Mercury, Mitayos, and the Violence of the Everyday:
The Bioarchaeology of the Santa Bárbara Mercury Mines in Huancavelica, Peru (16^{th}-19^{th} centuries CE)

By

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To John Janusek, brilliant mentor and beloved friend. Check it out! I did it!

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CHAPTER 1:
Introduction

The European invasion of the New World in the 15th century CE radically transformed the course of human history, spurring a centuries-long project of conquest and colonialism rooted in violence, extractivism, and racialized exploitation. Early forays by Spanish *conquistadores* to the Caribbean were followed by voyages to the mainland continent of the Americas in pursuit of land and wealth, justified by a mission to convert the Indigenous people they encountered to Catholicism. In 1519, Hernán Cortés landed on the Yucatán Peninsula and made his way towards Tenochtitlán, the capital of the Aztec Empire. After a multi-year campaign that involved the recruitment of local Indigenous groups to join in their fight against the Empire, Cortés captured Tenochtitlán and claimed it for the Spanish, beginning a colonialist project that led to Spanish dominance in much of the Americas (Blacker 2015, Restall 2004).

Emboldened by Cortés's invasion of the Aztec Empire in Mexico and the riches that came with it, Francisco Pizarro embarked on a mission to explore the Pacific coast of the South America. He arrived in 1532 in what would become Peru just as the Inka Empire, which controlled a territory spanning from modern-day Ecuador to northern Chile and Argentina, was coming to the end of a civil war between Huascar and Atahualpa, two half-brothers and rival claimants to the imperial throne. Taking advantage of the political fragmentation of the Empire following Atahualpa's victory, Pizarro, with fewer than 200 men by his side, mounted a surprise attack while meeting with the short-lived Emperor Atahualpa at Cajamarca, managing to take him hostage in the confusion. In an attempt to persuade the Spaniards to spare his life by appealing to their greed, Atahualpa offered them a ransom: "Atahualpa said that he would give a room full of gold […] He said that […] he would fill the room with various objects of gold - jars, pots, tiles and other pieces. He would also give the entire hut filled twice over with silver" (Xerez 1534, 335, cited in Hemming 1970, 48). The precious metals, stripped from magnificent altars, vessels, adornments made of silver and gold were funneled into Cajamarca in the coming weeks. This was the beginning of Spain's systematic extraction of precious metals from what would become the Viceroyalty of Peru (Hemming 1970). Over the course of the next three centuries, the Spanish Crown drained the Americas of their natural resources, desperately funneling wealth into wars on the European continent and provoking massive inflation in silver, which had acquired an immense importance as currency in both Europe and Asia (Lenman 1998).

The majority of the silver being sent back to Spain came from the mines of Potosí, in modern-day Bolivia. Dubbed the "Cerro Rico"—or Rich Mountain—for its seemingly limitless abundance of the shining ore, Potosí was the center of a massive mining project that led to the growth of a bustling colonial city. However, the initially torrent of silver slowed to a trickle as Spanish mine owners bled the veins of the mountain dry of high-quality silver ore within a few decades of its discovery. Desperate to maintain the influx of wealth, the Spanish Crown introduced a recently developed metallurgical technology—amalgamation—that was being used contemporaneously at mines across New Spain. This new technique required vast quantities of mercury, a toxic, liquid metal, to which the Spanish had some access in Europe at the mines of Almadén, Spain, and Idria, Slovenia (Van Buren 2010, Montero 2011, Bakewell 1971, Salazar-Soler 2009, Robins 2011). The cost of transporting mercury across the Atlantic to Bolivia was initially outweighed by the boost in production at Potosí, but the true stroke of luck for the Spanish came with the discovery of the mercury deposits at Santa Bárbara, in the hills of Huancavelica, Peru.

The ensuing centuries of exploitation of the Huancavelica mines helped to spur the implementation of new forms of labor organization in the Viceroyalty of Peru. A series of reforms, introduced by Viceroy Francisco Álvarez de Toledo in the 1570s, transformed a system of tributary labor used by the Inka Empire to mobilize the indigenous population for large projects. The Spanish modified this system for their own needs, perverting the basic tenets of reciprocity that underlay it, and implemented a program of forced labor. Much of the population subject to the new Spanish labor tax was sent to the mines of Potosí and Huancavelica to serve colonial mine contractors (Saignes 1987, Brown 2001, Dell 2008, 2010, Montero 2011, Robins 2011). Accounts of these mining activities are found in Spanish documents, as well as in the famous *El Nueva Corónica y Buen Gobierno* of the indigenous chronicler Felipe Guaman Poma de Ayala (1980[1615]), and have been explored by historians, economists, and archaeologists alike. However, an understanding of the actual lived experience of the individuals subject to this labor—one not filtered through the biased Spanish imagination—is impossible through historical investigation. We can, nevertheless, find some evidence for the lifeways of these indigenous laborers by looking at how these systems designed to exploit and extract labor and resources for the benefit of Spain were physically embodied in individuals. In this, bioarchaeology provides a unique opportunity to investigate the experience of a person in the world through the bones that have been shaped by their lives.

The Bioarchaeology of Colonialism

The bioarchaeology of colonialism follows in the footsteps of historical archaeology and the archaeology of colonialism in attempting to investigate the individuals whose voices have been erased from, or marginalized in, the historical record. Bioarchaeological studies of contact and colonialism have successfully demonstrated that the impacts of colonialism on Indigenous populations were not monolithic (Murphy and Klaus, eds. Murphy, Klaus, and eds. 2017); indeed, investigations across the Americas have shined light upon the diverse consequences of colonialism on Indigenous bodies, ranging from increases in joint degeneration from forced labor (e.g., Klaus, Spencer Larsen, and Tam 2009) to infectious diseases and traumatic injury (e.g., Stodder 1994, Stodder 1997, Harvey, Danforth, and Cohen 2017, Murphy, Boza, and Gaither 2017) to stress indicators related to restricted access to resources (e.g., Larsen et al. 2001, Winkler et al. 2017). Others have looked at the prevalence of Spanish violence against Indigenous people in the Americas, including the earliest known evidence of firearms used by the Spanish in conquest (Murphy et al. 2010). However, despite the insights provided by individual studies, the bioarchaeology of colonialism would be best served through an integration of these lines of evidence – in other words, examining both the invisible structural violence (see below) inherent within colonial institutions as well as the direct violence of abuse and interpersonal attacks that are used to uphold these structures of inequality. This will permit us to reconstruct a more complete, nuanced picture of the experience of the individual under colonial institutions.

The Embodiment of Violence

Bioarchaeology has long investigated the physical impacts of violence. In part, this is because the bioarchaeologist's toolkit includes trauma analysis, which is the most visceral presentation of violence to the body. Indeed, trauma analysis and associated patterns of violence remains a popular line of inquiry into the body, both at the level of the population and that of the individual (e.g., Redfern 2016, Pérez 2016, Walker 2001, Martin and Harrod, eds. Martin, Harrod, and eds. 2012, Scaffidi and Tung 2020, Tung 2012a, Knüsel and Smith 2013, Mant, de la Cova, and Brickley 2021). This form of analysis, of course, can provide the bioarchaeologist with a wealth of data about social life, lived experiences, and identity.

Scholars of bioarchaeology, however, have begun to widen the scope of what is meant by violence (Klaus 2012, Stone 2012, Nystrom 2014, Stone 2020, Halling and Seidemann 2017, Bright 2020, Tremblay and Reedy, eds. Tremblay, Reedy, and eds. 2020, Tung 2021), following in the footsteps of sociology, feminist theory, philosophy, and cultural and medical anthropology (e.g., Galtung 1969, 1990, Farmer 1996, Farmer et al. 2004, Rylko-Bauer and Farmer 2016, Parsons 2007, Ho 2007). For this dissertation, I outline a way of thinking about violence on a larger scale; I position the manifestation of indirect violence, or "structural violence," in the locus of the body, by focusing on the ways that the human skeleton is transformed under colonial policies and practices.

The theory of structural violence was first outlined by the sociologist Johan Galtung (1969); he reshaped the meaning of "violence" to include the invisible forms of violence that exist in the everyday. He argued that the general formula behind structural violence lies in inequality, specifically in the distribution of power and authority, which upholds unjust social structures and stratification through inegalitarian distributions of power (Galtung 1969). The violence is deemed structural because it is deeply embedded in social, political, and economic institutions, which in turn systematically deny individuals of their basic needs (Bright 2020, Galtung 1969, Farmer et al. 2006). This leads to a chasm between the potential and the actual: what separates what a person or community could have been, and the reality of what they *are*, can be defined as a form of violence (Galtung 1969). Galtung later elaborated on the various forms of and structures of violence through the introduction of "cultural violence," which—in conjunction with direct and structural violence—forms the third vertex of a tripartite model of violence (Figure 1.1) (Galtung 1990, Klaus 2012). In this model, he clarifies the forms that might be taken by structural violence through the denial of the four types of needs: survival needs, well-being needs, identity needs, and freedom needs (1990: 292). These insidious forms of invisible and indirect violence are frequently maintained through the systematic application or implicit threat of direct violence, and both are normalized within a society via cultural violence. This cultural violence might manifest through a number of domains within the social – religion, art, and science, among others – and serves to cement the inequality of the dominant social and political structures as natural and correct (Galtung 1990, Rylko-Bauer and Farmer 2016). The application of structural violence typically manifests along axes of identity related to race, class, and gender, and at the intersections of these categories (Bright 2020).

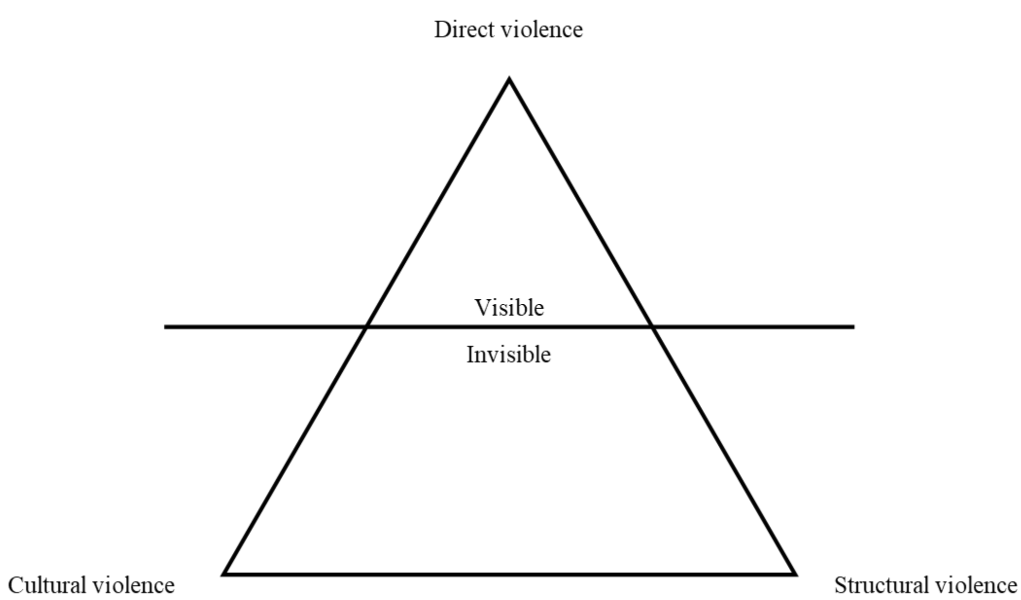

Figure 1.1 - The tripartite model of violence. Based on Galtung 1969.

Structural violence has since moved beyond the field of sociology and has been applied in numerous anthropological studies over the past three decades. In particular, cultural and medical anthropology have adopted this concept as a useful tool for understanding health disparities, and as a way of combating narratives of biological determinism (see Farmer 1996, Farmer et al. 2004, Farmer, Connors, and Simmons 1996, Lane et al. 2008, Lane et al. 2004, Gravlee 2009). A germinal application of structural violence in anthropology was Paul Farmer's examination of the long-standing consequences of European colonialism on the people of Haiti in relation to the high prevalence of tuberculosis and HIV/AIDS (Farmer 1996). The inaccessibility of healthcare, extreme poverty, and the stigma around HIV/AIDS in particular coalesced into a social context that perpetuated the spread of HIV/AIDS, particularly among the female, rural population. He argues that the nature of structural violence requires a biosocial understanding of disease to address not the symptoms (in this case, higher rates of tuberculosis HIV/AIDS infection among certain social groups), but the underlying causes of illness (the structural inequalities that perpetuate lack of access to health care) (Farmer et al. 2004).

In the past decade, structural violence has found its way into bioarchaeological studies investigating the impacts of colonialism, patriarchy, classism, and racism (Stone 2012, Schug et al. 2013, Klaus 2014, Nystrom 2014). However, the difficulty in investigating structural violence using bioarchaeological methods has to do with one basic premise of structural violence theory—specifically, structural violence requires a "rigidly hierarchical social context" (Bright 2020, 131). The fruitful application of this theoretical framework, then, requires that the particular presentation be firmly grounded in empirical evidence of a rigid hierarchy that results in structural inequalities. Where this can be established, the potential for investigation is clear: for example, in one such study, Klaus and his colleagues analyzed a Mochica skeletal population from Mórrope in the Lambayeque Valley in northern, coastal Peru. Mórrope was first occupied by the Spanish in 1532, and experienced full socioeconomic rupture in the 1590s: the Mochica were forced into economic servitude and poverty, and experienced political powerlessness under the rule of the colonists (Klaus, Spencer Larsen, and Tam 2009, Klaus and Tam 2009). Their findings indicate that there was a drastic decrease in overall health among the Mochica under the Spanish regime (Klaus 2012; Klaus, et al. 2009).

As Galtung (1990) emphasizes, structural violence operates in conjunction with direct and cultural forms of violence to continually maintain and reproduce dominant and unequal power relationships. One extension of this argument is that while we can identify the sources of structural violence in the social, political, and economic structures of a society, these various forms of violence manifest in the physical body and lived experience of the individuals who experience this form of indirect violence. Nevertheless, by itself, the idea of indirect violence does not sufficiently address the importance of lived experience as filtered through the lens of social identity and their intersections (e.g., age, race, gender), despite the impacts of structural violence on the physical body (Crenshaw 1989, 1991). The transformation of the physical body in response to social context is better understood through the theory of embodiment (Csordas 1990, Lock 1993, Csordas and Harwood 1994). The experience of the individual in the world and the body as the locus of culture has been explored extensively in historical, philosophical, sociological, and anthropological studies of embodiment (Mauss 1934, Levin 2002, Butler 1990, Wendell 1989, Csordas 1990, Csordas and Harwood 1994), growing out of a general interest in the body in its various forms as a useful point of study (Foucault 1977, Scheper-Hughes and Lock 1987, Foucault 1973). One of the earliest incorporations of embodiment theory into anthropological study is seen in the formulation of the “three bodies”: the tripartite conceptualization of the body as individual, social, and political, revealing the body as not just as a biological entity, but also as inherently social (Scheper-Hughes and Lock 1987). Anthropologists have successfully employed embodiment as a tool with which to collapse dualities such as mind-body and nature-nurture by positioning the body as both subject and object (Csordas 1994). Through embodiment, we can understand the ways in which the body is both a material object and simultaneously the locus through which we experience the world (Csordas 1990, Csordas and Harwood 1994, Ingold and Palsson 2013, Agarwal and Glencross 2011).

The first to explicitly incorporate embodiment into bioarchaeological studies, Sofaer (2006) interprets human remains as historically and contextually produced. The plasticity of bone makes the human skeleton not just a biological object, but a cultural object, that can divulge aspects of the deceased’s social and historical contexts (ibid). This draws upon work by Krieger (2005), who posits that bodies tell stories: that is, the biological incorporation of the social gives insight into individual lives. Much of this work in bioarchaeology has focused on cultural modifications of the body—altering the self to express identity within the individual’s social context, such as cranial modification, piercing, and tattooing among others (e.g., Torres-Rouff 2002, Blom 2005, Andrushko and Verano 2008, Knudson and Stojanowski 2009, Schrader and Torres-Rouff 2020). The skeleton remodels itself over a lifetime in response to experiences and trauma, and the remains that we find are the reflection of this lifelong process of changing and becoming through constant interactions with the larger world (Schrader and Torres-Rouff 2020). More recently, growing interest in situating violence in the body has led to new conceptions of what it means to embody the social (Klaus 2020, Tung 2021).

The methods of bioarchaeology provide the tools to empirically examine the embodiment of structural violence. If the body is perceived as both a biological and a social object shaped by social context, it holds that social context will create physical changes in the body – which, in a reciprocal fashion, shapes one's lived experience. Within the concept of structural violence, individual action is constrained by structures of violence that deprive the body of needs that are both physical and social. Integrating these two theoretical frameworks allows for an examination of the body as biological and cultural subject-object that is affected by structures of inequality – in this case, the colonial mining economy – while also operating within and transforming these structures. In contexts of a rigid hierarchy like that of colonialism, those in power can literally shape the physical body through the deployment of systems of inequality. Within this context, I integrate ideas of the tripartite forms of structural violence (such as the direct violence of Spanish abuses, the structural violence of programs of forced labor, and the cultural violence of colonizing diet) to look at how violence in all forms shapes human bodies and is in turn shaped by them. This research also sheds light on the nature of the Spanish colonial project in the Andes by documenting the lived experience of the indigenous subjects under Spanish rule, whose stories are unlikely to have been captured (or, alternately, wholly misrepresented) by historical documents.

The Importance of Mercury

The Spanish colonial project was fundamentally about the extraction of wealth and its transfer from the New to the Old World via indigenous labor. Silver was the single largest source of material wealth in the Americas during the Colonial Period, but by the mid-16th century, the Spanish Crown needed a new way to refine low quality ores due to overexploitation of silver.

The greatest advancement in this domain was quicksilver amalgamation, introduced to Peru by Viceroy Francisco de Toledo in 1572 (Van Buren 2010). The process required workers to walk through a sludge of mercury, silver ore, iron, salt, and water for days to form a metal amalgam of silver and mercury; the amalgam was rinsed and then burned, leaving behind pure silver. This technique was of capital importance for the Crown and for the functioning of the colonial economy as a whole. As a result, mercury became a key component of that silver economy, an essential and dangerous element that indigenous laborers procured for the process of amalgamation. The Santa Bárbara mine in Huancavelica, Peru (then the Viceroyalty of Peru), located 3972 masl in the Andes mountain range, was the largest mercury mine in the New World (Bakewell 1971, Puche Riart 2005, Robins 2011), where indigenous men, women, and children worked in dangerous conditions.

The system of labor organization was the Spanish *mita*: a tributary draft system appropriated from the Inka precursor of rotational labor tax, which was reformulated by the Spanish in response to worker shortages. This system tightened viceregal control over the indigenous population and ensured a constant supply of labor for the mining economy (Cole 1985, Dell 2008, Montero 2011, Wiedner 1960, Zagalsky 2014). Colonial documents and oral histories indicate that the Santa Bárbara mining settlement was used from the early 17th century to 1810, though exploitation of the mercury deposits at the mines began in the mid-16th century; it was the primary encampment for the miners and smelters of Huancavelica (Torres de Mendoza 1868 [1609], de la Escosura Morrogh 1878, Brown 2001, Smit 2018). The mercury mine of Santa Bárbara was therefore at the center of struggle over indigenous labor, the extraction of wealth from the New World, and the overall integration of the nascent global economic network (with the Crown of Spain at its center) during the 16th-18th centuries.

The Site of Santa Bárbara

The site of Santa Bárbara is an abandoned town adjacent to the entrance to the mercury mines of the mountain of the same name. The town grew organically out of an *ad hoc* settlement of miners who began construction on the horizontal tunnel Nuestra Señora de Belén that provided access to the lower galleries of the mines that had until then been worked by entering an open pit at the top of the hill. Over the time in which the access was built, the town of Santa Bárbara was formalized and transformed into a more typical Spanish settlement, centered on a Catholic church with a formal cemetery to the west and a churchyard of unknown use to the southeast of the structure.

Douglas Smit (2018) has conducted a general survey of the region surrounding Santa Bárbara, identifying the location of mercury refining ovens in the region that would have been used for processing the cinnabar recovered from the Santa Bárbara mine. He also led excavations at the site itself, excavating residential structures, the central plaza, and a restricted area of the churchyard to investigate how emergent colonial markets shaped the sociopolitical context of the indigenous laborers who lived there. He found evidence of a limited engagement with Spanish products, but one that engaged in the emergent commercial market, shaping it through their own daily practice. He notes that the Indigenous inhabitants of the site continued to use primarily traditional Andean ceramics in a household context, as community relationships were restructured into emergent notions of identity. By engaging with ideas of practice over top-down approaches, he demonstrates how the emergent Andean market opened up new modes of negotiation with Spanish policies (2018).

Smit’s excavations of the churchyard at Santa Bárbara uncovered the skeletal remains of eight individuals in primary context. The five adolescents/adults were buried in standard extended poses, and the remaining three burials were third trimester fetuses (Proctor in Smit 2018). During his excavations, he also uncovered three secondary burial deposits, which were left *in situ* (Smit 2018). The Indigenous individuals that are the subject of this dissertation were recovered from a series of secondary burial pits in the southeast churchyard, including the three originally uncovered by Smit. The majority of these burials were interred following extensive decomposition, suggesting that they were previously buried elsewhere—perhaps in the formal cemetery to the west of the church—and reinterred in this churchyard. Along with a team of community members, undergraduate students, and a graduate field chief, I excavated these burials in 2018 as part of an investigation into the lifeways of the Indigenous people who were brought to labor in the toxic Santa Bárbara mercury mines. The burials recovered at the site include the remains of at least 217 individuals, including males, females, and juveniles. These individuals form the basis for the bioarchaeological data examined in this dissertation.

Research Questions

This project investigates the ways in which the structural violence of the Spanish colonial project was embodied and embedded in the individual skeletons of the Indigenous people most affected by its policies and practices. I analyze how the plastic nature of the skeleton and the constant remodeling and uptake of materials by bone tissue helps us to understand how bodies respond to social and political contexts predicated on systems of inequality and exploitation. I address this topic through three primary research questions that are the subject of the data chapters of this dissertation and which center upon three lines of bioarchaeological data (see below):

1. **Direct violence and trauma.** What was the role of direct violence in upholding the social and political institutions of the colonial mining economy? The prevalence and frequency of trauma will test whether individuals at the site were subject to physical violence intended to cause harm. How was the experience of violence divided upon axes of social identities, including age, sex, and race? The types and patterns of injury seen in the individuals at Santa Bárbara can be used in conjunction with the demographic data of the population to delineate differences or similarities in the application of violence against the identified individuals. Finally, who were the perpetrators of this violence? Examination of wound shapes can be used to identify the weapons used to inflict these wounds and clarify the mechanism by which people were being harmed.
2. **Labor-related changes.** How were the bodies of the individuals at Santa Bárbara affected by the programs of forced labor introduced by the Spanish, and to what degree are colonial accounts of labor systems accurate in the historical record? Entheseal remodeling and degeneration of the joints can provide insight into how long and how hard these individuals engaged in strenuous labor at the site, as well as indicate what types of activities were being performed. In addition, who was engaged in these forms of labor, and was it restricted to the individuals outlined in colonial policies? Through an analysis of the demographics of those who experienced skeletal changes related to labor, I examine who worked at the site and for how long.
3. **Stable isotope analysis of diet.** How were resources distributed across different members of the population at Santa Bárbara, and did age and sex structure the types of foods that individuals consumed? By analyzing demographic data in conjunction with stable carbon and nitrogen isotopes, I reconstruct differences and similarities in dietary

resources accessed by the people of Santa Bárbara. Additionally, how did the introduction of colonial foodstuffs affect what and how foods were being consumed? By differentiating between stable isotope signatures of different types of food in conjunction with the historical record, I outline what we can and cannot tell about shifts in consumption patterns with the introduction of European foods. The imposition of foodstuffs and interruption of foodways may constitute a denial of identity needs as defined by Galtung (1990), though selective consumption of these foods may speak to the persistence of community relationships (Dietler 2010).

