individuals in the Barbadian sample were in the age range of 22-40 years, it is possible that they did not survive to labor long enough to induce joint degeneration. In order to ascertain whether degenerative joint disease was truly infrequent among enslaved individuals from Bridgetown, excavation and analysis of more human remains is needed.

Another interesting difference between the enslaved Barbadian individuals and those from the United States samples is the absence of fractures or evidence of interpersonal violence among the Barbadians. Multiple skull fractures were common among the enslaved individuals from the African Burial Ground, and a few minor fractures to the forearm and wrist were present in the human remains from the Cactocin Furnace (Wilczak et al., n.d.). As some individuals from the African Burial Ground experienced multiple cranial fractures at different healing stages and as many as five to six fractures throughout the skeleton, the authors felt these were most likely the result of interpersonal violence rather than occupational accidents and injuries (Wilczak et al., n.d.). It is possible that the absence of fractures in the Barbadian individuals reflects Higman (1984) and Welch's (2003) assertion that slave discipline in Bridgetown was less militant and brutal than in the plantation context. Overseers did not constantly supervise enslaved individuals in Bridgetown, and they were often allowed to operate relatively independent of their holders through the hiring out system (Higman, 1984). This greater range of mobility and freedom in Bridgetown may have prevented enslaved Barbadians from being subjected to the kind of physical
violence frequently associated with enslavement. Again, this hypothesis needs to be verified with more bioarchaeological research of individuals enslaved in Bridgetown.

Conclusion

Skeletal analysis of five women aged between 22-50 years and one man aged between 40-50+ years presumably enslaved in Bridgetown during the 18th century indicates that strenuous physical labor was probably experienced at a younger age than found among some prehistoric foragers (the Stillwater Marsh site) and urban dwellers (the Harappa site). The early age of onset of occupational related skeletal lesions observed in the Barbadian individuals is similar to that found among prehistoric agriculturalists in Mexico and both rural and urban slave regimes in the United States, although these lesions are less severe in the Barbadians. This may suggest a couple of possible explanations: 1) the individuals from the Pierhead and Fontabelle burial grounds were involved in strenuous physical labor at an early age and did not live long enough to experience severe lesions; 2) these individuals were subject to less strenuous labor than is associated with prehistoric agricultural work and the slave regimes in the U.S.

The localization of musculoskeletal stress markers in the upper extremities of the enslaved women in this sample may suggest these individuals performed more specialized tasks than what has been assumed for urban domestic slave labor. Higman (1984) asserts that the small-scale nature of urban slaveholdings necessitated that domestics be responsible for a wide variety of tasks, whereas the large-scale
nature of plantation holdings facilitated a great deal of occupational specialization. This viewpoint is also supported by bioarchaeological data from the urban slave regime in New York, as Wilczak et al. (n.d.) attributed the distribution of musculoskeletal stress markers throughout the entire skeleton among enslaved individuals from the African Burial Ground to labor involving a diverse range of activities. The patterning of musculoskeletal stress markers in the enslaved individuals from Bridgetown are more similar to that found among enslaved individuals from the Cactocin Furnace, where skilled labor dominated. It is also similar to the patterning found among the individuals from the South Carolina plantation, where specialization was likely.

While the moderate expression of occupational related skeletal lesions and the absence of fractures indicating interpersonal violence potentially conforms to Higman (1983) and Welch’s (2003) assessment that the slave regime in Bridgetown may have been less brutal and generally afforded a better quality of life than the plantation regime, there is also evidence that can potentially be used to contradict this hypothesis. There is no real difference in the average age at deaths between the Barbadian individuals and the individuals from the African Burial Ground, the Cactocin Furnace, or the South Carolina plantation. In all of these skeletal samples, the average age at death falls somewhere between 30-45 years. The average age at death among enslaved individuals from the Newton Plantation in Barbados was somewhat lower, being around 29 years (Corruccini et al. 1982). This may suggest that in Barbados, the urban regime of Bridgetown afforded a better quality of life for enslaved individuals than rural contexts such as the Newton Plantation. However,
while the labor required of the enslaved Barbadians may have been less severe than some slave regimes in the United States, evidence from the Pierhead and Fontabelle burial grounds suggests no dramatic differences in the life expectancy between enslaved individuals from Bridgetown, New York, South Carolina, and Maryland.

While individuals from the Cactocin Furnace, the African Burial Ground, the South Carolina plantation, and the Newton Plantation displayed potential evidence of infectious agents (periostitis and/or porotic hyperostosis), these lesions were not present in any of the human remains from Bridgetown examined for this analysis. This may be unusual, considering that Bridgetown was a densely populated, relatively unsanitary urban center where heavy port activity no doubt frequently introduced new and foreign pathogens into the population (Higman, 1984). If the individuals from Bridgetown did experience infectious agents, they did not survive the insult long enough for skeletal lesions to form. According to the “osteological paradox,” human remains with no evidence of pathological lesions may indeed represent individuals less healthy than those with an abundance of pathological lesions, as one would have to be able to withstand prolonged insult for the skeleton to be effected. Further excavation of skeletal remains of enslaved Barbadians in Bridgetown can no doubt elucidate and expand upon these observations.
REFERENCES


APPENDIX A

Letter of Permission for Photograph Use
March 20, 2006

Chris Crain
10240 East 22nd Road
Manton, MI 49662

Dear Chris Crain:

I would like to request your permission to use the following photographs of human skeletal remains from the Pierhead and Fontabelle burial grounds in Bridgetown, Barbados in my Master’s thesis:

- P7130035 - The right radius of PH1
- P7130036 - The right humerus of PH1
- P7130052 - The right clavicle of PH1
- P7130064 - Thoracic vertebrae # 7, 8 and 9 of PH1
- P7150005 - The left humerus of 30bu61
- P7070045 - The left humerus of 30bu72
- P7070047 - The right humerus of 30bu72
- P7120034 - Cervical vertebrae # 1 and 2 of 30bu85
- P7120042 - Lumbar vertebra # 1 of 30bu85
- P7080092 - A lower thoracic vertebra of 30bu89

Although these photographs have not been officially copyrighted, I am acknowledging that they are your property, and therefore feel it necessary to obtain your permission. You will receive full credit for providing these photographs in the manuscript. These photographs will be extremely beneficial, as they illustrate the characteristics that are discussed throughout my Master’s thesis.

For your convenience, I am including a space for your signature on the page to indicate your permission for my use of the above-mentioned material. By signing below, you also give ProQuest Information and Learning and Bell & Howell the right to supply copies of this material on demand as part of my Master’s thesis. Please attach any other terms and conditions for the proposed use of these photographs, if they should apply.

\[\text{Signature} \quad \text{March 23, 2006}\]

Name Date

Please return this letter in the self-addressed, stamped envelope provided. Thank you for your time and attention to this matter.

Sincerely,

Sarah Muno
2000 Goldsworlh Valley apt W8
Kalamazoo, MI 49008
269.387.6576