Through the application of bioarchaeological techniques, I investigate the experience of both the individual and their community, and how both of these articulate within an overarching social structure shaped by colonial institutions and priorities.

Structure of the Dissertation

Chapter 2 of this dissertation situates my project in the broader historical context of the Spanish project of extraction, conversion, and exploitation undertaken by the Spanish Crown in the Americas. Specifically, I examine the mining economy in the Viceroyalty of Peru. I begin by tracing the beginnings of silver exploitation in the Viceroyalty and the resultant exhaustion of the mines in Potosí, Bolivia by the mid-16th century. I then outline the technological advancements originating in Germany and then New Spain that allayed the flagging silver output, which involved the introduction of liquid mercury for refining ore-poor rocks containing precious metals. These new methods made mercury indispensable for securing wealth for the Crown, leading Spanish colonists to search for new sources of this metal. This brings us to the mountains of Huancavelica, Peru, and the circumstances through which the Spaniard Amador de Cabrera found these deposits with the help of the indigenous community leader, D. Gonzalo de Navincopa. I show how the cinnabar deposits discovered there led to a mass mobilization of indigenous laborers through the *mita*, an exploitative tributary labor system that depopulated regional communities and fundamentally reshaped labor relations in the Viceroyalty. The Indigenous people who arrived at Huancavelica were funneled into the cavernous and toxic depths of the mountains of Santa Bárbara and the nearby Chaclatacana in pursuit of cinnabar, resulting in large-scale death of indigenous laborers. I provide an outline of the salient reforms to mining practices in the region brought on by revolts and advocacy both by and for the indigenous people in the area surrounding Huancavelica. These led to changes in both the physical and legal realities under which ore was extracted from these mines, including the construction of a massive ventilation shaft around which the small town of Santa Bárbara grew in the early 17th century. I describe the rise of a wage labor class in Huancavelica, motivated by the systematic impoverishment of the indigenous laborers brought to Huancavelica, and the growing desperation of Spanish mine contractors to secure mining labor. After centuries of exploitation of both the mines and the people who labored within it, the labyrinthine galleries of Santa Bárbara collapsed, and the mines were shut down. The coda describes both the town and the community of Santa Bárbara as they exist today, nestled in the peaks near the modern city of Huancavelica.

The subsequent chapters are presented in the form of independent articles, each investigating an aspect of the lived experiences of the indigenous mine laborers of Huancavelica. Each begins with a short introduction that provides the necessary historical context for understanding the article, situating the mining economy within the larger colonial project. I provide a brief overview of the theoretical framework that I used to guide my interpretations, centered around the concept of structural violence described above, as it pertains to each question. I then introduce the site of Santa Bárbara, where I conducted my research, underscoring its importance for understanding the lifeways of indigenous people living under the violent and oppressive social and political structures of the Spanish colonial project. I describe past excavations at the site and introduce data from my own excavations. A discussion of the methods includes an explanation of the archaeological methods used in the excavations at Santa Bárbara and the results thereof, including basic information on excavation units, burial placements, and associated materials. I also provide an overview of the relevant bioarchaeological methods applied within each study, showing how and why these can help us to identify the embodiment of structural violence within the body, and extrapolate these to understand the realities of existing within these unequal structures of power.

Chapter 3 presents the results on the osteological analysis of trauma identified the remains of the indigenous laborers at Santa Bárbara. I present the value of using signs of skeletal trauma for understanding how violent structures are upheld through the threat and mobilization of direct violence. I examine both cranial and post-cranial trauma in the skeletons at Santa Bárbara, identifying the frequency of lethal attacks to elucidate intent on the part of the abuse, examining differences in the results of attacks across demographic categories, and performing comparisons of the wounds to known weapons in the colonial Andes. These allow me to reconstruct experiences of direct attacks on the individuals living and working at Santa Bárbara.

Chapter 4 looks at the laborways of the indigenous laborers at the mines. I use data on entheseal remodeling of the skeleton, which reveals the type and strenuousness of the activities the individuals interred at the site performed. I also look at the frequency and severity of degenerative joint disease in peoples' skeletons to understand how forced labor transformed people’s bodies, leading to disability at a young age. Overall, I show the ways that social identities like age and gender affected what kind of work the people of Santa Bárbara did, how this manifested in their skeletons, and how the structural violence of the colonial mining economy was painfully and permanently embodied.

Chapter 5 transitions away from osteological analyses to examine the stable isotope ratios found in the bones of the Santa Bárbara people. I explain the methods and logic behind using carbon and nitrogen isotopes for understanding diet. Using these methods, I attempt to reconstruct the diet of those individuals to clarify not only what they were eating, but what access they had to both general resources, and to foods holding social and cultural capital within the colonial context. I argue for the importance of understanding community and cultural persistence through selective consumption and the ways that food and ingredients shape and are shaped by the people that eat them, including the ways that consumption is shaped by social identities.

The final chapter of the dissertation synthesizes the conclusions of the articles to outline how structural violence, cultural violence, and direct violence intersected and reinforced each other in the context of the Colonial Period. I argue that the mining economy was at the center of debates around the mission of conversion, the extraction of labor, and constructions of the emergent concept of race.

CHAPTER 2:
A Brief History of Exploitation at Huancavelica

Al govierno y cuidado del cerro de plata de Potosí se sigue immediatamente tratar del de azogue de Guancavelica, que estos como tan importantes, y que uno a otro se ayudan promiscuamente, son como dos polo que sustentan estos Reinos, y los de Espana

The government and care of the silver mountain of Potosí directly follows from the treatment of the quicksilver of Huancavelica, that these are so important [that they] are like two poles that hold up these Kingdoms, and those of Spain.

- Viceroy Marqués de Mancera [1639-1648] (Toribio Polo 1899, 10)

Introduction

Accounts of the Colonial Period in Peru and in the Americas more broadly have often approached its history in one of two narratives: the Black Legend or the White Legend. The Black Legend narrative presents the Spanish conquest of the Americas as a campaign marked by slaughter and the absolute decimation of hapless Indigenous inhabitants. The White Legend—aptly named in its upholding of white supremacist discourse—holds that the Spanish brought civilization to a “backwards” world (Smit and Proctor 2020). In both narratives Indigenous agency is erased and supplanted by the idea of an all-encompassing structure that eliminated any possible navigation of or resistance to the imposed policies of the Spanish. More recently, scholars have moved towards investigations of the Colonial period using such models as resistance and negotiation frameworks to understand the interplay between the colonizers and the colonized (see for example Keehnen, Hofman, and Antczak 2019, Hofman et al. 2019, Albiez-Wieck 2018, Voss et al. 2008, Spencer-Wood 2016, Wernke 2013). Notions of resistance in the face of colonialism have largely stemmed from ideas put forth by James Scott (1985), who discussed the manner by which the colonized might resist in more invisible ways—evasian, false compliance, and sabotage among others. The utility of resistance have come under scrutiny by archaeologists, due to the invisibility of such actions in the record, as well as the overly broad application of the term. They have also critiqued the binary between colonized and colonizer as overly concrete, obscuring overlapping and intersecting interests of those involved (see Liebmann and Murphy 2011). Ideas of negotiation help to fill this gap, by suggesting ways to understand how people interact within a given system, acting to shape it through community action. Wernke's framing of the successive Inkaic and Spanish conquests of the region suggests space for the colonized to exercise their attachments to their landscapes, leading to the improvised reshaping of the colonial project to reflect community attachments to the landscape (2013).

I suggest that we engage with a framework that accounts for the role of individual actors living within a violent structure that constrains—but does not eliminate—the agential capacity of the actors in the system. That is, while indirectly employing the notions of indigenous agency under restrictive social and political structures, I use bioarchaeological analysis to present a finer-grained view that enables us to look not only at community negotiation or practices of resistance, but rather the experience of the individual within these complex contexts. In pursuit of a nuanced understanding of colonial lifeways, we can recognize the structural violence inherent in the colonial system, while also integrating it with an interrogation of Indigenous action. By engaging with analysis of both social and political structures and their juxtaposition of the individual's lived experience, it is possible to weave together historical narratives that acknowledge the complexity of the colonial project.

In this chapter, I outline the history and context of the colonial mining economy as an example of one such structure. I introduce the motivations behind the extraction of precious metals from the Americas and look particularly at the ways in which labor was mobilized in pursuit of gold, silver, and mercury. I then explore the ways in which the Spanish colonizers integrated and adapted pre-Hispanic—primarily Inka—political institutions to transition to a new mining economy; this applies not only to the mode through which large numbers of laborers were sent to mines, but the actual exploitation of deposits that had been used prior to Spanish arrival. Specifically, I examine the transition in the exploitation of cinnabar deposits at Huancavelica from a source for socially important vermillion pigments to an indispensable source of mercury for new technical developments in metal refinement. I focus specifically on the "discovery" and expropriation of the Santa Bárbara mines at Huancavelica and how this deposit grew into a labyrinthine complex that poisoned and swallowed generations of Indigenous workers from the surrounding area. I explore specific pathways of local Indigenous people through this exploitative system, navigating colonial policies concerning labor and community organization. Endpoints and legacies of these diverse pathways were equally varied, from short and traumatic turns in the mines and associated processing systems ending in acute poisoning, to others who established themselves in the urban center of Huancavelica and accumulated capital as wage laborers. Finally, I outline the series of reforms to mining practices in response to discourses surrounding Indigenous humanity and the dangers of the mine.

What follows is by no means a comprehensive history of the colonial mining economy, as the scope of the system is beyond this dissertation. However, the narrative I present offers a view of the nuance of the structural violence of the mining economy, Spanish and Indigenous understandings of belonging, and practices of resistance within these structures. It is with this understanding of the history of the region that I will proceed in the subsequent chapters, investigating the ways in which this system is embodied in the physical bodies of those who lived and died at the Santa Bárbara mercury mines.

In the 15th century, emerging powers like the Spanish and Portuguese monarchies operated under the belief that a monarchy's power lay in its control of sources of precious metals—specifically gold and silver—as well as more pedestrian metals. The invasion of the Americas coincided generally with technological advances in the realm of weaponry and warfare dependent on metal for construction. In the latter part of the century, especially, the decline in available sources of gold on the continent fueled much of the search for new sources of these metals. In the early 16th century, as Spanish ships sailed across the Atlantic, they encountered vast quantities of silver and gold, first in the Caribbean, and then in present-day Mexico, Bolivia, and Peru. By the 1540s, the plenitude of silver led to its greater exploitation in the Spanish colonies (TePaske 2010). The greatest source of silver in the Viceroyalty of Peru was Cerro Rico, or Potosí, located in present-day Bolivia.

As silver arrived en masse in Europe, the bullion dramatically impacted money supplies on the continent, provoking massive inflation (Brown 2012, 40, TePaske 2010, 306). Silver and gold, whether minted or in the form of bars, were used as the primary medium of exchange for both national and international trade. Much of the silver sent back to Europe was siphoned to India, China, and the Spice Islands in exchange for luxury goods such as spices and silks. Reassured by the seemingly endless supply of silver from the New World, Spain became a voracious consumer of imported manufactured goods, leaving their own manufacturing sector moribund amidst the rise of capitalism in Europe (Brown 2012, 41). However, the most easily extracted sources of precious metal exploited by the Spanish were finite, and as Spain continued to spend vast amounts of silver on trade and waging wars in the Old World, the availability of silver at Potosí dropped precipitously by the late 16th century. Thus, Spanish officials became desperate to bolster the flagging output of silver from the colonies. These pressures led to the introduction of a new system of labor mobilization based upon extant models established under the Inka.

From *Mit'a* to *Mita*

Under the Inka, a complex system of labor had been developed unlike any previously seen in the Andes. This program mobilized imperial subjects for large projects through corvée labor tributary obligations known as the *mit'a* (Covey 2006, D'Altroy 2014, Murra 1978, 1982, Pease 1982, Rostworowski 1983). Under this system, authorities of ethnic provinces within the Inka Empire were obliged to draft able-bodied adult males to engage in labor for the Inka state, tending to Inka state fields, participating in construction projects, and serving as part of the military over a period of a few months (Sillar 2016). Roles for laborers varied widely across the Empire, with particular responsibilities varying according to the resources available to a given community (D'Altroy 1992, 2002, Julien 1982, LeVine 1987). Labor was drafted by households from provinces near the site of the required labor, the individuals themselves chosen by the local *kuraka* to be *mit'ayoq* (D'Altroy 2015). These individuals were temporary workers, who sometimes served in distant provinces for limited periods of time. These corvee laborers were distinct from mitmaqkuna—ethnic colonists moved more-or-less permanently to distant provinces by the state and extricated from obligations to their home *ayllus* to perform specialized labor (Murra 1982, Moseley 1992, Davidson, Fehren-Schmitz, and Llamas 2021). As part of the *mit'a* system, the Inka administration provided the tools and resources required to perform the labor tax. The final products of the labor were the foundation of infrastructure and the production of goods under the Inka Empire (Sillar 2016). The *mit'ayoq* retained the rights to tend to their own fields and animals over the course of their service period, and were remunerated through access to pastoral and agricultural lands for their communities (Murra 1962, Costin 1996). The individuals living under the control of the Inka Empire and contributing to this system were also involved in and benefitted from codified practices of reciprocity such as commensal feasting (D'Altroy 2002, Murra 1982, Sillar 2016).

The Spanish *mita* was similar to that of the Inka in some ways, though the reciprocity of the system was abandoned. The mita became a system of forced labor enforced by the state, guaranteeing a work force to colonial entrepreneurs (Stern 1993). Introduced in response to labor shortages and to solidify a fragmented political network in the colonies, its implementation also tightened viceregal control over the Indigenous population (Zagalsky 2014). The Spanish had begun conducting general censuses of local communities early upon their arrival in the Andes as part of their program of resettlement into *reducciones*. The data collected regarding population, as well as information gleaned about the knowledge of the Andean *mit'a* system allowed the Spanish to use extant social structures in the mobilization of their own labor draft and facilitated tax collection for the Crown (Mumford 2012, 32). Indeed, upon implementation of the *mita*, Spanish governors, *encomenderos*, and *doctrineros*[1] demanded native labor by issuing orders to the local *kurakas*. In return for their exemption from service and additional privileges, the *kurakas* levied the necessary numbers of men to be sent as tribute (Rowe 1957, 170, Gareis 2008, 106, Montero 2011, 298). Like the Inka *mit'a*, the Spanish *mita* was a rotational labor draft. It still applied to adult men (now between 18 and 50), selected by their home communities

[1] A Spanish term for a clergyman

from populations in proximity to any given project. *Mitayos*, as they became known, were used in any number of economic sectors in the Andes (Montero 2011).

Making *Mitayos*

Colonial authorities had begun to regulate general labor tribute under the rule of acting Viceroy Pedro de la Gasca, who served from 1546 to 1550; initially, tribute labor involved negotiations between Spanish authorities and local communities. It was well understood that extracting tribute only really worked if those subject to levies were able to pay them (Montero 2011, 304). As royal demand for silver grew, discourse surrounding labor for mining grew. Indeed, even as Don Francisco Toledo prepared to depart for the Viceroyalty in 1568, he received a notice from King Philip II that said that while there was to be no forced Indigenous labor in the mines, that Andean subjects should be "attracted by all just and reasonable means" (SBN ms 2040, ff. 23-35 cited inBakewell 1984a, 62) to work there. This request was heavily influenced by the previous Viceroy Conde de Nieva's observations to the king in 1563, which noted that enslaved Africans brought to the Viceroyalty were unsuited to mining work and Spaniards refused to work in the mines (Bakewell 1984, 62). The debate surrounding the use of enslaved labor would continue for centuries, but it was largely believed that individuals brought from Africa would be ill-suited to the altitude and climate of the altiplano. This was compounded by the fact that enslaved people were expensive; using African labor would be more costly in the event of the laborer's death than using local people (Brown 2001, 495).

Discourse surrounding the morality of forced Indigenous labor had pervaded colonial documents and *relaciones* for decades and would continue to be a point of contention as long as Spanish officials occupied Indigenous lands. In the 1560s, judge Juan de Matienzo decried that the Indigenous people were "enemies of work and friends of laziness, only by force will they work" (ABNB, RC.571, cited in Robins 2011, 63). The Indigenous people of the region were also reluctant to go to the mines to work, which caused interruptions and inconsistency in the production of metals. For instance, in 1564, *kurakas* in seven *encomiendas* in the Huamanga region refused to send members of their community to work in the mines (Stern 1993, 41). However, the king insisted that labor in the mines should not be forced. So, with orders to both increase silver production for the Crown and to use only a voluntary labor force, the new Viceroy Toledo arrived in Lima in 1569. By 1570, he had written to the king explaining that if His Majesty wished to continue receiving a steady supply of silver, then concessions would have to be made—unsurprisingly, these concessions were to be moral rather than monetary. He argued that though the labor might be forced in a fashion, that it would be compensated, and that the workers would be clothed and fed. He did not hear back (Bakewell 1984a, 63).

Meanwhile, by the mid-16th century, production at Potosí had plummeted; the initially rich veins and surface deposits of nearly pure silver had given way to poor ores wrested from depleted veins in the Cerro Rico. The solution to this flagging output came in the form of a technological advancement that had been in use in New Spain since the 1550s: mercury amalgamation (Assadourian 1992, 57, Robins 2011, 21). In 1570, it seemed to be the miracle solution that the Spanish had been looking for to allay the dwindling flow from Potosí. This technique, they found, could reliably extract silver from the lead-laced rocks being drug from inside the mountain. The process involved grinding the silver-containing ores and mixing the product with liquid mercury, water, salt, and some kind of metal—often iron. The resulting mixture was deposited into large open plazas surrounding Potosí, where it was treaded by Indigenous laborers, up as far as their thighs in the toxic muck. The resulting silver-mercury amalgam was rinsed in large troughs to get rid of the dirt, and then squeezed in bags to extract as much of the mercury as possible to be re-used. What remained was burned in large ceramic ovens—the mercury would volatilize, and the silver would be left to cool and then collected (Robins 2011, 83-88). This process required a vast amount of labor, the totality of which was not being filled by wage workers. Having waited for years for a response to his query, and in 1572, Toledo proceeded on his own to institute the new *mita* labor system and began to send Indigenous subjects to Potosí and Huancavelica.

"Finding" Ores in the Andes

Though accounts of the "discovery" of the cinnabar deposits surrounding Huancavelica in November 1563 differ in their details, we consistently find Amador de Cabrera, an *encomendero*[2] from the nearby city of Huamanga at the center of this turning point in colonial history. According to Lohmann Villena, the first written account of the "discovery" of Huancavelica comes from the Jesuit priest P. Jose de Acosta, who he argues must have heard it directly from Amador de Cabrera—the named discoverer—upon his visit to the region in 1576 (Lohmann Villena 1949, 20). Yet, there are two popular stories that outline the fateful moment when the Spaniard was shown the cinnabar deposits. In one—less commonly told—Indigenous women from the Angaraes region[3] who used the cinnabar to make vermillion informed Cabrera of the deposits near the Falcas mines (Lohmann Villena 1949, 20). The other account, common in modern oral histories and described in a 1609 Relacion to King Philip III, suggest that Amador de Cabrera, was at a party in the area of what would become Huancavelica,

[2] Encomendero is a Spanish term for a Spaniard that was granted the right to extract labor or taxes from a local Indigenous population in exchange for converting them to Christianity.
[3] This was the area in which Huancavelica was located prior to it being reconfigured as the province of Huancavelica.

accompanied by a man named D. Gonzalo de Navincopa. Most accounts say that Navincopa was a local leader, likely from the nearby community of Chachas.[4] Cabrera had given his hat to Navincopa's son to play with, and the latter lost it, prompting Navincopa to attempt to assuage the Spaniard. He led Cabrera to a cinnabar deposit on the side of a hill. Elated, Cabrera promptly registered his claim to the deposits on New Year's Day 1564, barred Navincopa from mining the hill, and established the first of the mercury mines on the mountain above Huancavelica (Lohmann Villena 1949, 20, Montesinos 1906 [1566], 19, Robins 2011, 22, Eguren, de Belaunde, and Burga 2005, 41-42).

The people of the surrounding area had long been aware of these cinnabar deposits, though, and this was not the first time that they had been exploited. Lohmann Villena writes that, "Since the pre-Hispanic era, deep galleries had been used in the same mountain of Huancavelica" (1948, 7). Indeed, it appears that cinnabar from the hills of Huancavelica may have been traded across the south-central highlands, as far away as the north coast of Peru as long as 3,000 years ago. When ground into powder, cinnabar forms the vibrant red pigment vermillion, known as *llimpi* by the people of the region. Vermillion has been used for ceremonial objects and funerary masks in the Andes as early as the Formative Period at Chavin (Cooke et al. 2013, Young 2017). In the Late Horizon, members of the Inka nobility used the pigment—in this case called *ychsma*—to paint their faces, both for cosmetic purposes, as well as to intimidate (Lohmann Villena 1948, 13). Following the registration of the hill by Cabrera, however, the extraction of cinnabar for these purposes would be overrun by those who would refine cinnabar—mercuric sulfide—to produce elemental mercury, which would become indispensable in the Spanish quest for silver.

[4] Chachas would later be moved as part of Toledo's resettlement project, and become the reduccion Acoria.

The Rise of Huancavelica

Before 1570, Huancavelica had been little more than a mining camp. However, the introduction of amalgamation had made the mercury mines at Huancavelica an invaluable resource for the colonial economy, and focus shifted to the relatively empty valley near the Santa Bárbara hill (Robins 2011, 29). Following Cabrera's discovery, Spanish *mineros*[5] had staked claims across the ridge between the hills of Huancavelica and the nearby Chaclatacana in rectangular lots measuring 50 by 25 meters (Lohmann Villena 1949, 21). Conveniently for Toledo, Spanish law stated that all subsoil land rights belonged to the Crown, and he promptly expropriated all mines that had been established in the hills surrounding Huancavelica. The mine owners of the time—including Amador de Cabrera—were reorganized into a guild of contractors known as a *gremio*, and were given permission to work the mines, selling all extracted mercury directly to the Crown (Brown 2012, 23, Lohmann Villena 1949, 59). The Viceroy mandated that any exploitation of the mines without the knowledge and express permission of the royal government was illegal (Torres de Mendoza 1868 [1609], 426). At the same time, the Crown prohibited any production or mining of mercury outside of Huancavelica. The Huancavelica mines would supply all necessary quicksilver to the silver mines of the Andes, while New Spain would continue to receive mercury from the Almaden mines in Spain. This not only assured a tighter control of production but enabled the governing body to measure silver output and applicable taxation; the ratio of mercury to silver in the amalgamation process was about two to one. Thus, oversight of mercury production gave the government a simple metric by which to prevent the mining guild in Potosí and others from illegally mining and selling silver outside of

[5] In this dissertation, "mineros" refers specifically to the mine owners, and not to the laborers who worked in the mines. At any given time, there were between 26 and 30 mineros in control of the mines at Huancavelica (Contreras 1982).

the official market (Robins 2011, 9, Alonso 2000, 347). With control of the mines now in the hands of the Crown, the distribution and sale of mercury also came under a state monopoly. In a move that will be familiar to all capitalists, the state would collect the mercury and resell it at a profit to silver mine owners in Potosí. Because mercury was necessary for the refinement of silver in the first place, Potosí mine owners frequently had to acquire mercury on credit, which created massive monetary deficits (Brown 2012, 23).

As the importance of the Huancavelica mines grew, Toledo sought to establish a new jurisdiction for the small hamlet that was growing at the base of the hills. On August 4, 1571, the city of Huancavelica was formalized under the name of Oropesa, as a tribute to Viceroy Toledo, Count of Oropesa. The town was emancipated from the larger area of Huamanga to be governed as an autonomous city. The *raison d'être* of the existence of Huancavelica was to produce mercury and to house the *mineros* and laborers of the Huancavelica mines (Lohmann Villena 1949, 61-62). Having taken over all the Viceroyalty's mining interests, it fell to Toledo to ensure that there was enough labor for a consistent production of both silver and mercury. Thus, in 1573, the first cohort of *mitayos* was sent to Huancavelica. Toledo vastly expanded the territory from which labor could be drawn for the mines; at Potosí, communities as far as 200 miles[6] away were required to send eligible men for labor duties (Assadourian 1992, 58-59). Those who were eligible for the *mita* were (purportedly) men between the ages of 18 and 50 (Montero 2011, 299). However, in some areas, all those who were married were subject to the *mita* (Montero 2011, 303). According to Toledo, only one seventh of the eligible population of each region was to serve in a given rotation (Lohmann Villena 1949, 97). The number of individuals in each rotation at Huancavelica in its first iteration varies but seems to have been around 900 people (Brown

[6] This is based on the conversion of 80 leagues, where one league is ~2.63 miles (Britannica 2004)

2001, 20). By 1577, this number had increased to somewhere between 2200 and 3000 *mitayos* (Torres de Mendoza 1868 [1609], 430, Bradby 1982, 203). According to official policies, the term of service in Huancavelica was to last two months—this was much reduced compared to the term at Potosí due to the toxic nature of the mercury mines—and *mitayos* were to be paid a wage of two reales per day (Lohmann Villena 1949, 178).

The Huancavelica mines certainly earned their moniker "the mine of death". Few *mitayos* survived two months there (Smith 2004, 33). Miguel Agia, a Franciscan legalist who argued in favor of the *mita*, conceded that sending them to serve at Huancavelica meant "sending them to die" (1946, 62). So dreaded was the *mita* that in the provinces surrounding Huancavelica, mothers would maim their sons or baptize them as girls to exempt them from the service (Brown 2001, 474, Robins 2011, 47, Smith 2004, 33). The Franciscan chronicler Buenaventura de Salinas y Córdoba wrote in 1631 "How the Indians are brought in groups of fifty and one hundred, chained up like criminals, with branches and shackles of iron, the women and children and relatives bidding farewell from the churches, leaving their houses closed up, and they followed them, crying out to the sky, pulling their hair, singing sad songs and lugubrious laments in their language, saying goodbye to them, without hope of seeing them again, because there they will stay, to die sadly in the mines and labyrinths of Huancavelica" (Salinas y Córdoba 1631, cited in Robins 2011, 48).

The *mitayos* were not the only Indigenous people to come to the mines. Indeed, they frequently brought their families. Women and children would often work to supplement the *mitayo*'s earnings by acting as servants or selling goods like textiles in the cities. The workers also brought along staples to be eaten during their service at the mine (Robins 2011, 48). In his 1603 description of a group of *mitayos* on their way to Potosí, Alfonso Messia writes that "each

Indian takes at least eight or ten llamas and a few alpacas to eat. On these they transport their food, maize and chuño [dried potatoes], sleeping rugs and straw pallets to protect them from the cold, which is severe, for they always sleep on the ground" (cited in Montero 2011, 309). While it was illegal to force Indigenous men to work in the mines, the wages that they were paid were meager—often in devalued silver—and the *mitayos* were still required to pay not only for their own supplies while serving their term after running out of whatever they had brought from home. Not only this, but they were expected to render tribute to their *kuraka* upon return to their home ayllu (Robins 2011, 150). It was a common practice for the mine owner to pay the *mitayos* in kind, deducting the costs of food from the individual's pay. In his description of the *mita* at Huancavelica, the Indigenous chronicler Guaman Poma de Ayala wrote "First, they receive great damage from the miners and justices there. They are hanged by the feet, nude, and whipped. They make them work day and night, and they are not paid. If they ever get paid, half is stolen." (Guaman Poma de Ayala 1980[1615], 964[982]). As such, during the weeks in which they were supposed to have time to rest, *mitayos* would frequently hire themselves out as wage laborers to earn more money to pay off said debts. Others stayed because it was a better alternative to going back to a community where they would then have to pay tribute to their *kurakas*.

The Lethality of Mercury Mining

When exploitation of the mercury mines commenced, laborers worked in an open pit, primarily extracting surface ore. This form of mining was particularly advantageous given the nature of cinnabar deposits. Rather than occurring in long veins in the way that silver does, cinnabar ore is generally distributed in large, irregularly shaped pockets (Lohmann Villena 1949, 171).[7] However, as workers dug deeper, the pit walls began to cave in—particularly in the rainy season between January and April—and *mitayos* would be trapped and galleries blocked by landslides (Brown 2001, 471). And so, around 1600, there came a shift to shaft mining, and the galleries beneath the mountain grew deep and labyrinthine (Alonso 2000, 347; Robins 2011, 52). In his observations of the Huancavelica mines, the Spanish Carmelite Friar Antonio Vazquez de Espinosa wrote, "When I was in that town (which was in the year 1616) I went up on the range and down into the mine, which at that time was considerably more than [100] 130 stades[8] deep. The ore was very rich black flint, and the excavation so extensive that it held more than 3,000 Indians working away hard with picks and hammers, breaking up that flint ore; and when they have filled their little sacks, the poor fellows, loaded down with ore, climb up those ladders or rigging, some like masts and others like cables, and so trying and distressing that a man empty-handed can hardly get up them" (Vázquez 1942, 543). The long climb up to the sole entrance to the shafts was dangerous, claiming many lives to falls from the ladders.

However, falls were far from the only dangers of working at Huancavelica. The candles and torches that lit the galleries for the miners produced massive amounts of smoke that mingled with the smell of sweat and waste, creating "an intolerable foul stench [and] a great infection and corruption of the air, very prejudicial and injurious to human health." (de Jeria 1604, cited in Brown 2001, 472). De Jeria, General Protector of the Indians, observed that the acrid nature of the air was only part of what made the candle and torch smoke so dangerous. The carbon monoxide from the small fires slowly sank to the galleries further under the ground; this toxic air was called *umpé*, and laborers learned to avoid it by observing the strength of their candles as

[7] Ironically, this made underground mining all the more dangerous later as it removed large areas of the hill, undermining the structural integrity of the area.

[8] One stade is equivalent to one eighth of the mile. One hundred and thirty stades is equivalent to 16.25 miles.

they descended. If the flame grew weak or went out, they did not dare to enter for fear that the *umpé* would kill them (Brown 2001, 476, Povea Moreno 2010, 266).

Carbon monoxide was not the only poison that lurked in the air inside the mountain. Working close together underground, Indigenous laborers would inhale a toxic combination of cinnabar, arsenic, arsenic anhydride, and volatilized mercury vapors (Lohmann Villena 1949, 173). As workers picked away at the walls, silica particles combined with mercury-laden dust settled into the miners' lungs. Laborers from the mines were at high risk for silicosis, which would slowly turn their lips purple as their bodies struggled for oxygen. Manifesting first as long-lasting colds, silica in the lungs would lead to violent coughs and weakness. In the worst cases, this would result in a bloody cough laced with liquid quicksilver. It made those afflicted vulnerable to more severe infections, like pneumonia and tuberculosis, conditions aggravated by the drastic temperature differences that miners would experience as they exited the sweltering mines for the freezing air above Huancavelica (Lohmann Villena 1949, 173; Brown 2012, 63). In a report to the king in 1600, the new Viceroy de Velasco wrote, "These quicksilver ores, when they extract them in the mines, they give out a dust that enters itself into the Indians as they breathe and settles in the chest, of such evil quality, that it causes them a dry cough and light fever and at the end death without repair, because the doctors have it for an incurable evil." (Velasco 1600, cited in Brown 2001, 472).

Of course, we cannot forget the greatest risk posed to the Indigenous workers at Huancavelica—the mercury itself. Mercury in all forms is dangerous to humans; the element is not used in any process in the body, and accumulates in the blood and kidneys, causing damage to the kidneys and central nervous system. The inhabitants of Huancavelica came to recognize the effects of mercury poisoning, referring to the sick as *azogados*, from the Spanish word for mercury. The *azogados* would become gaunt and their teeth would fall out—telegraphing their illness through a ghastly appearance. Their gums would bleed, and they would drool excessively (Brown 2001, 480; Robins 2011, 107-109). Individuals who are exposed to high levels of mercury would also experience uncontrollable tremors. A description of a poisoned miner at the Spanish mercury mine at Almaden recounts that "he suddenly began to have violent spasms of the right leg […] about 60 times per minute […] By the time the spasm ended, the miner was exhausted. He had only been able to consume liquids, a little at a time, because he could not remain still long enough to swallow more" (D'Itri and D'itri 1977). Other accounts describe how the wives and mothers of the miners would have to feed them like children because the shaking was so bad (Brown 2001, 481). However, mercury's effect on the nervous system would not have been fully understood by their contemporaries. We now know that the bioaccumulation of mercury causes a number of psychological symptoms that would have made afflicted persons erratic and unpredictable (Bluhm et al. 1992).

Psychological symptoms of mercury intoxication vary across individuals, but include mania, anxiety, depression, and irritability. In some cases, the sick would become extremely timid. However, it could also manifest in bouts of uncontrolled violence. When combined with hallucinations, it is no wonder that the ill were considered "insane". Over time, exposure to mercury leads to more chronic conditions as well. These include female infertility, a higher frequency of miscarriage, congenital disabilities, osteoarthritis in young people, and immune disorders that would have made the *azogados* even more vulnerable to the innumerable diseases that continued to ravage the Viceroyalty (Brown 2001, 488; Robins 2011, 107-109).

As word of the brutality of working in the Huancavelica mines spread, eligible men opted for any number of alternatives to going to Huancavelica. One option available to Indigenous people seeking to avoid the Huancavelica *mita* was simply fleeing. An individual that had left their home community was deemed a *forastero*. As a *forastero*, they had no claim to communal lands, but were thus exempted from tribute to the *kuraka* and—more importantly—the *mita* (Robins 2011, 179, Tandeter 1981, 102). This course of action is perhaps unsurprising when we look at the realities of work inside the mines, though categorizing the entire labor force of Huancavelica as forced belies the complexity of the situation. According to Bradby, the rise of the free wage-labor class was due in large part to "the double squeeze of Spanish state obligations and the Indian [*kurakas*]" (1982, 201); paying taxes to both local communities and Spanish elites was impossible as a *mitayo*. It is also possible that some *mitayos* may have stayed as free wage laborers temporarily to earn enough money to get home (Brown 2001, 483). The confluence of these factors along with the rapid decimation of the Indigenous population due to Spanish diseases led to a precipitous decline in the number of would-be *mitayos* in the provinces surrounding Huancavelica. Because *mita* tribute was levied according to population records from the *visita*s, *mita* draft numbers typically didn't account for the change in the actual demographics of a given ayllu or region. Thus, while theoretically each eligible individual within the population of each province was subject to the tax every seven years, men from the surrounding area often found themselves in Huancavelica every two or three years instead, acting as an additional contributor to outward migration (Robins 2011, 35).

The Indigenous inhabitants came up with other ways to avoid the *mita*—at various stages of the drafting process, would-be *mitayos* could pay a ransom to avoid service. A man selected to go to mine could pay his kuraka with a quantity of silver that the kuraka would pay to the *mita*yo captain, thus relieving the individual of his mining duties, and making him an *indio de plata*. Should this happen after arrival at the mines, it was possible to instead remit this money to the mine owner to whom he was assigned, as an *indio de faltriquera* (Smith 2004, 38; Robins 2011, 36). While some money was no doubt pocketed by the *kuraka* or mine owner, the primary purpose of the silver was to recruit someone else to take the laborer's place—a *minga*[9], or rented laborer. This practice was the primary mode by which an emerging class took hold at Huancavelica and Potosí—the wage laborer.

Wage Labor in Huancavelica

While the rise of the wage laborer implies a degree of choice, it is essential not to disregard larger structural factors at play. Choices within the structure of the colonial mining economy were often motivated by motivation to minimize self harm rather than to maximize one's wellbeing. *Mitayos* would become indebted to the mine owners who paid them in kind and deducted wages in advance for goods like alcohol and coca; frequently, the remainder was paid to the *mitayo* in cloth rather than in money (Bradby 1982, 212). By the end of their service, they would frequently be left with insufficient funds to make their own way back to their home communities, where they would need to pay their tribute. Upon returning home, they frequently found that they had lost their land and their homes, leaving themselves and their families destitute (Robins 2011, 150). Thus, the wage laborers may have been tempted by slightly higher wages and the possibility of some social mobility in the city of Huancavelica albeit restricted by Spanish policies and attitude towards Indigenous people.

Wage laborers also enjoyed slightly better working conditions than the *mitayos* at the mines. The division of labor was stark in the mining *mita*, dividing the labor force into skilled

[9] The term *minga* derives from the Inka term *minka*, a form of community labor (Brush 2016). The *minga* was often chosen by the *kuraka* to fill a *mitayo*'s place, thus expanding the term to include community members working in place of *mitayos*.

and unskilled groups. Long-term laborers, who had spent more time in the mines, were often given the task of serving as *barreteros*, or pickmen. These individuals would use thirty-pound crow bars, chisels and hammers to break ore from the walls of the galleries; as blasting was increasingly adopted in the latter half of the seventeenth century, these individuals would also drill the holes into which they would place explosive charges (Brown 2012, 59). This division of labor grew naturally as the free wage laborer class increased, as the actual picking required a fair amount of skill that could not be optimally achieved in two-month terms (Tandeter 1981, 132). *Mitayos*, meanwhile, would work as to clear the tunnels of debris, or engage in the arguably more grueling and dangerous job of *apiri*—they would carry the bags of broken ore to the entrance of the mine, which was all the more dangerous with the beginning of shaft mining (Robins 2011, 197-202). According to Toledo's *Ordenanzas*, written in 1574, work at Huancavelica was to be conducted in alternating day and night shifts. However, mine owners were unsatisfied by the amount of mercury being extracted in these shifts, and instead introduced an illegal quota system to maximize profits. Under this system, *mitayos* were expected to carry up one load per day, measured in a large leather bag called a *tapadera* that was "about four and one-half feet high and one and one-half feet wide, not much smaller than a person" (Robins 2011, 52). The more highly paid wage laborers were thus seemingly indispensable in the functioning of the mine; however, the *gremio* viewed them as an extra cost which should have been filled by *mitayos*. In the 1598 agreement between the *gremio* and the Crown, a prohibition of the use of wage laborers was introduced (Bradby 1982, 202). This prohibition was short-lived, though, and the proportion of the workforce filled by the wage laborers grew steadily, even as extended periods of time in the mines threw into stark relief the dangers of the mine.

By the beginning of the 17th century, advocates for the Indigenous people working in the mines became insistent. In 1603, a Franciscan clergyman, Father Agia visited the mine. He was appalled by the conditions at Huancavelica, arguing that the King had no choice but to close the mine as the laborers who were sent there were “irretrievably condemned to death” (Agía in Alonso 2000, 352). Damian de Jeria wrote in 1604, “The harm done the Indians working underground is so well known that it is certain that more Indians have died during the last contract [1598-1602] than in all the other time that mines have been worked in Huancavelica."(de Jeria, cited in Brown 2001, 490). De Jeria argued that what would be lost in quicksilver production would be gained in the preservation of Indigenous lives. In response to de Jeria’s protests, and the opinions of legalists, clerics, and political officials, Viceroy de Velasco ordered a return to open pit mining in 1604. The following year, Hernando de Arias y Ugarte—who would become the Archbishop of La Plata—arrived in Huancavelica to supervise the open-pit mine. He concluded that this method of extraction was impossible and advocated for a return to underground mining. Thus, Velasco’s successor, Viceroy Conde de Monterrey, approved a return to underground shaft mining on the condition that the gremio regularly rotate the workers underground (Brown 2001, 473; Robins 2011, 53). However, Indigenous laborers refused to work in the deepest galleries, and particularly in the mercury-rich *Hoyo Negro*[10] gallery, often filled with umpe and almost invariably lethal (Lohmann Villena 1949, 360). Under pressure to improve the conditions and stem the flight of potential *mitayos*, the gremio began construction of a large horizontal access tunnel in 1606 (Brown 2001, 473). The goal of this ambitious construction project was to alleviate some of the toxic conditions inside the mine.

[10] Literally “Black Hole”

The Second Stage of the Santa Bárbara Mine

As construction on the tunnel—Nuestra Señora de Belén—progressed, the nearby mining encampment began to grow, and was formally established as the village of Santa Bárbara. On October 26, 1610, Alonso de la Cruz completed the construction of Santa Bárbara's principal church under the direction of the Jesuit order (Salas Guevara 2008, 121). The haphazard distribution of the stone structures at Santa Bárbara, and particularly the lack of centralization of the church diverges from the planned grid system of the *reducciones* established under Viceroy Toledo's General Resettlement of Indians (Mumford 2012). The camp seems to have expanded organically, made primarily by those long-term wage workers who were laboring at the mine. The completion of the Nuestra Señora de Belén tunnel in 1642 was a pivotal moment in the mine's history, pushed along at an accelerated rate with the introduction of blasting in the 1630s. As the new access tunnel penetrated the depths of the galleries, entering into the infamous *Hoyo Negro*, fresh air rushed through the mines. Laborers were now able to bring the ore out along the relatively horizontal access, largely eliminating the need to climb the precarious ladders leading out of the top of the mining complex. The village of Santa Bárbara continued to grow as more wage laborers were hired by the gremio, and the buildings that grew up across the settlement were used as housing for the foremen and laborers, and supply sheds for mining equipment (Brown 2001, 482).

In 1645,[11] the *asiento* between the government and the gremio dropped the size of the *mita* to 620 individuals from nearly 3000 in the late 16th century, where it would stay until the end of Spanish exploitation of the mine. However, even at this reduced rate, provinces would frequently send far less than their quota with fewer than 300 *mitayos* arriving with each rotation

[11] Alonso (2000) writes that this happens in 1683

at Huancavelica by the 1680s. Indeed, this *asiento* was partly in response to a 1645 survey which revealed that only 95 individuals working at the Huancavelica mines were *mitayos*. The rest of the labor was supplemented by *mingas*, wage laborers, and other *forasteros* living in the city of Huancavelica. The *mitayos* who *were* sent were to be set to work doing repairs, cleaning the tunnels, and drilling (Bradby 1982, 221; Brown 2012, 59). According to Whitaker, this *asiento* came into being in 1683, negotiated by the *Duque de la Plata*. Regardless of the date of implementation, this longstanding contract lasted until nearly the second half of the 18th century, and also fixed the price of mercury at 75 pesos a *quintal*, providing the gremio with what was in practice a cash advance to pay *mitayos*, while netting the miners about 58 *reales* per *quintal* of mercury produced (Whitaker 1941, 12).

By the early 18th century, Huancavelica's production dropped precipitously, and the members of the *gremio* scrambled to extract enough mercury to have sufficient tribute to send to the Crown while maintaining a profit, as they were still required to pay back the 125,000 pesos a year that was advanced to them by the Crown (Whitaker 1941, 12). However, despite this promised advance, piracy along the coast had made it nearly impossible to send the full amount to the gremio by the agreed upon date, for which the mitayos suffered, as the miners could not—or would not—pay their whole wage (Whitaker 1941, 16). As debts accumulated, Marquis de Casa Concha—the Governor of Huancavelica at the time—believed that to produce the required 4,000 quintal quota of mercury for Spain, that eighty laborers per shift, both day and night, would be sufficient (Alonso 2000, 353). Between 1700 and 1720, though, official production dropped to an average of 3,000 quintales per year, with a production of only 1,500 quintales in 1705, though there was likely more mercury being poured from Huancavelica into the growing French contraband trade along the Pacific (Pearce 1999). These numbers also belie a growing illegal trade in mercury, as merchant stakeholders invested in mines, buying mercury for well below the fixed price of mercury at only 43 reales per quintal. These enterprising individuals would then sell the mercury to the Crown at a profit, enriching themselves even as the mine owners failed to meet their quotas or repay their debts in pesos (Whitaker 1941, 16).

Desperation took hold of the gremio as the quicksilver pockets were depleted and their debt to the Crown grew, leading mine owners to demand that prospectors begin to mine the support pillars and bridges left in place in the tunnels. Despite the fact that this was explicitly banned in Toledo's reforms, the practice became common enough that the structural integrity of the mine was compromised. This imprudence led to events like the 1714 collapse, in which the ventilation to the mine was completely cut off, sending shockwaves of fear through the local communities again. Repairs did not begin until 1716, when a new governor arrived in Huancavelica (Alonso 2000, 352).

A lack of labor again became a problem following a wave of disease between 1719 and 1721, which "consumed many Indians in all the kingdom, and in this city" (Casa Concha 1726, cited in Alonso 2000, 354). This epidemic followed the establishment of a new dynasty in Spain following the War of the Spanish Succession (1701-1713) that had led to the establishment of the Bourbon dynasty as the new monarchs of Spain. The Bourbons instituted sweeping reforms across the Viceroyalty (see Vives 2020, Whitaker 1941, Ayluardo 2019, Fisher 2000, García, Flores, and Villagaray 2000). Among these, King Philip V had ordered in a 1720 Royal Decree that while the *gremio* should continue to mine Huancavelica, they were to do so without the *mita*.

To this end, the Marquis of Casa Concha arrived in Huancavelica in 1723 as the new Governor, and managed to attract sufficient wage labor for about a little over a year (Brown 2001, 484). In the interim, proposals for ways to supplement the number of laborers were brought forward, including the use of prison laborers and enslaved people. While prison laborers were indeed brought to work at the mines, the use of enslaved people was once again rejected in the name of cost and a fear of the loss of investment (Tandeter 1981, 104). However, in 1724, he wrote to the king, "I must tell your Majesty with reflection, and truth, which begs the gravity of the matter and without any interest or other affection, other than that in the service of God and Your Majesty, that there will always be insurmountable difficulty in maintaining this [Huancavelica] mine without the *mita*, and with voluntary Indians [...] after a year and four months that I have spent trying various remedies for this problem, I have not found another one, but this one, and so it is true that either *mitayos* must come in person to this mine or the Kingdom will not have its mercury" (Casa Concha, quoted in Alonso 2000, 355). And so, the *mita* continued.

In a break from the tradition of promoting extant viceregal officials to higher positions, Geronimo de Sola y Fuente was named the new governor and superintendent of Huancavelica, serving a period of 12 years (1736-1748). His reforms were few, and in fact he decreed that the practices and structure of the mining economy should remain unchanged. However, over the course of his tenure, mercury output from Huancavelica increased by about 20%, leading Huancavelica mine owners to dub him "*restaurador de la mina*". More importantly for our account, he also insisted on the implementation of blasting to excavate rather than digging with pick and shovel. This not only reduced labor costs and made the mines more profitable, but it also drastically decreased the chances of mercury poisoning among the laborers in the Santa Bárbara mines (Whitaker 1941, 25).

By the 1750s, forasteros in other regions were being pressured to pay community tribute obligations to the leaders of the lands to which they had relocated, and those who were traditionally considered ineligible for the *mita* suffered the brunt of the consequences of depopulation. Women who had lost their spouses or other male relatives were charged exemptions to compensate for the lost tribute, and increasingly, disabled people and children were sent as replacement workers. For example, Robins writes that in 1793, in Nunoa, a group of children between seven and fourteen years old were sent to Potosí, where they were supposedly rejected by the mine owner to whom they were assigned (Robins 2011, 49). While this is an example from a different mine, this undoubtedly occurred at Huancavelica as well, as we shall see in the following chapters, and they were not always turned away.

The Collapse

Debates about the role of Huancavelica in the colonial economy raged on throughout the 18th century, with a number of critics advocating for the closure of the mine on the basis of three primary issues: 1) the production costs were too high, 2) there was an excessive mortality rate among the Indigenous habitants of the region, and 3) the illicit trade of mercury to the miners of Potosí was leading to a loss of capital for the Crown (Whitaker 1941, 27). However, as we have seen, the laboring population was at this point composed largely of wage laborers rather than mitayos; in addition, the change in extraction practices had made the work much less dangerous. Despite the structural precarity of the mine, the environmental hazards of the mine had greatly diminished, making it a more attractive prospect for the free laborers living in Huancavelica. As communities began to commute *mitayo* quotas through a monetary payment to the gremio and the number of wage laborers increased, payment for these laborers reached a nadir (Brown 2001, 485). This first strike against arguments for closing the mines was underscored when an accident in 1751 at Almadén—Spain's European mercury mine—crippled Spanish production so profoundly that Huancavelica became the primary source of mercury for not only Potosí, but the mines of Mexico as well (Whitaker 1941, 27-29). Santa Bárbara once again became indispensable for the production of mineral wealth in the colonies.

Calls for the closure of Huancavelica continued, but were repeatedly rebuffed as it became clear that supplying Potosí with mercury from Almaden was not only expensive due to the limited supply, but impossible if the mines of Mexico were to receive sufficient quicksilver for their booming mining projects. A series of governors were brought to the highland city, each boosting Santa Bárbara's output for a few years and promising to reinvigorate commerce. However, one by one, they failed to maintain the initial increase (Whitaker 1941, 53-56). Finally, after bringing in experts in mining administration from Europe and various attempts at reform, there came a complete rupture in the way the mine was run.

In 1779, the *gremio* at Huancavelica was formally abolished, and the control of the administration of the mines was handed to an *asentista* Nicolas de Saravia as part of a system overseen by the *visitador* Jose Antonio de Areche (Whitaker 1941, 60). This followed almost three decades of violent resistance from local mine owners following the initial discussion of dissolution beginning with Governor de la Cerda y Leyba in the 1750s. While this ensured a greater supply of mercury for the monarchy, it also led to a drastic decrease in the available capital of Huancavelica itself (Whitaker 1941, 29; Brown 2012, 183). Under the new contract, the price of mercury for the Crown plummeted from 72 *pesos* to 45 *pesos* per *quintal* for the crown, and from 79 to 55 *pesos* at Huancavelica. Areche was also tasked with producing 6,000 *quintales* per year—an amount unheard of since the beginning of the 18th century. However, the complete transformation of the administration of Huancavelica led to a chaotic and disastrous decade; in the first six months of 1782, Santa Bárbara didn't produce a single pound of mercury (Whitaker 1941, 61-62).

In an effort to remedy the situation, the Crown finally took complete administrative control of the mines; this system would last from 1782-1795. While not as great a failure as the previous reforms, it wasn't successful by any stretch, and Huancavelica now had to compete with both Spanish and Germany mercury in Potosí (Whitaker 1941, 65). It was nearly impossible for the Viceroy to administer the mines directly, leading once again to a growing ring of corruption among local officials and the alliance of miners. When he took over as Governor in 1784, Fernando Marquez de la Plata sought to suppress growing crime in response to the spread of poverty in the city. He wrote to the Viceroy asking for funds to establish a greater military presence at Huancavelica. He believed that he could help to stimulate the economy of the region by paying local soldiers, and argued that the city was almost defenseless, counting only "95 swords, 25 halberds, 25 long pikes, and 95 short pikes, all belonging to the king" (Povea Moreno 2010, 270). In his proposal, de la Plata asked for 300 firearms and accompanying ammunition to arm the defenseless "jewel of the Crown" (AGI Lima 1329, quoted in Povea Moreno 2010, 270).

De la Plata also doubtless sought to intervene in the practice of *guasacho* that further impacted mercury production. *Guasacho* was the illegal mining of deposits at Huancavelica by the Indigenous miners there, both at the principal Santa Bárbara mine and surrounding deposits such as Trinidad, Botija Puncu, and Gran Farallón. This supplemental income source had been begrudgingly tolerated by the mine owners of the gremio since the late 1500s, as they had no real recourse to prevent Indigenous laborers from extracting quicksilver outside of regular operations. By the late 1700s, though, *guasacho* compounded the problem of overexploitation of the mining tunnels as the independent Indigenous excavators supplemented the easily accessible ore by also mining the supports (Robins 2011, 97-99).

The pressure of quotas, combined with rampant corruption, and flagging output, fueled dangerous mining practices that led to cave-ins, making mine work all the more dangerous despite better environmental conditions. The worst of these—the Marroquin collapse—occurred in 1786, when the top half of the mountain of Huancavelica collapsed, crushing more than 200 Indigenous workers (Brown 2012, 198). The disaster also cost Spain over half a million dollars, and led to the arrest and removal (and in one case execution) of the officials responsible for the mine's operations. Santa Bárbara would not reopen until the end of the Spanish administration of Peru despite attempts at reform and the intervention of German metallurgists. Each recommendation was deemed too costly, and the mine sat empty (Whitaker 1941, 71-73).

In 1793, the governor-intendant Conde Ruiz de Castilla introduced a system of free enterprise known as *pallaqueo*, under which anyone who wished to work the mine could do so at their own risk and expense. They were granted access to the dangerous mercury ovens to refine the mercury and could retain profits from mining, on the condition that all mercury was sold to the local government. Though it began at a limited scale, by 1795, the government completely relinquished the administration of the mine, and opened all exploitable areas to local Spanish, criollo, mestizo, and Indigenous inhabitants of Huancavelica (Whitaker 1941, 73). Though the Santa Bárbara mine remained closed, *pallaqueo* enabled a partial recovery of mercury production from the Huancavelica region upon the discovery of the Sillacasa mine two kilometers to the north, and it seemed as though another era of prosperity was in the cards for Huancavelica (Wise and Féraud 2005). Rapidly, though, this new source of mercury was depleted, and the mines fell into disrepair such that by 1810 neglect and poor administration led to the flooding of any mines still in operation (Whitaker 1941, 77-84). The death knell of Huancavelica resonated until control was completely and finally wrested from the Spanish with the independence of Peru in the third decade of the 19th century, bringing a temporary end to exploitation in the region and the long-coming collapse of the *mita*.

Conclusion

The city of Huancavelica still stands in the highlands, the capital of its namesake province and region though the town of Santa Bárbara stands abandoned, its residents having fled only after the arrival and violence of the terrorist group Sendero Luminoso in the region. The community of Santa Bárbara, though, persists in a neighborhood along the ridge overlooking the rest of the city, stretching up to the estancias in Sacsamarca. The Spanish project of extraction and its legacy are inextricably tied to the past and present of Huancavelica; we see it in the street names of Amador de Cabrera and Calle del Mercurio in the upper reaches of the city and the small home ovens for artisanal mercury refinement in homes across the region.

However, this does mark the end of the story for our purposes. We have seen the ways in which Indigenous communities shrank and grew, migrated and settled across the landscape. Drafted into mining service under oppressive policies, they nevertheless found ways to subvert colonial practices and engage in a thriving economy, leveraging the Spanish need for laborers. Spanish ideas of Indigenous identity and humanity remained in flux, at the center of a discourse that stretched across the centuries of occupation of Indigenous lands. At the nexus of a system which in turn brought wealth to and indebted the Spanish Crown, Santa Bárbara formed and transformed on the hills above the Villa Rica de Oropesa. It is with this story in mind that we continue on to the next chapters to investigate the way that this system transformed bodies and communities over two and a half centuries.

CHAPTER 3:
"They fear neither God nor justice": A Study of Violent Trauma

En las dichas minas de Guancabilca de azogue es adonde tiene tanto castigo los yndios pobres y rreciuen tormentos y mucho muerte de yndios. […] Los dichos mineros y mayordomos, españoles, mestizos o yndios son tan señores apsulutos que no temen a Dios ni a la justicia porque no tienen rricidencia ni becita general de cada tercio y año. Y ancí no ay rremedio.

In the mercury mines of Huancavelica where the poor *indios* receive such punishment and torment, and much death […], the *mineros* and *mayordomos* are such absolute lords that they fear neither God nor justice.

— Felipe Guaman Poma de Ayala (1980, /532/)

Introduction

In the 16th century CE, Spain emerged as a powerful economy on the European continent through a project of rapacious extractivism (Vives 2015). Through this endeavor, Spanish colonists drained the New World of natural resources—primarily, silver—and relied on newly constructed racial categories to rationalize the forced labor of indigenous people, often in dangerous and toxic conditions. As a means of mobilizing massive labor forces for mining silver and other metals in the Andes, the Spanish appropriated and transformed the Inka rotational labor tax to impose a tributary draft system known as the *mita* (Rowe 1957, D'Altroy 2014, 1992). The employment of this system tightened viceregal control over the indigenous population through periodic census taking and forced resettlement, and ensured a consistent labor force (Cole 1985, Dell 2008, Montero 2011, Wiedner 1960, Zagalsky 2014). This became crucial in the mid-16th century following the rapid overexploitation of silver in the Americas, as the Spanish Crown needed a new way to refine lower-quality ores. The greatest advancement in this domain was quicksilver amalgamation, introduced to the Andes in 1572 by Viceroy Toledo (Van Buren 2010); this process involves the combination of silver ores with mercury, salt, iron, and other elements which would be mixed for days in large patios to form an amalgam. This was subsequently placed in conical molds and fired in massive ovens, leaving behind pure silver. The Santa Bárbara mine in Huancavelica, Peru was the largest mercury mine in the New World (Bakewell 1971, Puche Riart 2005, Robins 2011), placing it at the nexus of a struggle over indigenous labor, the extraction of wealth from the New World, and the integration of the nascent global economic network centered on the Crown of Spain during the 16th-19th centuries. The practices and policies enacted at Santa Bárbara mines and the colonial mining economy writ large affected the bodies of the Indigenous people who labored within it through a program predicated on insidious forms of violence, both visible and invisible, explicit and implicit. This article explores the ways that these forms of violence intertwine and are embodied in those affected by it through an analysis of trauma visible in the skeletons of the Santa Bárbara miners.

Understanding violence

To understand how violence is mobilized in the colonial mining economy, we must first define what we mean by violence. Violence, as an anthropologically productive concept, is best understood as encompassing a wide array of interrelated institutions and actions, applied on both a personal and systemic level, that are designed to coercively control the behavior and resources of certain groups of people. This configuration was first developed by Galtung (1969); he reshaped the meaning of "violence" to argue that the general formula behind structural violence lies in inequality, specifically in the distribution of power and authority, which upholds unjust social structures and stratification through inegalitarian distributions of power. It manifests in the systematic violation and denial of basic human needs: survival, well-being, freedom, and identity (Galtung 1969). Scholars have since applied structural violence theory to cultural and medical anthropology (e.g., Farmer 1996, Farmer et al. 2004, Benson 2008), public health (e.g., Lane et al. 2008, Lane et al. 2004), and critical race studies (Dressler, Oths, and Gravlee 2005, Gravlee 2009) to understand how social structures deprive individuals of some or all of their basic needs (Galtung 1969). Expanding upon this idea Galtung later introduced the tripartite model of violence. In this model, structural violence exists as part of a larger system composed of structural, cultural, and direct violence (Galtung 1990). Each upholds and reinforces the other, and they are linked inextricably, so that one cannot disentangle enacted direct violence from underlying structures of violence, nor the ways in which culture is mobilized to entrench oppressive social and political practices that cause harm. Thus, direct violence, in the form of individual or collective acts intended to cause personal harm, is an essential part of this model (Galtung 1969, Farmer et al. 2004, Klaus 2012). Direct violence, then, does not exist within a societal vacuum, but rather stems from and reinforces social and cultural pressures that serve to uphold or disrupt extant structures and relationships.

Violence at Santa Bárbara

In Guaman Poma's accounts of the relationship between *mitayos*[12], *mineros*[13], *corregidores*[14], and *mayordomos*[15], he describes the mines as a place "where there is such punishment of the poor *indios* and they are tormented, and there is much death of *indios*"[16] (Guaman Poma de Ayala 1980[1615], /526[530]). He also notes that not only were the indigenous miners beaten and locked in stocks, but were also unpaid, leading to accumulated

12 Indigenous laborers
13 Spanish mine owners and guild members
14 Spanish supervisors
15 Spanish overseers at the highest level of authority below the Viceroy
16 Author's translation. Original Spanish: "En las dichas minas de Guancabilca de azogue es adonde tiene tanto castigo los yndios pobres y rreciuen tormentos y mucho muerte de yndios."

debt they were forced to pay through further labor (Guaman Poma de Ayala 1980[1615]). The laborers were thus trapped in a cycle of abuse and restricted freedoms, working endlessly to escape the labor tributes imposed by the Spanish, while fighting for their own survival. Guaman Poma's instinctive connection between physical violence and the systematic denial of the needs of the laborers underlies the real connection between direct and structural violence. While direct violence is easily identified here, the structural violence reinforcing and defining the legitimacy of physical abuse is more elusive in its presentation. Thus, while direct violence is only one part of the picture, understanding its impact on the lifeways of the Santa Bárbara inhabitants is essential for reconstructing the ways that overarching structures of violence and oppression became embodied through changes to their skeletons.

The site of Santa Barbara presents a unique opportunity to understand the ways in which the violence deployed by the Spanish Crown was incorporated into indigenous bodies, and upheld systems of structural violence enacted through the policies of the mining and labor economies of the Viceroyalty of Peru. When tracing the lifeways of the marginalized members of a society structured by violence and inequality, we must look to the institutions and practices that legitimize and enable subjugation. We can clearly recognize direct violence and its particular manifestation in the skeleton by looking at examples of trauma sustained in life, and particularly cranial trauma, which offers the best evidence for intentional violence as opposed to trauma that could have been the result of accidents (Walker 2001, Tung 2008a, 2012b). The data on violence-related cranial trauma informs discussions on the ways that the Spanish colonial system overtly deployed physical violence as a means of upholding a socio-political and economic system that enabled the oppression of indigenous Andeans.

The Mines of Huancavelica

The apocryphal tale of the “discovery” of the mercury deposits at Huancavelica varies in its details, but here I present the most popular one. In November of 1563, Spanish colonist Amador de Cabrera gave his hat to the son of a local community leader to play with. The boy, being a child, lost the hat. His father, D. Gonzalo de Navincopa, sought to placate the Spaniard by bringing him to the site of a large deposit of mercury sulfide in the hills of Chaclatacana and Huancavelica. Well aware of the importance of this mercury, Cabrera registered the deposit on New Year’s Day 1564, banning Navincopa, and embarking upon the first Spanish mercury mining activity in Huancavelica. Not long after, the Spanish Crown expropriated the mines from Cabrera and the other mine owners, relegating them to contractors for the Viceroyalty (Lohmann Villena 1949, Robins 2011, Eguren, de Belaunde, and Burga 2005, Montesinos 1906 [1566]). The mercury was important in and of itself for silver refinement, but also allowed for the imposition of a standardized system of taxation on silver producers, given the static ratio of mercury to silver required for amalgamation (Brown 2012, Robins 2011).

Having acquired the metal necessary to boost silver production, the Crown found themselves in need of a steady labor force. This reform was implemented in 1570 by Viceroy Toledo, in the form of the aforementioned *mita*, which required adult men from the surrounding region to serve at Huancavelica for a period of two months every seven years. However, over the next two centuries, the cavernous depths of Huancavelica swallowed many of those who toiled within it, earning it the moniker “the mine of death.” Rather than subject themselves to such dangerous conditions willingly, many Indigenous people fled service in the mines, relinquishing property rights in their home communities (Robins 2011, Bakewell 1984b, Brown 2001, Montero 2011, Rivera 1990, Wiedner 1960). This resulted in severe labor shortages in the Santa

Barbara mine. In order to counteract this, Spanish overseers sought to alleviate the most horrible conditions inside the mine that were resulting in carbon monoxide poisoning and heat exhaustion through a series of reforms over the following decades. Thus, in 1606, they began construction on a horizontal tunnel that travelled perpendicular to the mining shafts further down the slope. At the entrance to this tunnel, the community of Santa Bárbara slowly formed—first, as a small encampment for the miners, and eventually as a town that would be occupied for nearly four centuries (Lohmann Villena 1949, Smit 2018).

The Mercury Mining Site of Santa Bárbara

Santa Bárbara is located in the Department of Huancavelica in central, highland Peru at 3972 masl (Figure 3.1). The first excavations at the site were conducted in 2014 as part of an investigation into the role of Santa Bárbara and its residents within the larger colonial economy (Smit 2018). Smit's project revealed that Santa Bárbara was occupied from the early 17th century through the 1980s, when it was abandoned due to terrorist violence (Smit 2018). The town of Santa Bárbara was constructed in three phases—the Middle Colonial Period (1564-1700 CE), the Late Colonial Period (1700-1821), and the Republican Period (1821-1920) (Smit 2018). Early in the construction of the settlement, a Catholic church was erected. On the northwest side of the church, there is a formal cemetery that has been in use for at least the last two centuries. On the southeastern side of the church is a small churchyard, measuring approximately 9 meters by 13 meters. In 2014, Smit excavated a series of primary burials (n=8) in this courtyard, which were analyzed by the author (Proctor and Smit 2016, Smit and Proctor 2020), and uncovered three commingled burial deposits which were left *in situ*. The burials discussed here derive from excavations conducted in 2018 in the southeastern courtyard.

Figure 3.1 - Map of the location of the site of Santa Bárbara

Relatively few artifacts were recovered with the burials, including colonial-era ceramics in both local and imported styles, such as lead- and tin-glazed ceramics, Peruvian and Panamanian *majolica*, mercury *ollas*, and large pieces of *botijas* usually used for the transportation of prestige goods like wine (Figure 3.2). All of these indicate that they are from the Spanish Colonial Period (16th to early 19th century). However, the presence of British transferware and painted whiteware superior to the deposits suggest that they may have been reinterred in the early Republican Period.

Figure 3.2 - Representative ceramics from Santa Barbara

Materials and Methods

The Sample

The skeletal remains analyzed in this study were excavated in 2018 as part of a larger investigation into the lives of the inhabitants of Santa Bárbara in the colonial period. Excavations consisted of two primary units, averaging about 1.5 meters in depth, and covering 23 square meters of the courtyard. Within these units, my team uncovered seven secondary burial deposits, filled with comingled human remains, and three primary burials. Six of the seven secondary deposits of bones ranged from about 0.40 to 0.70 meters deep; the remaining context was very small and only 0.10 meters in depth. All deposits ranged in area from 0.16 square meters to 1.18 square meters, with a median size of 0.96 square meters (Figure 3.3).

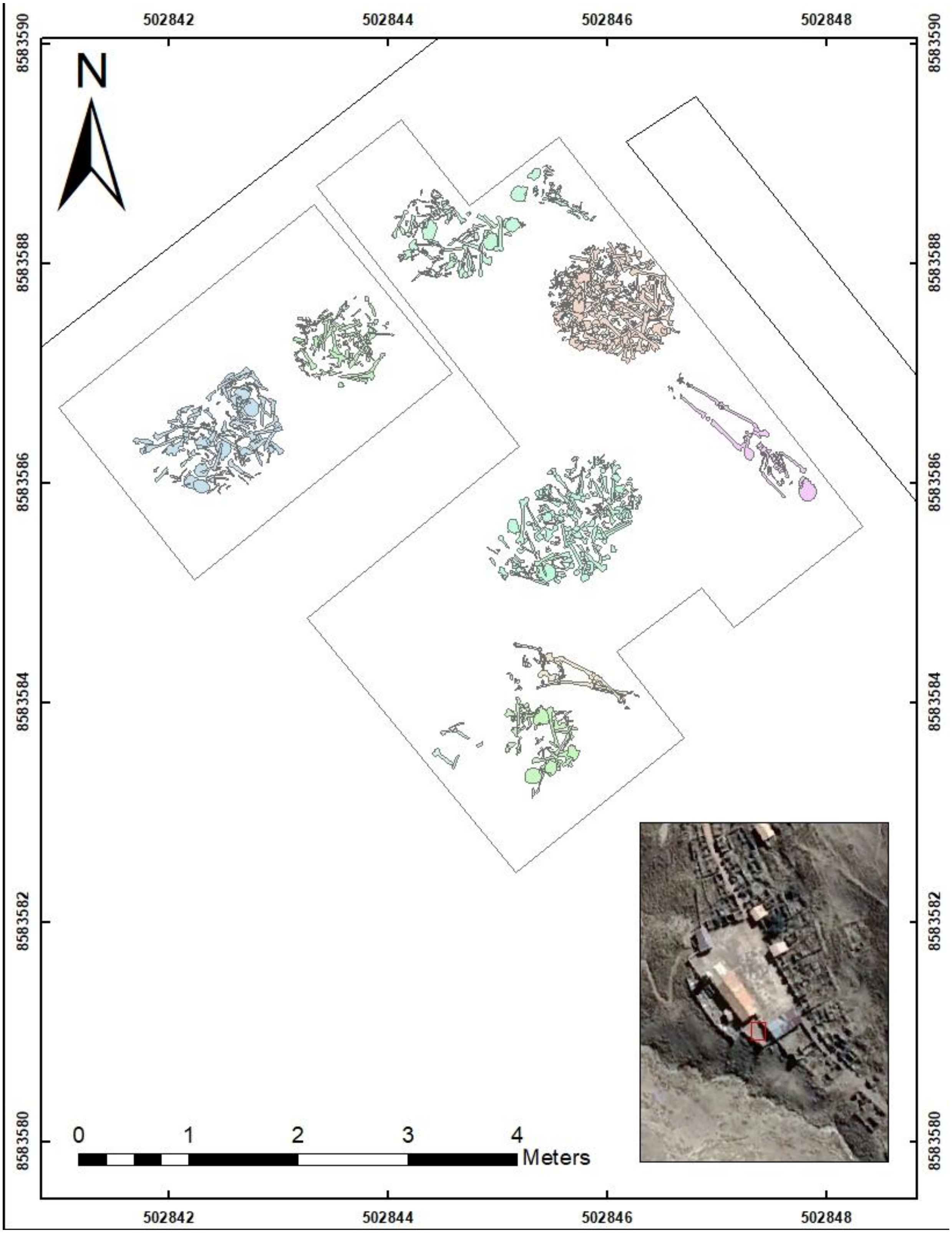

Figure 3.3 - Map of excavation units and burial deposits

The minimum number of individuals (MNI) found in the commingled burials was determined through counts of complete long bones as well as crania. The greatest number of intact long bones were right femurs (n=217). The individuals in the secondary burials were buried following extensive decomposition in most cases, as evidenced by the relative lack of articulated or anatomically positioned skeletal elements. There are only ten instances of articulated remains, including an articulated vertebral column, a forearm, a cranium with two cervical vertebrae, and an os coxa with a femur and two lumbar vertebrae, among others. It is likely that the individuals in these secondary deposits were originally buried in the formal cemetery to the northwest of the church, and subsequently moved to the churchyard when the cemetery became too full. Relocating burials was not uncommon on the European continent in the medieval and post-medieval periods (Anthony 2015, Kenzler and Tarlow 2015), and this may be an example of the entrenchment of Catholic practices in the Andes following the project of conversion of the Spanish.

Analyzing Trauma Patterns: Attack or Accident?

When attempting to identify direct violence and its systemic use, distinguishing between accidental or occupational trauma and intentional acts of aggression is imperative to avoid attributing occupational injuries to violent attacks (Guyomarc'h et al. 2010, Lefèvre, Alvarez, and de la Grandmaison 2015, Kremer et al. 2008). Given the perilous nature of the labor at Santa Bárbara, many of the injuries sustained by the individuals at the site may have been a result of occupationally-related accidents. Discriminating between blunt force trauma and falls, specifically, is often also possible by observing the location of the trauma: trauma sustained during accidents is usually found along the hat brim line (HBL), which runs along the circumference of the head inferior to the glabella and superior to the center of the external auditory meatus (Guyomarc'h et al. 2010, Kremer et al. 2008, Kremer and Sauvageau 2009). In particular, falls usually result in linear radiating fractures to the cranium, which appear as long lines radiating from the point of impact in the fall (Lefèvre, Alvarez, and de la Grandmaison 2015, Guyomarc'h et al. 2010); these fractures present without a defined margin or cranial depression, unlike a blow with a weapon. Others have noted that linear and comminuted fractures are also related to impact with a broad object or surface, such as a large stone from a cave-in, or the bottom of a mineshaft (Galloway 1999). Postcranial trauma varies in its etiology, though particular forms of fractures are typically understood as resulting from intentional attacks, including fractures of the proximal ulna (parry fractures).

However, most cranial wounds are widely acknowledged to serve as a good proxy for direct violence (Walker 2001, Tung 2012b), and fractures resulting in depressions of the cranial vault, penetration wounds, and projectile injuries are most often the result of intentional attack (Murphy et al. 2010, Tung 2007, Tung 2012a, 2008b, 2012b). To distinguish between blunt force trauma and falls, Guyomarc'h and colleagues (2010) have suggested the integration of a multi-criteria approach in evaluating cranial trauma. They conclude that blunt force trauma presents with the following characteristics:[17] (1) comminuted or depressed calvarial fractures; (2) fractures located above the HBL; (3) a left-side lateralization of lacerations or fractures; and (4) presence of facial fractures. Galloway (1999) has also argued that depressed fractures are more often related to an attack with a round or tubular object, while penetrative fractures result from blows with a pointed weapon and present with relatively clean margins. Facial fractures, including zygomatic and orbital fractures are also disproportionately attributable to direct

[17] This list is more extensive in their study. However, I am noting exclusively characteristics that can be observed without the presence of soft tissue.

violence (Le et al. 2001, Martin and Harrod 2015). Particularly of interest in the case of Santa Bárbara is the preponderance of wounds that completely penetrate the cranial vault, which point to intentional violence rather than falls, regardless of height of the fall.

Coding for Age

Standardized bioarchaeological methods were used to estimate age and sex from crania and post-cranial remains and establish a demographic profile (Buikstra and Ubelaker 1994). Subadult age was determined using the fusion of secondary ossification centers and dental eruption (Scheuer and Black 2004), as well as measurements in the case of fetal remains (Baker, Dupras, and Tocheri 2005). In the case of crania, adults were categorized as Young Adult (20-35), Middle Adult (35-50), or Old Adult (50+), based on the systematic scoring of ectocranial suture closure patterns, as well as qualitative assessment of dental attrition and antemortem tooth loss (Meindl and Lovejoy 1985, Smith 1984, Scott 1979). Age of the os coxae was estimated based on the wear of both the pubic symphyseal and auricular surfaces (Brooks and Suchey 1990, Lovejoy et al. 1985, Todd 1920). The concurrent use of these techniques may help to make age estimation more accurate when considered as a whole. In all cases when both surfaces were available, overlapping age ranges were applied in the evaluation of the age of the remains. The remaining post-cranial remains with completely fused secondary ossification centers were labelled as Adult. Because of the disarticulated and commingled nature of these remains, all age estimation conducted is subject to methodological limitations. The multifactorial nature of skeletal aging is best understood in complete skeletons, only two of which were recovered during excavations.

Sex Estimation

Standard bioarchaeological methods were used to estimate sex in both crania (n=175) and pelves (n=373, MNI=116) (Buikstra and Ubelaker 1994). Because crania and mandibles were not found in association, the mental eminence was not used in estimation of sex; rather, evaluation was based on the relative gracility or robusticity of the supraorbital margin, supraorbital ridge, nuchal crest, and mastoid process. These traits were scored along a standardized spectrum ranging from very gracile (female) to very robust (male), according to the following scale from Buikstra and Ubelaker (1994), and an aggregate score was used. Pelvic sex was estimated using as many as possible of the following morphological features, depending on the portion of the os coxa present[18]: the ventral arc, the subpubic concavity, the ischiopubic ramus ridge, and the greater sciatic notch. Presence or absence or the preauricular sulcus was also noted, but was excluded from sex estimation due to its ambiguous presentation. These bones were also scored along a spectrum ranging from very gracile to very robust, according to diagrams presented in Buikstra and Ubelaker (1994).

Trauma Analysis

Trauma in the population was documented using coding established by Buikstra and Ubelaker (1994) to record the type of fracture, its shape, and its degree of healing. Antemortem trauma, evidenced by healing of skeletal wounds, often in the form of bony callus formation, provides insight into lifeways of individuals at the site. Perimortem trauma can be identified using several characteristics used to differentiate these wounds from destruction of the body after death. Typical perimortem trauma can be identified by breaks in the bone that manifest at an

[18] The MNI indicated previously counts os coxae that are over 25% complete and include the ilium

acute angle due to the flexible and plastic nature of the tissue. In addition, bones broken at the time of death will show consistent coloration between the surface of the element and the site of breakage. Injuries to laminar bone in particular (e.g., cranial bones, scapulae) may show signs of incomplete depressions, or depressions resulting in hinging along the margin of the defect. Perimortem injuries caused to laminar bone by projectiles, and especially those of a higher velocity, may result in the creation of a "bone plug" that is expelled from the main element, leading to the formation of beveling at the point of exit through the bone.

Postcranial trauma is often more useful in understanding hazards and accidents experienced by an individual. For the purposes of investigating direct violence, specific fractures such as "parry fractures"[19] are often attributed to interpersonal conflict (Judd 2008). Inferences from postcranial trauma should, when possible, be looked at in association with other skeletal elements. However, due to the nature of the Santa Barbara sample, collecting data on multiple fractures within a single individual was impossible. In the absence of this information, the type of fracture may also help to clarify the cause of the trauma, specifically by providing evidence into the forces required to create the break. Falls are usually characterized by vertebral, clavicle, and forearm fractures. Post-cranial fractures associated with violence are more variable in their location (Guyomarc'h et al. 2010). Analysis of wound shape can also be compared to the shape of available weapons to assess intent.

For the purpose of trauma analysis on the cranium, only those which were at least 60% complete were selected (n=175), in order to facilitate comparisons between the location of wounds[20]. Cranial trauma is highly indicative of interpersonal violence (Walker 2001). Wounds

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19 A fracture of the distal shaft of the elbow, named for the act of warding off a blow to the cranium.

20 Three additional primary burials were excavated in the churchyard: one male, one female, and one fetus. None of them exhibited any signs of cranial trauma

on the skull are unlikely to be a result of accidents; indeed, patterns of head wounds have been correlated with practices ranging from warfare to raids to ritual battle across the pre-Columbian Andes (see Arkush and Tung 2013, Tung 2007, Scaffidi and Tung 2020, Tung et al. 2016, Murphy and Juengst 2019). Studies of cranial trauma have yielded a wealth of information for distinguishing intentional blows from falls; these hold that injuries at the hat brim line are more indicative of blows (Kremer et al. 2008). However, this is not always true, and others have suggested a move towards a multi-criteria approach to analyzing and interpreting cranial trauma. For example, Guyomarc'h and colleagues present a list of criteria to be used when interpreting head wounds (2010). While this study includes soft tissue evidence, they also note that linear and radial fractures are characteristic of falls, while comminuted and depressed calvarial fractures are generally indicative of a blow to the head. Fractures to the maxillofacial region, particularly on the left side of the cranium are also generally attributed to interpersonal conflict rather than accidental trauma.

Results

Age-Based Differences in Cranial Trauma Rates

Table 3.1 provides a demographic profile of the individuals recovered at the site as well as the frequency of cranial within each group.[21] Among juveniles, 14% (4/29) exhibited evidence of cranial trauma. Only one infant cranium was found, which showed signs of perimortem cranial trauma. Of 10 children aged 7-12, only one showed signs of perimortem cranial trauma.

[21] Age was estimated in the crania through dental eruption and cranial suture closure.

Finally, 12 individuals, aged 12-17, were excavated and two of these young individuals (17%) showed cranial trauma. There is no evidence of healing of cranial wounds in any of the juveniles.

Among adults, 34 of 146 adults (23%) exhibit some form of head trauma. Specifically, 13 (8.5%) show antemortem trauma (Figure 3.4) and 22 (14.5%) have perimortem trauma.[22] The age-at-death of the individual can reveal key insights into who was engaging in violent interactions of the lethal or sublethal kinds. Within the groups of late teens to young adults, cranial trauma is documented in 10 of 52 individuals (19%): four have perimortem trauma (7.5%) and six have antemortem trauma (11.5%). Among young adults, four of 21 have cranial trauma (19%): perimortem and antemortem trauma are each seen in two individuals (9.5% each). Among mid-adults, 13 of 38 individuals have cranial trauma (34%): nine of these have perimortem trauma (24%), and four have antemortem trauma (10%). In mid to old adults, six of 10 exhibit signs of cranial trauma (60%): three individuals show exclusively perimortem trauma (30%), two have exclusively antemortem trauma (20%), and one individual shows both antemortem and perimortem trauma (10%). The one old adult found has no signs of cranial trauma. Overall, in this sample, cranial trauma frequency in adults increases concurrently with age (χ^2, p=0.033) (Table 3.1).

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[22] One adult female exhibits both antemortem and perimortem cranial trauma, and is included in both categories.

Table 3.1 - Cranial trauma frequency across age groups in Santa Bárbara population. Ante- and perimortem trauma is combined in this table.

Age Category	Number of Individuals	Cranial Trauma Frequency
Infant (Birth – 3 years)	1	1/1 = 100%
Infant to child (3 – 7 years)	6	0/6 = 0%
Child (7 – 12 years)	10	1/10 = 10%
Child to teen (12 – 17 years)	12	2/12 = 17%
Teen to young adult	52	10/52 = 19%
Young adult	21	4/21 = 19%
Mid adult	38	13/38 = 34%
Mid adult to old adult	10	6/10 = 60%
Old adult	1	0/1 = 0%
Adult general[23]	24	1/24 = 4%
Total	175	38/175 = 22%

Figure 3.4 - Antemortem cranial trauma on adult male skull from Santa Bárbara

[23] In some cases, age range could not be determined based on dentition or suture fusion

Sex-Based Differences in Cranial Trauma

Among adult females, 19% exhibit some form of cranial trauma (11/57); of these, six show signs of perimortem trauma (6/57=11%), and five have antemortem trauma (5/57=9%). Among adult males, 23 individuals are affected by cranial trauma (23/70=33%); 15 have perimortem injuries (21%) and eight have antemortem injuries (11%) (Figure 3.5,

Table 3.2). The difference in cranial trauma between the sexes is not statistically significant (χ^2, p=0.086), suggesting that males and females were at equal risk of being the victim of violent attacks. The remaining 25 adult individuals could not be sexed through cranial traits, and only one shows any signs of cranial trauma (4%) (

Table 3.2).[24] Statistically, males and females are equally susceptible to perimortem trauma (χ^2, p=0.549). A single adult female and one adult male have both antemortem and perimortem injuries, indicative of injury recidivism and repeated exposure to violence. Since there are both healed and lethal wounds, evidence of both points to at least two incidences of injury. Only three of the thirteen adults with antemortem trauma (23%) show evidence of more than one wound. Five of 21 individuals (24%) with perimortem trauma present with multiple perimortem injuries.

[24] I recognize that these individuals constitute 16% of the overall adult population; however, supposing an even divide between males and females in the unknown group (the most statistically likely outcome), there is no change in the statistical significance of the cranial trauma. Thus, unsexed adults will be excluded from the subsequent discussion and analysis.

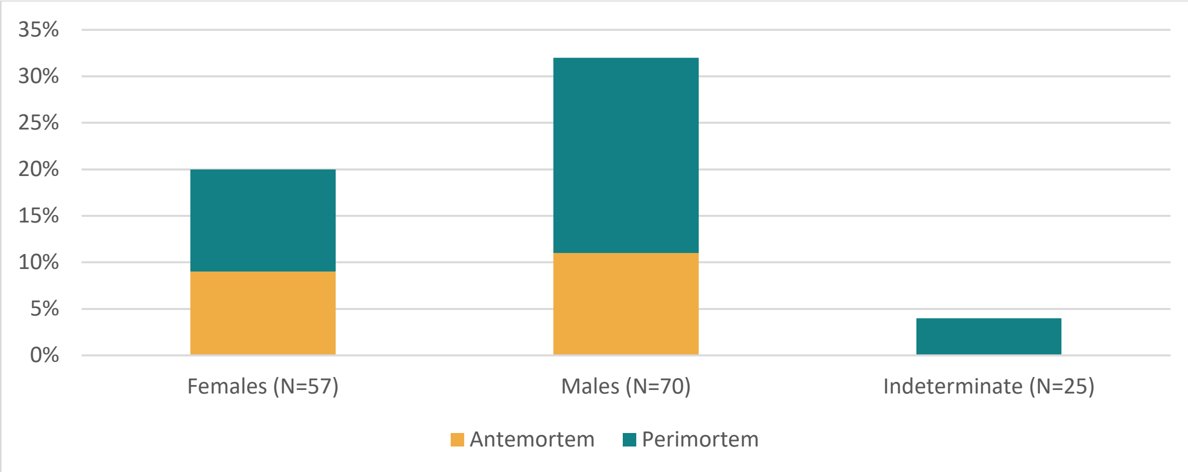

Figure 3.5 - Rates of cranial trauma across skeletal sex groups in Santa Bárbara population

Table 3.2 - Frequency of cranial trauma across skeletal sex groups in Santa Bárbara population

	Antemortem	**Perimortem**	**All Trauma**
Females	5/57 = 9%	6/57 = 11%	11/57 = 19%
Males	8/70 = 11%	15/70 = 21%	23/70 = 33%
Indeterminate Adults	0/25 = 0%	1/25 = 4%	1/25 = 4%
Total Adults	13/152 = 9%	22/152 = 14%	35/152 = 23%

Cranial Wound Counts

Among the 34 adults with trauma, 26 individuals[25] (76%) have only one head wound, four have two head wounds (12%), two have three head wounds (6%), and two have four head wounds (6%) (Table 3). Only two individuals with multiple head wounds exhibit both antemortem and perimortem injuries. Of the six remaining individuals with multiple head wounds, three have exclusively antemortem wounds and three have exclusively perimortem wounds. None of the three juveniles have more than one headwound. Among 11 females, eight

[25] This number excludes an individual with a trepanation, as the accompanying injury is unclear due to the missing section of cranium.

(72%) have only one headwound; the remaining females include one individual with four perimortem head wounds, another with three antemortem head wounds, and a third with one antemortem and one perimortem trauma. Among 22 males, 18 (82%) have only one headwound. Of the remaining males, one individual has two antemortem wounds, the second has four antemortem wounds, the third has two perimortem wounds, and the fourth has one antemortem headwound and one perimortem headwound.

Table 3.3 - Distribution of cranial wound frequency across demographic groups in Santa Bárbara population

	1 head wound	2 head wounds	3 head wounds	4 head wounds
Females	8	1	1	1
Males	18	3	0	1
Unsexed adults	0	0	1	0
Juveniles	3	0	0	0
Total	29	4	2	2
Total No. of wounds	29	8	6	8

Cranial Wound Location

Among adults, 10 of 48 cranial wounds are located on the anterior face (21%), one of 48 are located on the posterior portion (2%), 27 of 48 are seen on the superior portion (56%), five of 48 are on the left lateral surface (10%), and five of 48 are located on the right lateral surface (10%) (Table 3.4). It is important to distinguish between the location of antemortem versus perimortem trauma in order to make inferences about the social context of these encounters – that is, the lethality of various practices leading to cranial trauma. In this case, there is no statistically significant difference in the location of perimortem and antemortem wounds (χ^2, p=0.264).

Table 3.4 - Location of wounds on the crania in Santa Bárbara population (A = anterior, P = posterior, S = superior, LL = left lateral, RL = right lateral)

	Perimortem					Antemortem				
	A	**P**	**S**	**LL**	**RL**	**A**	**P**	**S**	**LL**	**RL**
Males	2/15 = 13%	0/15 = 0%	8/15 = 53%	4/15=27%	2/15 = 13%	5/13 = 38%	0/13 = 0%	6/13 = 46%	1/13 = 8%	1/13 = 8%
Females	2/9 = 22%	0/9 = 0%	4/9 = 44%	1/9 = 11%	2/9 = 22%	1/8 = 12.5%	1/8 = 12.5%	6/8 = 75%	0/8 = 0%	0/8 = 0%
Unknown Adults	0/3 = 0%	0/3 = 0%	3/3 = 100%	0/3 = 0%	0/3 = 0%	N/A	N/A	N/A	N/A	N/A
Juveniles	0/3 = 0%	0/3 = 0%	3/3 = 100%	0/3 = 0%	0/3 = 0%	N/A	N/A	N/A	N/A	N/A
Total Adults	**4/27 = 15%**	**0/27 = 0%**	**15/27 = 56%**	**5/27 = 19%**	**4/27 = 15%**	**6/21 = 29%**	**1/21 = 5%**	**12/21 = 57%**	**1/21 = 5%**	**1/21 = 5%**
Overall	**4/30 = 13%**	**0/30 = 0%**	**18/30 = 60%**	**5/30 = 17%**	**4/30 = 13%**	**6/21 = 29%**	**2/21 = 10%**	**12/21 = 57%**	**0/21 = 0%**	**1/21 = 5%**

Specifically, among males with perimortem trauma, three of 15 wounds are on the anterior portion of the cranium (20%), seven of 15 wounds are on the superior portion (47%), three of 15 wounds are on the left lateral surface (20%), and two of 15 are on the right lateral surface (13%). Among females with perimortem trauma, three of nine wounds are on the anterior portion of the cranium (33%), three of nine wounds are on the superior surface (33%), one of nine wounds is on the left lateral aspect (11%), and two of nine wounds are on the right lateral surface (22%) (Figure 3.6).

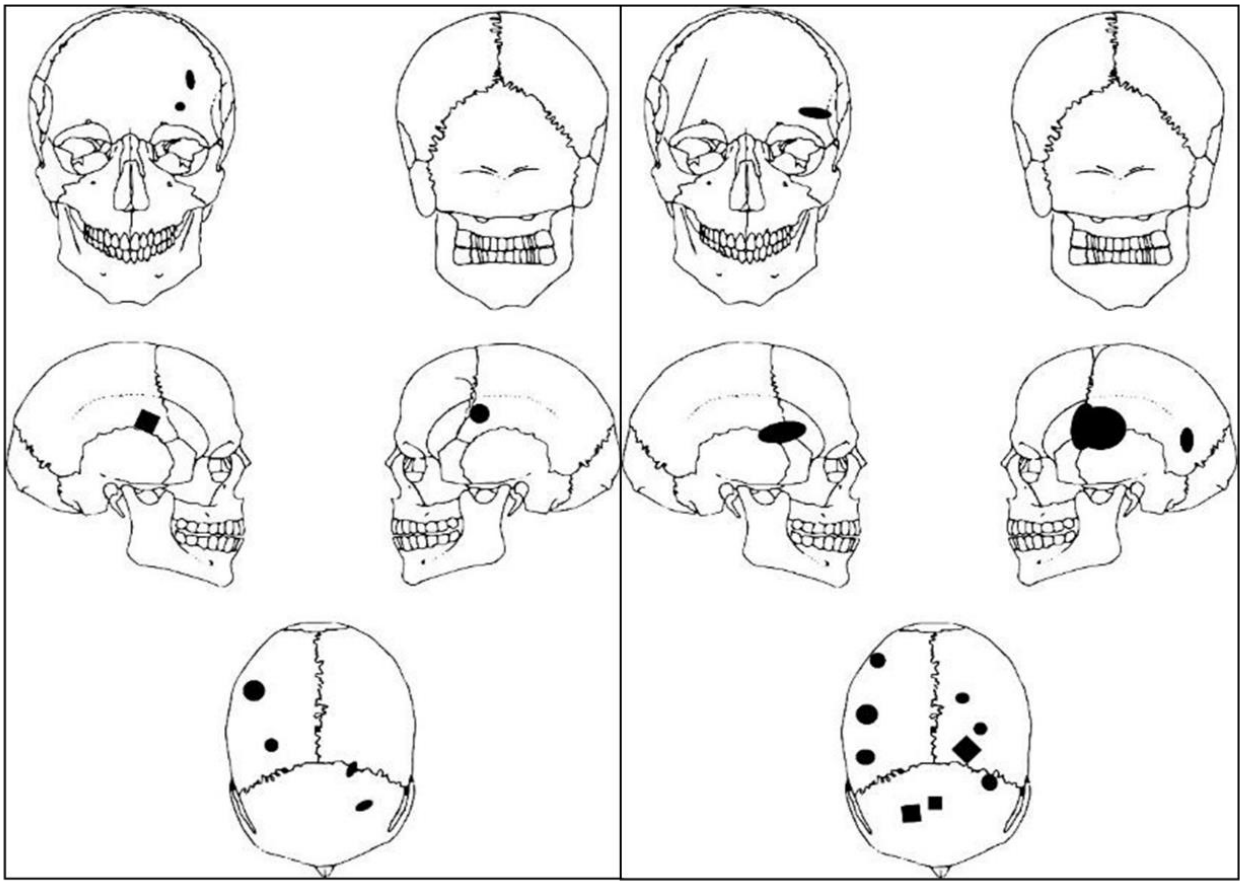

Figure 3.6 - Location of perimortem cranial wounds in females (left) and males (right)

Among males with antemortem injuries, five of 13 wounds are on the anterior aspect (38%), six of 13 wounds are on the superior surface (46%), one of 13 wounds is on the left lateral surface (8%), and one of 13 wounds is on the right lateral surface (8%). Among females with antemortem trauma, one of eight wounds are on the anterior aspect (12.5%), two of eight wounds are on the posterior side (25%), and five of eight wounds are on the superior surface (62.5%) (Figure 3.7). There is no statistically significant difference in wound location between males and females (χ^2, p=0.682). Among adults of indeterminate sex, all three perimortem wounds are located on the superior surface; there are no observed antemortem wounds. Among juveniles, all three perimortem wounds are, again, on the superior aspect of the cranium; there are no antemortem wounds (Figure 3.8).

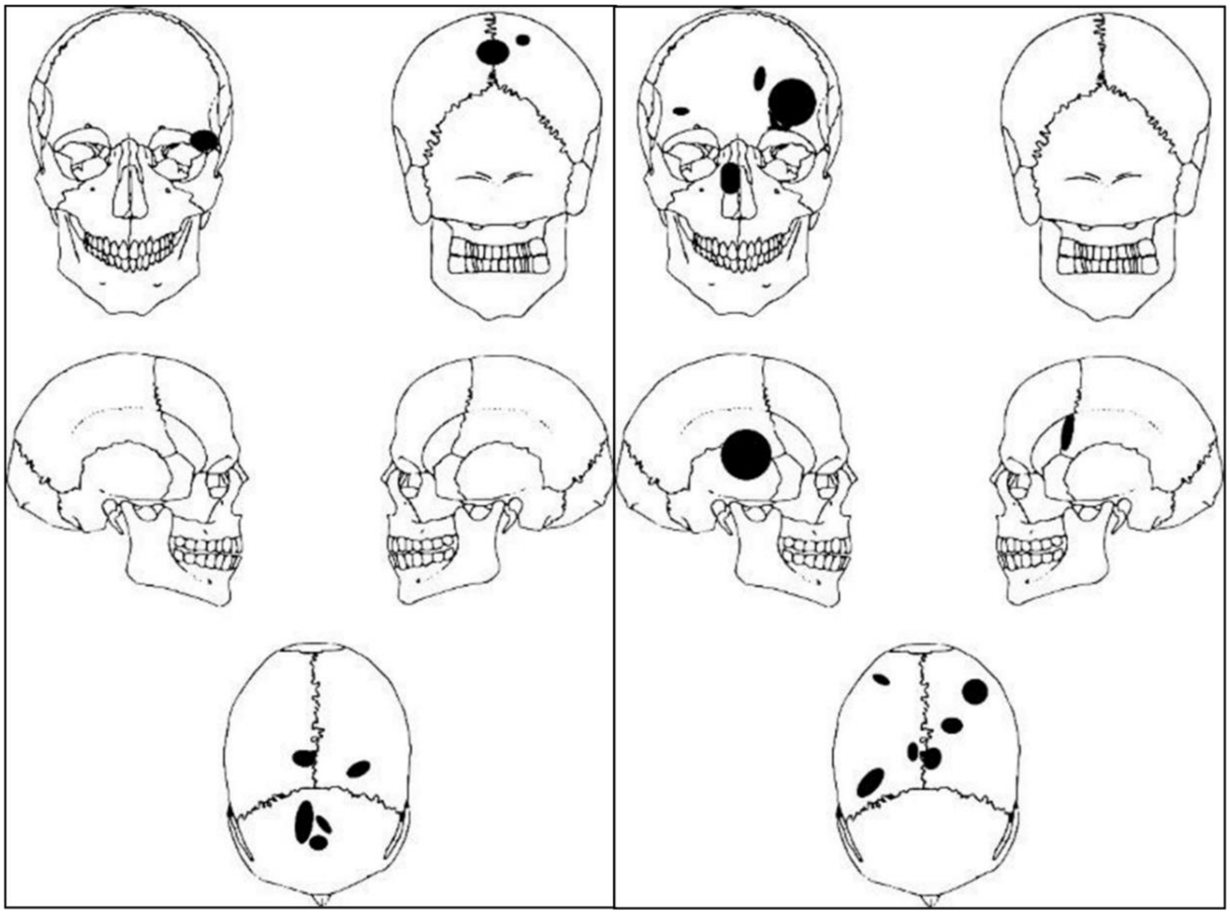

Figure 3.7 - Location of antemortem cranial wounds in females (left) and males (right)

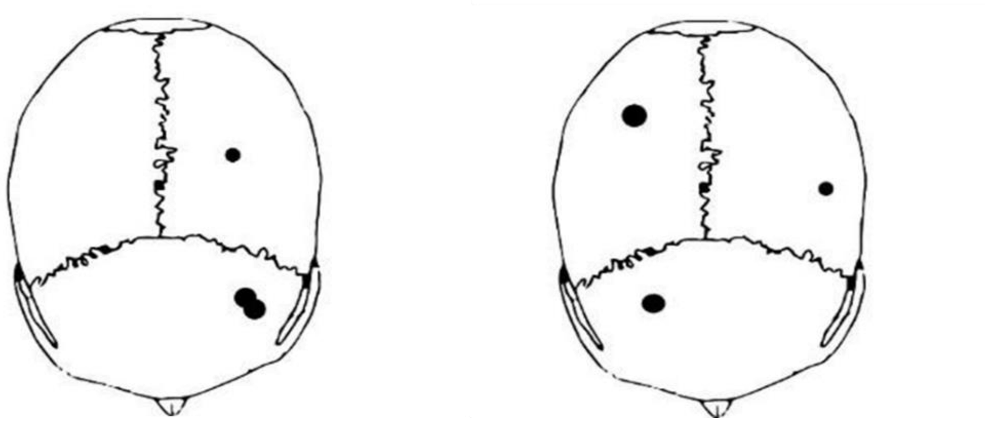

Figure 3.8 - Location of perimortem wounds in crania of adults of unknown sex (left); Location of perimortem wounds in juveniles (right)

Size and Shape of Cranial Wounds

Within the population, 18 of all 51 observed cranial wounds (35%) are round, and range in size between 6.45mm and 40.40mm in diameter; this includes both ante- and perimortem trauma. Four of the 51 wounds (8%) are square puncture wounds ranging in size between 9.50mm and 16.67mm in width (Figure 3.9); all four of these are perimortem puncture wounds that have fully penetrated both tables. Among the population, 24 of 51 wounds (47%) are ovoid in shape ranging in size between 10.53mm and 40.79mm in length and between 5.42mm and 35.50mm in width. One wound is a non-specifically shaped healed nasal fracture. There is also an antemortem orbital fracture. The final three wounds (6%) are radiating fractures originating from other wounds.

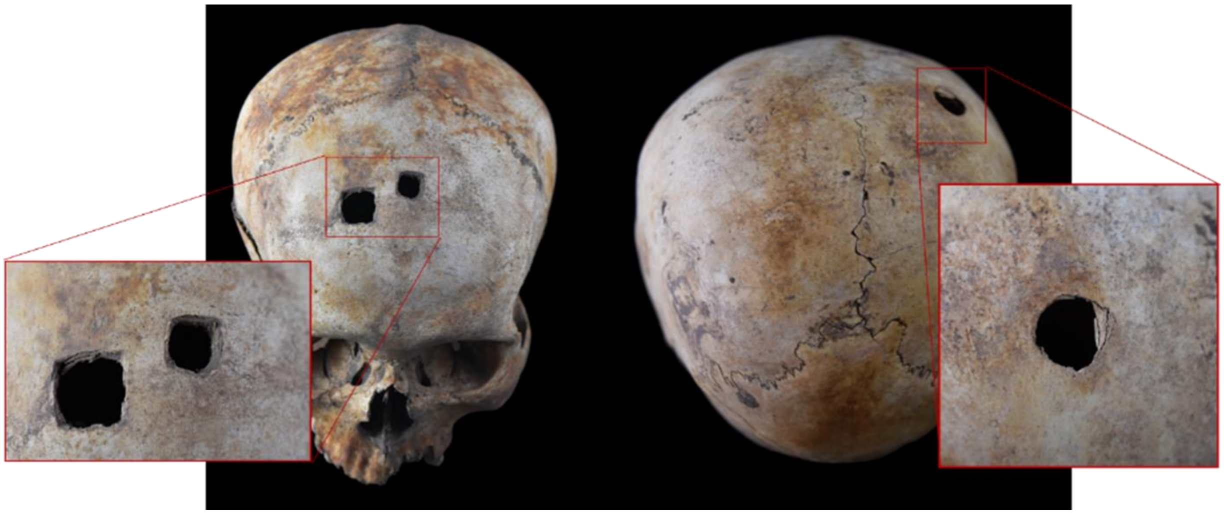

Figure 3.9 - Perimortem puncture wounds in young male (left) and child (right)

Of the perimortem cranial wounds, 14 of 30 wounds (47%) are round, four of 30 (13%) are square, and nine of 30 are ovoid (30%). Of the antemortem wounds, four of 21 (19%) are round, 15 of 21 (71%) are ovoid, and the remaining two are non-specific in shape. Of the round wounds, 13 of these 18 (72%) are perimortem puncture wounds and these range in diameter from 6.45mm to 18.72mm. The remaining five of 18 round wounds (28%) are the result of blunt force trauma, and these range in size between 11.29mm and 40.4mm in diameter. Of the ovoid wounds, two of 24 (8%) are puncture wounds, while the remaining 22 of 24 (92%) appear to be the result of blunt force trauma (Figure 3.10).

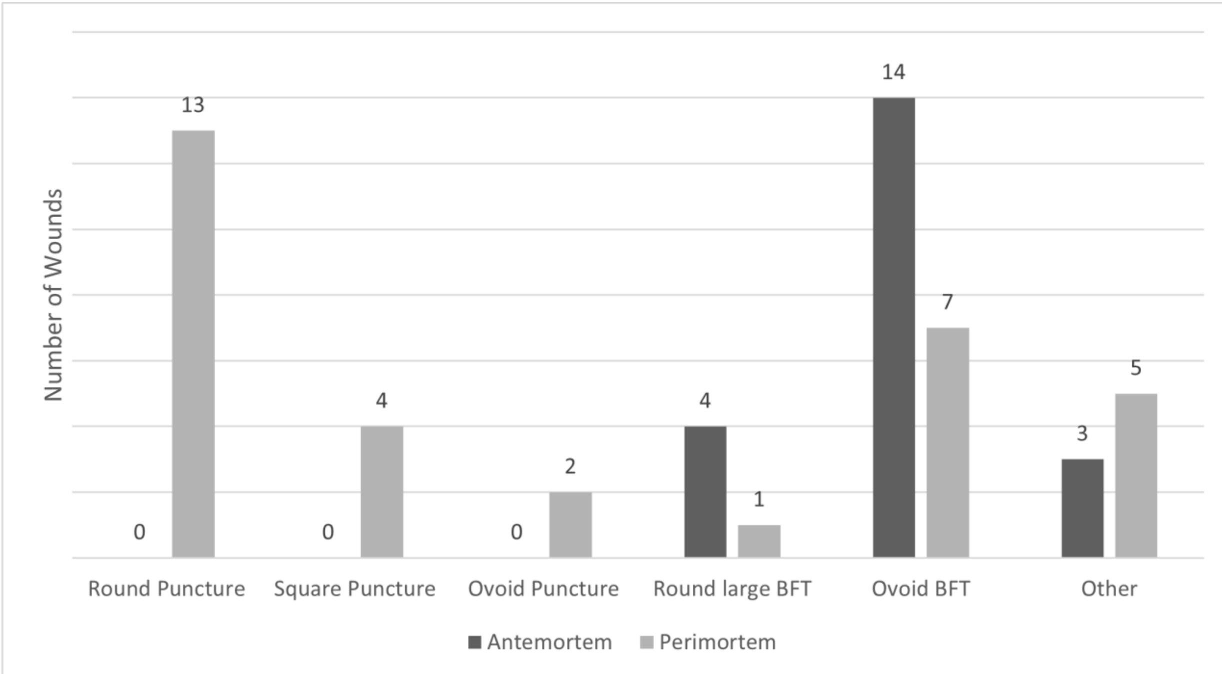

Figure 3.10 - Number of wounds according to shape and type

Among females, five of 17 cranial wounds (29%) are round, one is square (6%), nine are ovoid (53%), one is an antemortem orbital fracture, and the remaining wound is a radiating fracture. Among males, seven of 28 are round (25%), three are square (11%), 15 of 28 are ovoid (54%), one is an antemortem nasal fracture, and the remaining two are radiating fractures (7%). There is no significant difference in the shape of wounds between males and females (χ^2, p=0.898). Among adults of indeterminate sex, all three wounds are round punctures. Finally, all three wounds observed in juveniles are also round punctures.

Postcranial Trauma

Evidence of trauma at Santa Bárbara is seen on 33 postcranial skeletal elements (

Table 3.5). This assemblage is constituted of the following ten bone types[26]: clavicle (N=121), the scapula (N=50), the ribs (N=287), the humerus (N=331), the radius (N=182), the ulna (N=203), the femur (N=438), the tibia (N=326), the fibula (N=202), and the metatarsals (N=405). All postcranial trauma is found in adult individuals for whom sex could not be estimated.

Table 3.5 - Frequency of postcranial trauma at Santa Bárbara by skeletal element

Bone	Side	Number affected	Number examined	Trauma frequency (%)
Clavicle	L	0	63	0.0
Clavicle	R	3	79	3.8
Scapula	L	0	64	0.0
Scapula	R	1	56	1.8
Ribs	Both	5	334	1.5
Humerus	L	1	197	0.5
Humerus	R	0	183	0.0
Radius	L	1	107	0.9
Radius	R	4	113	3.5
Ulna	L	4	118	3.4
Ulna	R	0	123	0.0
Femur	L	5	237	2.1
Femur	R	2	252	0.8
Tibia	L	1	189	0.5
Tibia	R	1	183	0.5
Fibula	L	3	116	2.6
Fibula	R	1	132	0.8
Metatarsals	L	0	39	0.0
Metatarsals	R	1	47	2.1

[26] Number of bones is based on counts of elements that were at least 50% complete

Description of Postcranial Wounds

Among the 33 affected elements in the population, there are a total of 40 wounds of varying etiologies. Of these, 65% (26/40) occurred antemortem, and 35% (14/40) are perimortem. Only four bones exhibit more than one wound; 50% (2/4) have two wounds, and one each (25% ea.) have three and four wounds, respectively. Both elements with two wounds (one rib and one femur) have injuries that were sustained antemortem. The right tibia with three wounds and the left femur with four wounds both suffered all injuries around the time of death.

Size and Shape of Postcranial Wounds

Within the sample, 20 of the 40 wounds are complete, transverse breaks (20/40 = 50%) and all of these are healed. Among these, five are distal radial fractures suggestive of accidental injuries resulting from falls (Figure 3.11); three others are parry fractures, typically indicative of warding off a blow (Figure 3.12). A transverse break on the femoral neck of one element resulted in the nonunion of the femoral head during healing. All other transverse and spiral fractures occur on the shaft of long bones or on the body of ribs, save for a transverse fracture that bisects the body of a scapula. Four wounds (4/10 = 10%) are complete spiral fractures (Figure 3.13), all of which occurred antemortem. One femur also has a healed greenstick fracture (1/40 = 2.5%). There is a single antemortem, comminuted fracture (1/40 = 2.5%) of the proximal end of an ulna that resulted in the complete obliteration of the olecranon process (Figure 3.12). On one tibia and two fibulae (3/40 = 7.5%), there is evidence for healed avulsion fractures. These are located at the attachments for the soleus muscle in all cases.

Figure 3.11 - (a,b) antemortem Colles' fracture of left radius; (c,d) antemortem Colles' fracture of left radius; (e,f) antemortem Smith's fracture of left radius

Figure 3.12 (a,b) antemortem fracture of ulna resulting in non-union of olecranon process; (c,d) antemortem parry fracture to left ulna; (e,f) antemortem parry fracture of left ulna

Figure 3.13 - Badly healed transverse fracture of left femur

There is one complex, perimortem fracture (1/40 = 2.5%) originating from a single penetrating blow from a sharp-edged rhomboid object to the proximal third of the femoral shaft that radiated and resulted in a spiral fracture of the shaft. The same square shape is seen in two other wounds (2/40 = 5%); all square penetrating wounds were suffered around the time of death. Of the remaining wounds, seven (7/40 = 17.5%) are round depression fractures. One of these is healed, and the remaining six are perimortem. All penetrative wounds are located close to articulations, particularly the hip, the knee, and the ankle. Finally, the distal end of a femur shows three parallel cutmarks on the lateral condyle (1/40 = 2.5%), all sustained in the same injury near the time of death.

Discussion

Increased Cranial Trauma in Older Individuals

Though cranial trauma is found in all age groups within the sample, the frequency of this trauma clearly increases with age (χ^2, p=0.033). However, while some scholars have argued that this patterning of cranial trauma frequency is reflexive of the accumulation of life course experiences related to both social and physiological factors (e.g., fragility resulting from age) (Glencross 2011), there is no difference in the degree of lethality of the cranial trauma observed between demographic groups in this population. The cranial fractures documented in the Santa Bárbara population are primarily the result of direct violence intended to cause harm. Long-term, recurrent accidental trauma in older members of the population would result in a higher number of antemortem wounds in these individuals or fractures that do not match patterns of attack to the skull. In addition, there is no obvious cumulative effect in the appearance of cranial wounds among individuals; it does not appear that the inhabitants of the site were frequently victims of multiple violent encounters over the course of their lifetime.

Only 15% of adult individuals (5/34) indicate injury recidivism; of these individuals, only two have healed trauma in addition to the perimortem trauma related to their deaths. The remaining three individuals who may have been victims of multiple violent attacks show multiple antemortem wounds, although it is impossible to know whether these injuries are all the result of the same encounter in the past. However, despite the presence of a few individuals showing cranial injury recidivism, the ratio of lethal wounds to healed traumas remains approximately the same across demographic categories. This suggests that rather than compounding effects leading to higher numbers of wounds overall, the observed patterns can be explained by increased rates of violence against older individuals in general. In any case, the fact remains that most of the head traumas seen across the whole of the population are lethal perimortem injuries. This presents interesting questions as to why older individuals were more often targets of lethal violence. Of eight individuals ranging from middle adult to old adult, two exhibit round puncture wounds likely related to weapons wielded by the Spanish[27] (see below). It may be that these older individuals were at a higher risk of violence from mine overseers as their bodies slowed and their potential as laborers declined through the degradation of the skeleton (Proctor n.d.).

All Sexes at Equal Risk of Injury

Contrary to the differences observed between age groups, there is no significant difference between males and females when it comes to experiences of violence leading to cranial trauma (χ^2, p=0.549). Instead, it appears that the experience of violence was both ubiquitous and undifferentiated in the population, regardless of sex. This differs from what has been found in bioarchaeological studies of trauma in the Andes prior to Spanish arrival. Studies of pre-Columbian societies have documented cranial trauma in both males and females in the Middle Horizon and Late Intermediate Period (see Torres-Rouff, Costa-Junqueira, and Llagostera 2005, Tung 2007, Murphy et al. 2010, Murphy and Juengst 2019, Andrushko and Torres 2011, Scaffidi and Tung 2020). Comparing the patterns of the wounds found in these

[27] This is much higher than other age classes, although the low sample size should be considered.

populations and accompanying interpretations helps us to clarify the ways in which violence was transformed in its presentation. For example, Tung (2007, 2012) has documented high levels of cranial trauma among populations in the heartland of the Wari Empire, but this cranial trauma presents itself differently along lines of sex. The stereotypically male role of warrior in Wari populations, evidenced by iconography of males dressed for battle and laden with trophy heads, correlates with high levels of trauma on all surfaces of the cranium of males, but especially on the anterior aspect (Tung 2007, 2012). Women, on the other hand, typically exhibit wounds on the posterior portion of the cranium, indicative of fleeing or protecting their faces during raids (Tung 2012). Contrary to patterns of wounds among Wari females, only 12% of females recovered at Santa Bárbara exhibit wounds to the posterior of the cranium, none of which were lethal as evidenced by the complete healing of the cranial vault. While we cannot assume gender, the homogeneity of the application of violence points to an erasure of gender categories, subsumed under the imposed social identity of "Indigenous".

The cranial trauma patterns at Santa Bárbara point to interpersonal encounters, as seen primarily among the male Wari individuals. However, unlike the massive blunt force traumas seen in those populations, the wounds at Santa Bárbara are instead depression and puncture fractures with clear margins. Indeed, the majority of lethal wounds to the superior portion of the cranium appear to be the result of either pointed projectile weapons—firearms, longbows, or crossbows—or Spanish military weapons with hafted metal heads, such as halberds or lances. This is evidenced by the relatively consistent diameter of the wounds and observed beveling of the endocranial surface, which indicates concentrated force at high velocity, though there are no indications of projectile exit wounds in the population.

Attacks with Military Armaments

When considering the high frequency of lethal penetrative wounds to the superior portion of the cranium (Table 3.4), identifying the scenarios in which these injuries might have been inflicted is crucial. The superior and high lateral positions of these penetrative traumas suggest that the victims were either kneeling at the time of death, or were below their attackers. Given the steep, hilly topography around the Santa Bárbara encampment and the effective ranges of the *arquebus* (120 meters) and crossbow (200 meters), it is unlikely that the wounds inflicted upon the inhabitants would have been fired upon from higher ground. Far more plausible is that these wounds were inflicted at close range from individuals on horseback. In Guaman Poma's accounts of the administration of the mines (1615), the Spanish *mayordomos* are depicted on horseback, punishing the indigenous laborers (Figure 3.14). It is also highly unlikely that the indigenous miners of the Santa Barbara encampment would have had access to armaments, though many mining tools may have served as *ad hoc* weapons. Despite the general preference of military swords as weapons—valued primarily for their ease-of-use relative to their lethality—there is no evidence for sharp force trauma on any of the analyzed crania. The aforementioned cutmarks on the left knee of one femur are the sole evidence for the possible use of bladed weapons intended to inflict injury at Santa Bárbara (Figure 3.15).

Figure 3.14 - A mayordomo beats his porter; from Guaman Poma de Ayala (1980[1615]:399[/524])

Figure 3.15 - Perimortem sharp force trauma on lateral condyle of right femur

The round and square penetrative wounds to the skeleton in this population appear, at first glance, to be the result of bows, crossbows, or firearms. The rhomboid penetrative wounds seen in one of the femurs are nearly identical to those identified in the crania. Similarly, the round depressions in the femur and tibiae overlap in size with those round fractures seen in individual crania recovered at the site (Figure 3.16). All these perimortem depression and penetration fractures occur at the site of joints—specifically, the femur fractures are seen at the hip and knee, while the affected tibia shows this type of wound at the knee and inner ankle (Figure 3.17). Unlike the crania, only one of these shows complete penetration of the cortex, though this may be an artifact of the increased bone density of the bone and underlying trabecular support structure in the hip, ankle, and knee areas. Several small cutmarks in the lateral condyle of a right femur show consistent targeting of the articular surfaces of the legs. This may be evidence for intentional immobilization of the victim of violence, especially given that many of the affected individuals died shortly after suffering these traumas.

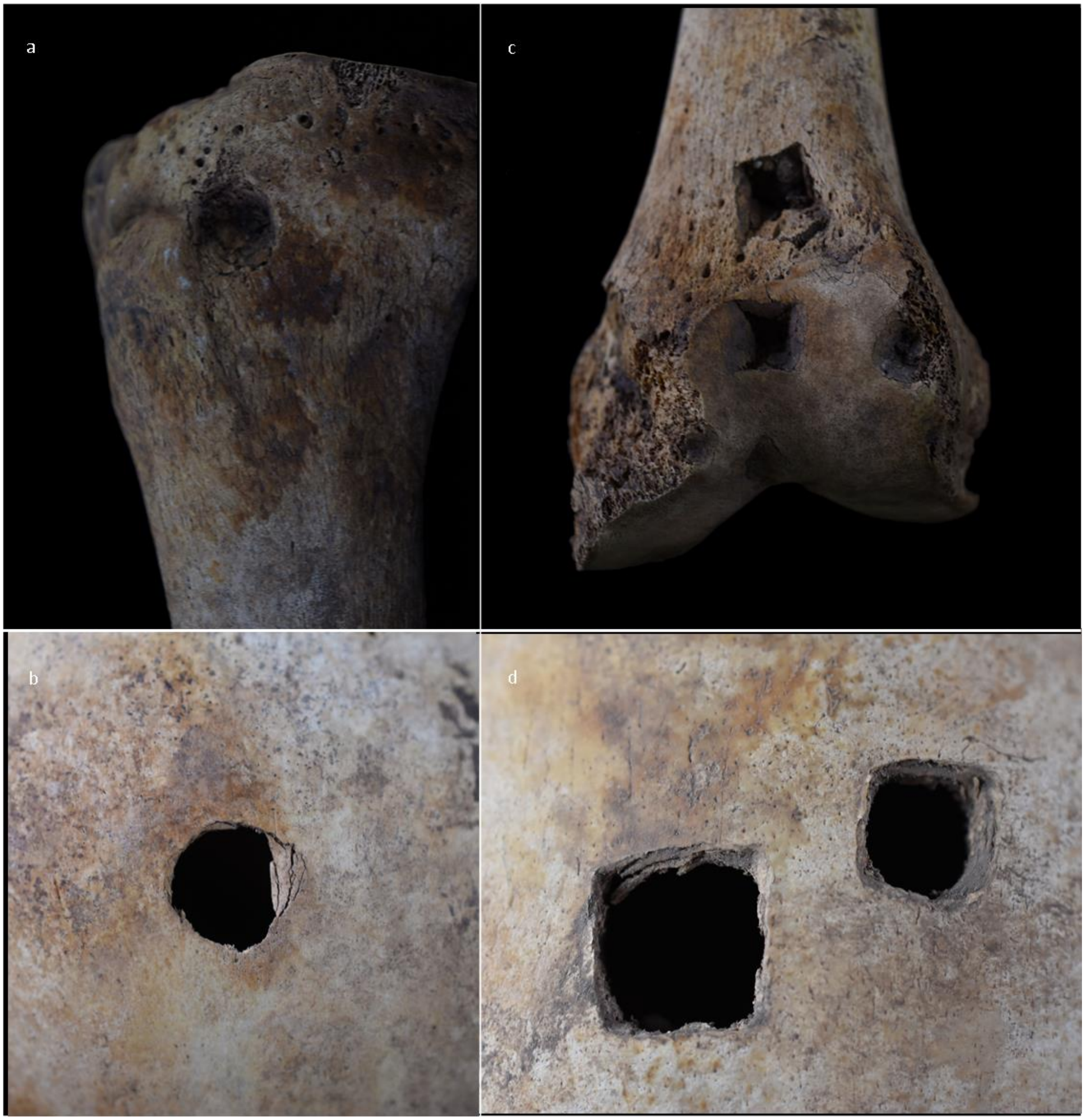

Figure 3.16 - (a) round perimortem wound adjacent to tibial tuberosity of left tibia; (b) perimortem round wound to cranium; (c) perimortem rhomboid penetrative wound on distal end and patellar surface of left femur

Figure 3.17 - (a) anterior view of right tibia with three round, penetrative perimortem injuries; (b) detail view of perimortem wound medial to tibial tuberosity; (c) detail view of wound inferior to tibial plateau on lateral surface; (d) detail view of penetrative wound on medial malleolus

Murphy (2010) and colleagues note that while the crossbow and *arquebus* were likely part of the Spanish arsenal, they were large, unwieldy, and generally inaccurate weapons; it is thus surprising to find so much high velocity trauma in the population at Santa Bárbara. To explore the possible mechanism(s) behind the observed traumas, we must clarify what types of weapons would have been used or available in order to better compare the signature of the various armaments. I propose three hypotheses for the specific mechanism behind these injuries: (1) firearms, (2) crossbows and longbows, or (3) blunt force trauma with hafted weapons.

The most likely candidates for firearms used in the Viceroyalty vary from century to century. Historical documents from the Colonial Period point to the ubiquity of the *arcabuz* and the *escopeta*, as when a Spanish chronicler describes the location of the Santa Bárbara mercury deposits as only "an arcabuz shot" from the nearby hill of Chaquilatacanas (Torres de Mendoza 1868 [1609], 422). The *arcabuz* typically refers to a "handheld, muzzle-loading weapon" (Deagan 1987, 270), likely with a matchlock, but may also have been a flintlock.[28] The *escopeta* noted in the historical documents likely refers to a light musket. Between 1630 and 1728, the *escopeta* was issued to foot and mounted troops, and did not require a stand as opposed to the large muskets used in the 15th and early 16th centuries. However, a dearth of data on the characteristics of early colonial gunshot wounds makes it difficult to assess the viability of the firearm hypothesis. The velocity of the projectiles produced by these firearms ranges from approximately 170 m/s to over 300 m/s. This is certainly a high enough velocity to cause lethal penetrative trauma: the higher velocity is similar to bullet velocities from .45 and .22 caliber modern firearms, while M16 rifle bullets have a velocity of about 960 m/s (Murphy, Spatola, and Weathermon 2014). It is also notable that any firearm projectiles used by the Spanish would have been balls rather than jacketed bullets; as such, the projectile would have been flattened somewhat upon impact with cranial bone, and significantly slowed by cerebral tissue.

However, other considerations are inconsistent with the firearm hypothesis. The range in sizes of the round projectile wounds in the Santa Barbara population falls is between 6.45mm

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[28] The matchlock was introduced earlier, in the 16th century, and was improved upon by the flintlock, which was introduced into the Americas in the 18th century, and eliminated the need for a match to ignite the gunpowder (Deagan 1987).

and 12.39mm (Figure 3.18); this is equivalent to 0.25 to 0.49 caliber shots. Due to a lack of standardization in firearms in the 16th through early 17th century, the caliber of the bullets used in these weapons varies between .58 and .75 caliber (Murphy, Spatola, and Weathermon 2014, 266). *Escopetas* recovered from sites in New Mexico dating from the late 17th through the 18th centuries range in caliber from .60 to .69 (Brinckerhoff and Chamberlain 1972). In 1703, the Spanish military adopted the *fusil*, which was a smaller infantry musket that used a standard caliber of .69 beginning in 1728 (Brinckerhoff and Chamberlain 1972). These differences in caliber are all quite minor, and although large differences in caliber would be evident from the size of entry wounds, small differences in bullet caliber would be indistinguishable (Quatrehomme and İşcan 1999). As a further confounding factor, the size of the entry wound varies not only based on the size of the bullet, but also on the elasticity of the skin (Berryman, Smith, and Symes 1995). As a result, we would not be able to determine whether the penetrative wounds seen in the crania of the Santa Barbara population are a product of *arcabuces, escopetas,* or *fusiles.* However, for all of these weapons, the conventional bullet size would have been too large to have caused the cranial wounds observed in the population at Santa Bárbara; the regular use of firearms at this site is therefore unlikely.

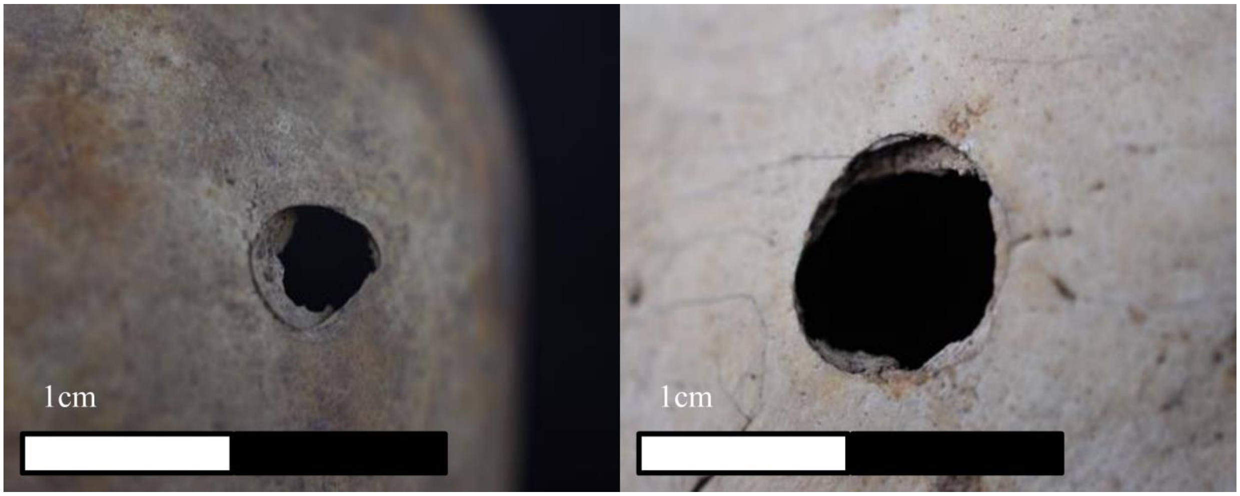

Figure 3.18 - Round projectile wounds in infant cranium (left) and teen male cranium (right).

A second possibility is that these wounds are the result of longbow arrows or crossbow bolts. The relatively small width and almost perfectly square shape of some puncture wounds is similar to the four-sided bodkin head commonly used in conventional arrows and crossbow bolts from the medieval period (Figure 3.19) (Gorman 2016). The relatively low velocity of the projectiles fired from 16th century crossbows and traditional bows (approximately 35-55 m/s) is consistent with the lack of observed hoop fractures and small radiating fractures. It also accounts for the presence of residual hinging in both the round and square fractures, accompanied by beveling on the endocranial surface (Peterson 1991, Gorman 2016, Quatrehomme and İşcan 1999) (Figure 3.20). In addition, the clean entry wounds seen in the crania may indicate a more structurally rigid projectile than the previously mentioned lead shot, which would have deformed upon impact with bony tissue, leading to a much larger and ill-defined trauma. The low velocity of the crossbow bolts would also account for the observed lack of exit wounds in complete crania, as the projectile would have been slowed dramatically upon contact with hard tissue and brain matter.

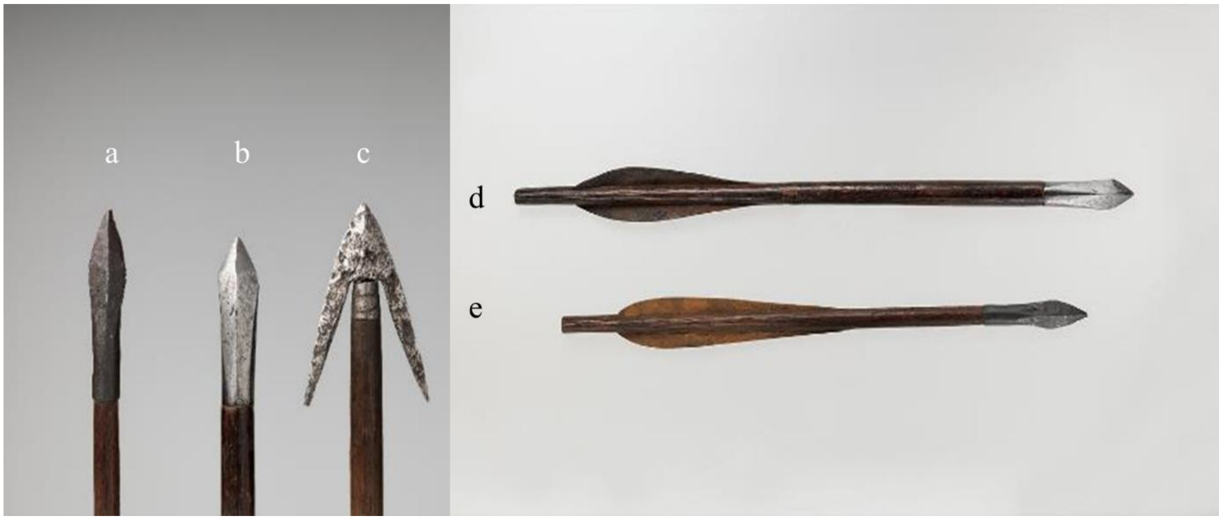

Figure 3.19 - Crossbow bolts from 15th to 17th century Western or Central Europe; bodkin arrowheads (a,b,d,e), barbed arrowhead (c); (Metropolitan Museum of Art, New York)

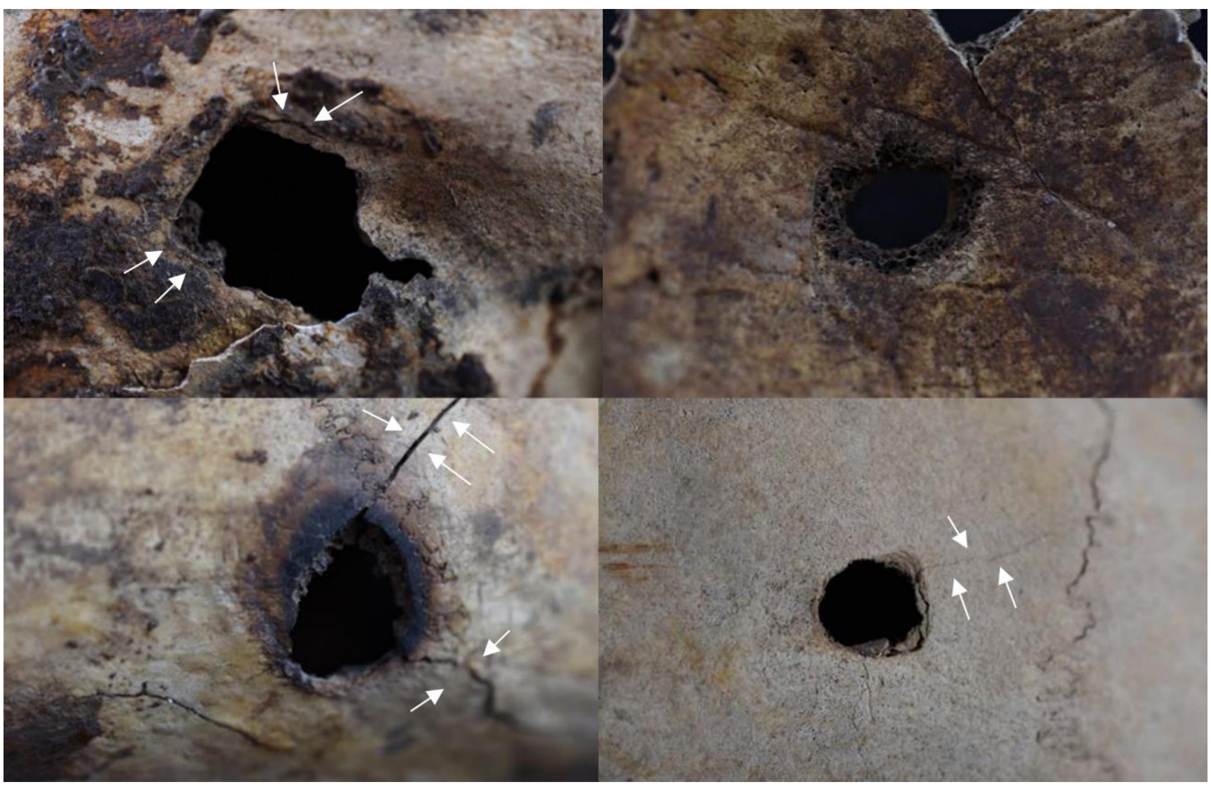

Figure 3.20 - (clockwise from top left) Square penetration wound with hinging; endocranial beveling on round penetration wound; round penetration wound with radiating fractures and hingeing; round penetration with radiating fractures and burning.

However, despite this evidence, it remains possible that these injuries are instead the result of a direct attack using a pointed weapon. In their study of medieval and Renaissance burials in Turin, Italy, Giuffra and colleagues (2015) describe a rhomboidal wound similar to those seen in the Santa Bárbara population, noting that these wounds may have been inflicted by pointed blunt weapons such as spears and halberds. In another case study of a medieval battlefield cemetery in England, Novak (2007) suggests that the rectangular wounds are similar in profile to the beak of a war hammer, or the top spike of a poleaxe; the quadrangular penetrations from this site are nearly identical to those seen at Santa Bárbara. The Spanish arsenal was varied, to be sure, but much of the Spanish army—and presumably the overseers—carried pikes and polearms in addition to their swords (Murphy et al. 2010). In almost all depictions of the *corregidores* and their various punishments of the indigenous population, they are seen carrying slender staffs, which may be simplified drawings of these long, handheld weapons (Figure 3.21).

Figure 3.21 - Images of corregidores with long staves (Guaman Poma 1980[1615]: /494, /499)

The weapons involved in the other, non-penetrative wounds seen at the site appear to have been varied; that is, wounds—particularly those that are ovoid and antemortem—vary considerably in size. While these are likely related to blunt force trauma, the weapons used in the case of these larger, more irregular wounds is unclear. A variety of improvised weapons may have been used at the site, ranging from clubs to maces, whether by the Spanish or by the indigenous inhabitants of Santa Bárbara. Blunt force trauma attacks, though, may not have been intended to be lethal; in the crania, only 28% (8/29) of these types of injuries were lethal blows showing no evidence of healing. It should be noted, additionally, that 38% (3/8) of these lethal blunt-force wounds may in fact be the result of glancing blows from projectiles, not unlike keyhole[29] fractures, though from much lower velocity weapons.

Fear, Threats, and the Persistence of Violence

While it is impossible to say with absolute certainty that the cranial trauma documented among the Santa Bárbara population was entirely the result of Spanish abuse, ethnohistoric documents from Guaman Poma (1980[1615]) suggest rampant abuse of the indigenous people working in the mines in the form of whipping and beatings intended to both punish and deter rebellion (Robins 2011). Implicit in this is that the subjugated populations, except in possible rare cases, would not have had access to a means of defense from the Spanish, making their use of lethal weapons rather unlikely; explicitly, the "Laws of the Indies" prohibited giving or selling arms to indigenous people (Lynch 2001). While this prohibition was less strictly enforced among some indigenous leaders, descriptions of the *mitayos* and the circumstances under which they lived indicate that the use of military weapons would have been restricted to *mineros, mayordomos,* and *corregidores*. As such, the wounds inflicted upon the population recovered at the site of Santa Bárbara are directly related to assault to indigenous bodies.

The colonial mining industry was built upon structures of inequality and the denial of basic needs; maintaining these institutions required the calculated use of a variety of direct assaults upon the indigenous person. Fear and suffering were embedded and embodied at Santa Bárbara, situating the indigenous at the edge of mortality made fragile and uncertain. Abuse as punishment or deterrence—for not making quotas, for perceived disobedience—was ubiquitous. Healing in many of the cranial wounds suggests that, in fact, the intent was not always to kill, but

[29] This type of trauma results in a circular wound with an associated fragmentation of the surround cranial surface (Dixon 1982)

rather to reinforce the imminence of the threat of death. This practice underlies extractive practices under systems of colonial power. In his discussion of the project of rubber extraction in Putumayo, Taussig describes at length the tortures experienced by the Indigenous workers, living under a "culture of terror,". He argues that this practice is akin to a ritual enactment of colonial power. That is, this direct, extraordinary violence is inherent in colonial projects of extraction. This underpins the tripartite nature of Galtung's explanation of violence, providing evidence for the necessary use of direct, intentional violence as a way to gird the inegalitarian institutions around which the colonial mining economy—and colonial society writ large—was constructed and maintained.

CHAPTER 4:
Lives of Labor: Reconstructing Daily Activities through Entheseal Remodeling and Degenerative Joint Disease

Introduction

In the post-medieval period, the European continent was in a state of flux economically and politically. The expansion of colonial endeavors by the continental powers had led to vast increases in natural wealth through the exploitation of colonies and the accompanying projects of population displacement and cultural erasure enacted across the world. In particular, in the 16th century, Spain ascended to the apex of the European economic market by draining the New World of precious metals—especially silver—that had formed the basis for the monetary system across Europe and Asia. The voraciousness with which the Spanish Crown consumed the resources of the Americas rapidly led to the depletion of the mineral deposits in the colonies, and Spain grew desperate to maintain their steady import of silver. A key measure in increasing output—and therefore maintaining power despite an abysmal manufacturing sector—was the mass exploitation and abuse of the Indigenous inhabitants of the Americas through programs of forced labor.

In the Viceroyalty of Peru, extensive labor needs set off a project oriented towards the mass mobilization of labor through a system known as the *mita*, a type of rotational tributary labor tax that—officially—required Indigenous men to serve a pre-determined amount of time engaged in labor for the Crown. For many individuals in the highlands, this labor including working in the silver mines of Potosí, Bolivia and the mercury mines of Huancavelica, Peru. The control over the population of the Viceroyalty was upheld by census data and the vise-like tightening of the grip of colonial authorities, who rounded people up so that they could more easily be removed from their homes as part of a larger project of resettlement and conversion

(Cole 1985, Dell 2008, Montero 2011, Wiedner 1960, Zagalsky 2014, Wernke 2013, Mumford 2012). In conjunction with the program of resettlement of Indigenous communities into planned towns, the *mita* system assured a consistent labor force composed of tributary workers known as *mitayos*. This article will explore how the abusive systems of labor implemented by the Spanish were at the base structures of violence rooted in inequality and oppression through an analysis of burials found at the mercury mining site of Santa Bárbara in Huancavelica, Peru. This indirect violence was made corporeally manifest—embodied in the physical body—through the plastic remodeling and slow degeneration of the skeleton in response to exploitative labor demands driven by the Spanish *mita* system and the Crown's voracious desire for wealth and resources.

The Violence of Labor

Labor lies at the root of studies of the state and the legitimation of power through the construction of docile bodies. Most labor systems—especially including the Spanish *mita*—are built upon constructed systems of inegalitarian power distributions. This difference in power and its associated oppression form the basis for Galtung's idea of structural violence—an invisible, insidious, and indirect form of violence that manifests in the systematic violation and denial of basic human needs: survival, well-being, freedom, and identity (Galtung 1969). Scholars have since applied structural violence theory to cultural and medical anthropology (e.g., Farmer 1996, Farmer et al. 2004, Benson 2008), public health (e.g., Lane et al. 2008, Lane et al. 2004), and critical race studies (Dressler, Oths, and Gravlee 2005, Gravlee 2009) to understand how social structures deprive individuals of some or all of their basic needs (Galtung 1969). The genesis of globalization, and the beginning of transcontinental economies it entailed, complicated extant hierarchies, and led to the development of divisions of labor based on racialized classifications;

the construction of the race concept was central to colonial endeavors and justifications for forced labor and mistreatment of indigenous and enslaved groups. Among characteristics attributed to different groups, the capacity for moral action and salvation became an important feature. Forced labor and beliefs about indigenous Andeans' potential to be Christian become thoroughly intertwined with ideas of labor, and hard work was seen as an essential part of religious conversion.

The fog of structural violence hangs heavy over the Spanish *mita*, exemplifying the concept through the denial of several of Galtung's basic needs (1990). The most obvious manifestation of structural violence is the denial of well-being needs. The extreme toxicity of mercury led to grave illness among miners and smelters alike. Inhalation and exposure to mercury sulfide due to mining ores and—possibly, even worse—inhalation of methylmercury vapors from smelting led to neurological disorders, tremors, and tooth loss. *Mitayos* were forced to work underground for days at a time without emerging, even needed to pay for their own candles to light their work (Smith 2004). The well-being of the laborers was not of particular concern to Spanish officials and mine overseers; both occupational trauma and direct violence are explicit violations of well-being needs. However, this extends beyond trauma. In this case, this denial of "well-being" is can be observed in the painful degradation of joint surfaces and the remodeling of the skeleton, resulting in the bony growths and severe lesions that will be discussed in this paper.

Forced labor extends beyond physical harm to the denial of "freedom needs" as well. Individuals labored for days at a time in the darkness, obligated to meet unreasonable quotas each day (Smith 2004). The insidiousness of the colonial mining economy also manifests in the Sisyphean nature of the tributary labor term. Proposed terms of two months at Santa Bárbara extended far longer, and *mitayos* found themselves indebted to the Spanish guild members and mine owners. Though nominally paid for their labor, these wages insufficient to meet even basic subsistence needs, which were not paid by their Spanish overseers. Restricted in the ways that they could pay back what they owed, *mitayos* were made captive to laboring at these sites by their debt obligations, essentially as indentured laborers. Even so, they were often unable to meet their financial obligations, leading entire families to migrate to the site and engage in whatever labor was available. The denial of freedom needs was therefore extended from *mitayos* to whole communities. The *mita* system at its core was also inextricably intertwined with the resettlement project, which forced individuals from their homes into *reducciones* and obligating them to convert to the Christian faith. Bodies were policed in nearly every sense: geographically, physically, and spiritually. With this in mind, we can begin to understand how these various denials are embodied in the Santa Bárbara community. While labor activities can sometimes be identified in the archaeological and historical records, bioarchaeology is uniquely positioned to lend support to or challenge these claims. Employing a theoretical model of the embodiment of physical labor—and by proxy, structural violence—we can reconstruct lifeways in past populations to understand the ways in which colonial policies became entrenched in the physical bodies of those most affected by them.

Mining, Mercury, and the Mita

As the rocks being pulled from the depths of the exhausted Potosí[30] mine grew poorer and poorer in silver ore through the mid-16th century (Bakewell 1984b), Spain sought technical advancements for increasing silver output. Their salvation came in the form of mercury

[30] Located in present-day Bolivia

amalgamation, a technique developed by a German mine owner, which had previously been used in New Spain to the north. In 1572, this technique was brought to the Viceroyalty of Peru (Van Buren 2010). Mercury amalgamation used the affinity of mercury for other precious metals; the ores coming from depleted mines were crushed, combined with liquid mercury, salt, and iron, and then trod for days in large patios. The resulting amalgam of silver and mercury was washed and then burned. Due to its higher sublimation point, the mercury volatilized, with some recollected and the rest released into the air around Potosí. The result was pure silver (Robins 2011). With this development, mercury became nearly as valuable as the silver it could extract, and a quest began for the discovery of a mercury deposit in the Americas with sufficient output to supply the miners at Potosí with enough of the liquid metal to maintain a flow of silver back to Spain. The salvation of the Spanish—and resulting decimation of the local Indigenous population around Huancavelica—came in 1563 with the "discovery" of the mercury deposits of Santa Bárbara, Peru.

As for most "discoveries" in the Americas, the deposits of Santa Bárbara had previously been used by local people. In its natural state, mercury there occurred in the form of mercuric sulfide—or cinnabar—a vibrant, red stone that could be ground into a pigment called vermillion. Used for cosmetic and decorative purposes, cinnabar was traded across the Andes for millennia prior to Spanish arrival (Cooke et al. 2009). In November of 1563, Spanish colonist Amador de Cabrera was shown these deposits by local community leader, D. Gonzalo de Navincopa, who sought to curry favor with the Spaniard after his son had lost the official's hat. Cabrera promptly registered the deposit on New Year's Day 1564, expelled the local people from the region, and banned them from exploiting the deposits. Quickly, the Spanish Crown expropriated these mines from Cabrera and the other mine owners, turning them into contractors, rather than proprietors of the mine (Lohmann Villena 1949, Robins 2011, Eguren, de Belaunde, and Burga 2005, Montesinos 1906 [1566]).

The intensive application of the *mita* was one of Viceroy Toledo's many reforms implemented in 1570. Under this system, adult men from the surrounding region were to serve at Huancavelica for a period of two months every seven years. However, it quickly became clear to the Indigenous inhabitants that a rotation at the mines was akin to a death sentence, as many who went to Huancavelica never returned, or came back with debilitating illness due to mercury exposure (Robins 2011, Bakewell 1984b, Brown 2001, Montero 2011, Rivera 1990, Wiedner 1960). As the supply of labor waned, with unwilling tributaries fleeing their home communities, the Spanish began to implement reforms to alleviate the lethality of the mine. Carbon monoxide poisoning was a key antagonist in the decline of the health of the miners, so mine overseers began construction on a horizontal tunnel that travelled perpendicular to the mining shafts in 1606. This was to bring in fresh air as well as provide a less perilous entrance to the mines. This tunnel, known as Nuestra Señora de Belén, became the locus around which the community of Santa Bárbara slowly formed. Over the nearly forty years it took to construct the tunnel, a community of miners grew into a town that would be occupied for nearly four hundred years (Lohmann Villena 1949, Smit 2018).

The Mercury Mining Site of Santa Bárbara

Santa Bárbara is located in the Department of Huancavelica in central, highland Peru at 3972 masl (Figure 4.1). In 2014, Smit conducted excavations at the site to investigate the role Santa Bárbara and its residents within the larger colonial market (Smit 2018). This project showed that Santa Bárbara was occupied from the early 17th century through the 1980s, until it was abandoned due to terrorist violence (Smit 2018). Constructed in several phases—the Middle Colonial Period, the Late Colonial Period, and the Republican Period—the settlement grew out of a mining encampment and into a town surrounding a central Catholic church erected around 1610 (Smit 2018). On the northwest side of the church, there is a formal cemetery that has been in use for at least the last two centuries. On the southeastern side of the church is a small churchyard, measuring approximately 9 meters by 13 meters. In 2014, Smit excavated three commingled burial deposits which were left *in situ* and a series of primary burials (n=8), which were analyzed by the author of this paper (Proctor and Smit 2016, Smit and Proctor 2020). The burials discussed here derive from the southeastern courtyard.

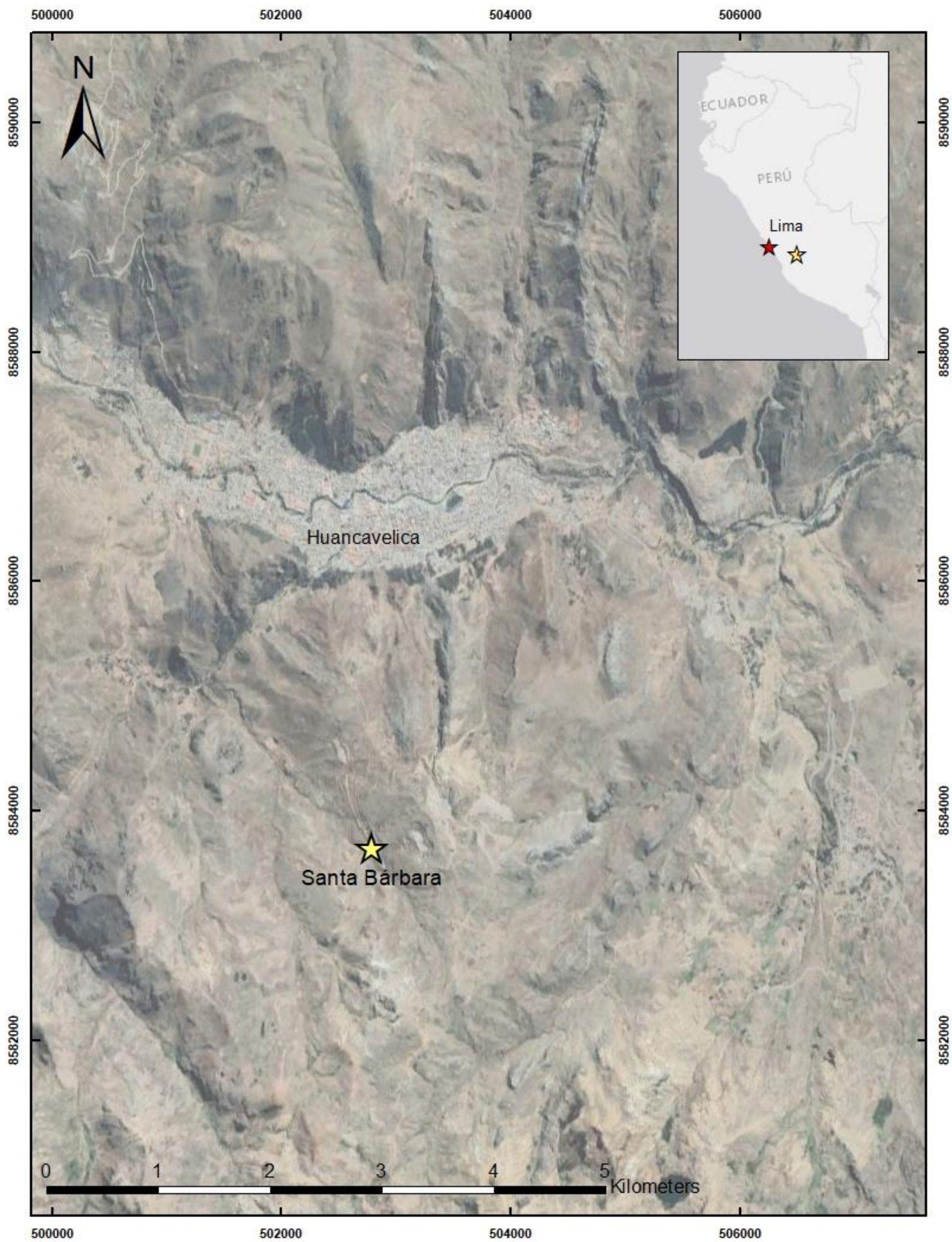

Figure 4.1 - Map of the location of Santa Bárbara in relation to the highland city of Huancavelica

The skeletal remains examined in this paper were recovered from the seven secondary burial pits in the Santa Bárbara churchyard (see below). Artifacts found with the burials include colonial-era ceramics in both local and imported styles, including lead- and tin-glazed ceramics, Peruvian and Panamanian *majolica*, mercury *ollas*, and large pieces of *botijas* usually used for the transportation of prestige goods like wine (Figure 4.2). All of these indicate that they are from the Spanish Colonial Period (16th to early 19th century). The presence of British transferware and painted whiteware in the upper layers suggest that they may have been reinterred from primary burials to the secondary contexts in the early Republican Period. All of the material found with the burials is highly fragmented, suggesting that these were simply discarded as part of the fill for the burial pits.

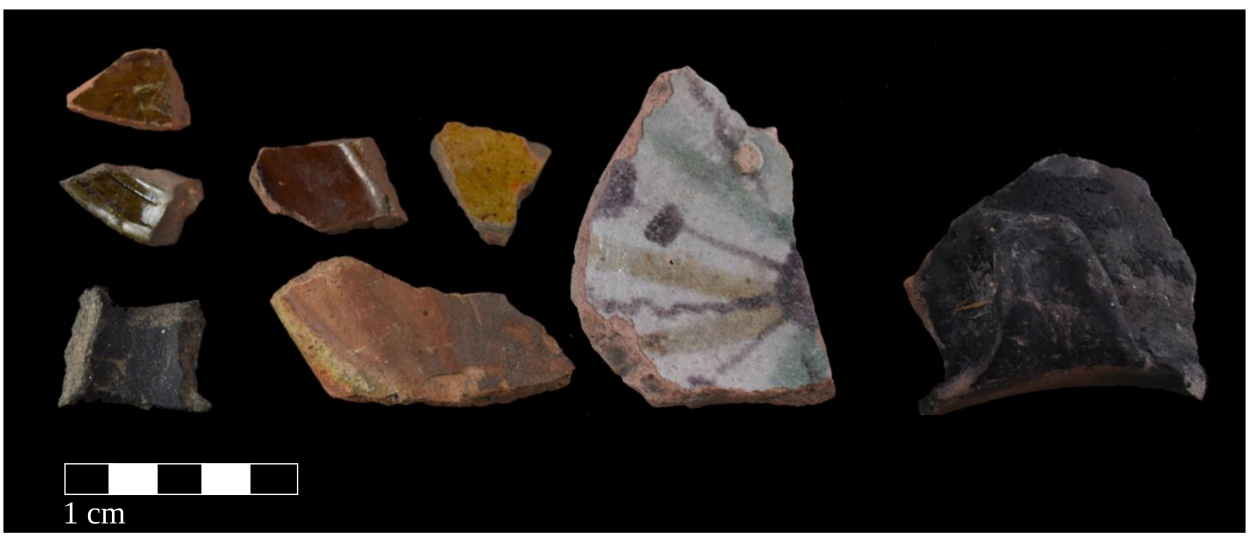

Figure 4.2 - Ceramic sherds associated with Santa Bárbara burial contexts

Materials and Methods

Archaeological Excavation

Data for this paper derive from excavations conducted in 2018 as part of an investigation into the daily lifeways of the inhabitants of Santa Bárbara. Excavations covered 23 square meters in total in two primary units, averaging about 1.5 meters deep. Within these units, my team and I recovered seven secondary burial deposits and two primary burials, which we excavated in artificial 0.3-meter levels. The excavations were documented using overhead photography with a telescoping photo pole and assembled into orthomosaics and 3-dimensional models.

The individuals in the secondary burials were buried following extensive decomposition in most cases, as evidenced by the relative lack of articulated or anatomically positioned skeletal elements. There were ten examples of articulated remains, including the lumbar portion of a vertebral column, a forearm, a cranium with two cervical vertebrae, and an os coxa with a femur and two lumbar vertebrae. The individuals recovered from these secondary deposits appear to have been originally buried in the formal cemetery to the northwest of the church, and then moved to the churchyard when the cemetery became too full, a practice seen with some frequency in Europe in the medieval and post-medieval periods (Anthony 2015, Kenzler and Tarlow 2015). Six of the seven deposits of bones ranged from about 0.40 to 0.70 meters deep; the remaining context was very small and only 0.10 meters in depth. All deposits ranged in area from 0.16 square meters to 1.18 square meters, with a median size of 0.96 square meters (Figure 4.3).

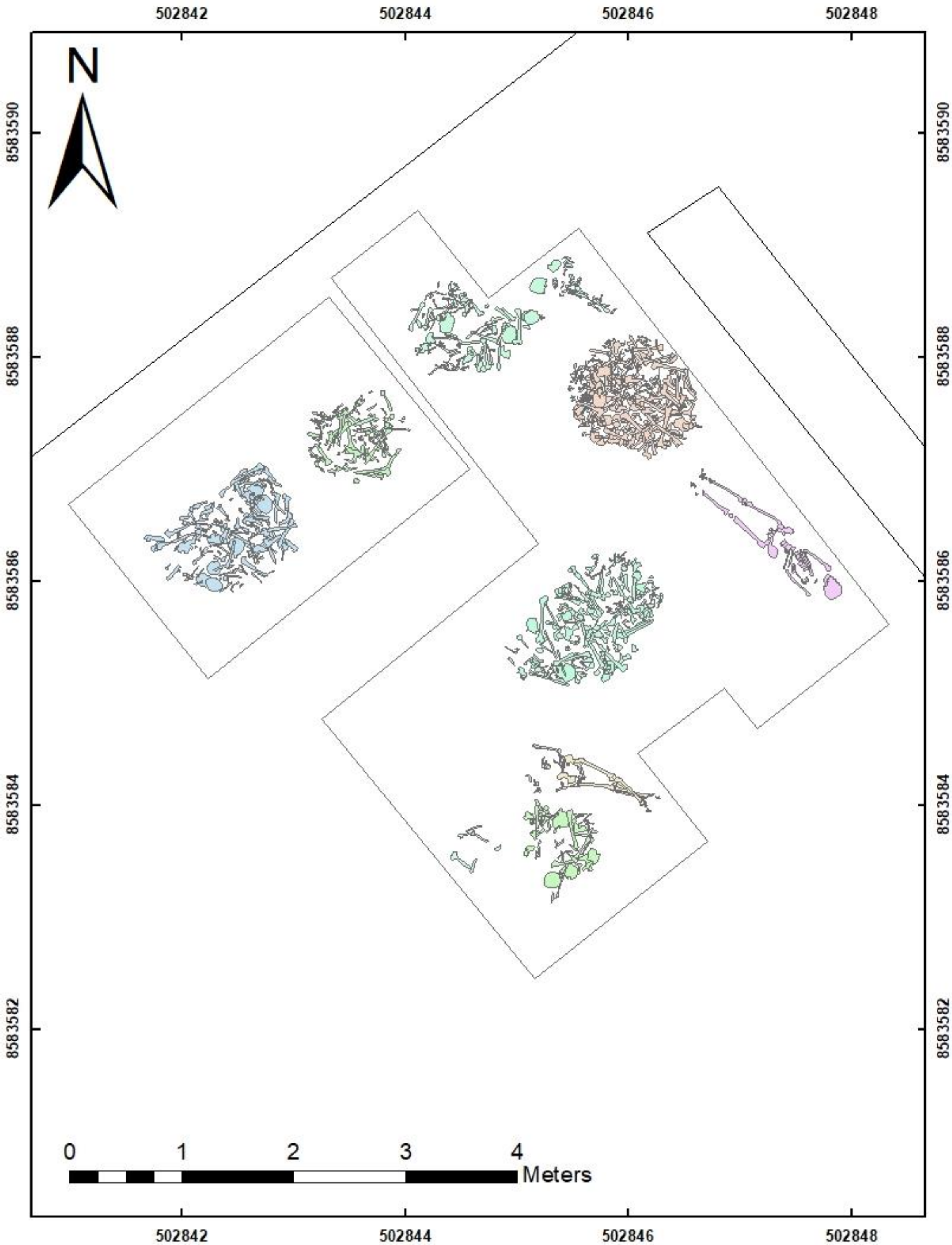

Figure 4.3 - Map of excavation units and burial contexts

The Sample

The minimum number of individuals within the commingled burials was determined by counts of complete long bones and crania. The highest number of complete long bones were right femurs (n = 217). Evidence for musculoskeletal markers was collected from 29 attachment sites on the clavicle (n=123), humerus (n=326), radius (n=189), ulna (n=213), femur (n=419), tibia (n=356), and fibula (n=241). Only bones that were at least 30% complete are included in analyses of entheseal remodeling in this study. The documented population ranged in age from young children to adults, and indicate an MNI of 221 individuals based on counts of right femurs across age groups.

Coding for Age

Standardized bioarchaeological methods were used to establish a demographic profile through age and sex estimations from post-cranial remains (Buikstra and Ubelaker 1994). Subadult age was determined using the fusion of secondary ossification centers (Scheuer and Black 2000), as well as measurements in the case of fetal remains (Baker, Dupras, and Tocheri 2005). Where possible, adults were categorized as Young Adult (20-35), Middle Adult (35-50), or Old Adult (50+), based on the wear of both the pubic symphyseal and auricular surfaces (Brooks and Suchey 1990, Lovejoy et al. 1985, Todd 1920). Other post-cranial remains with completely fused epiphyses and secondary ossification centers were labelled as Adult. Due to the commingled and disarticulated context of the remains, all age estimation conducted is subject to methodological limitations.

Sex Estimation

Standard bioarchaeological methods were used to estimate sex in pelves (n=373, MNI=116) (Buikstra and Ubelaker 1994). Pelvic sex was estimated using as many as possible of the following morphological features, depending on the portion of the os coxa present: the ventral arc, the subpubic concavity, the ischiopubic ramus ridge, and the greater sciatic notch. Os coxae were scored along a spectrum ranging from very gracile to very robust, according to diagrams presented in Buikstra and Ubelaker (1994).

Documenting Degenerative Joint Disease

Skeletal evidence for osteoarthritis may include lipping, or osteophyte formation, along the margin of the articular surface; porosity on the articular surface; or eburnation of the surface. Eburnation is the process by which articular surfaces become polished in appearance due to bone-bone contact following the complete degeneration of articular cartilage. For each of these conditions, data on degenerative joint disease (DJD) extent and severity was recorded using standard bioarchaeological coding (Buikstra and Ubelaker 1994) by the author to ensure consistency across specimens. Gross observation of the articular surfaces of amphiarthrodial and diarthrodial joints allows the bioarchaeologist to assess the presence and, if applicable, severity of osteoarthritic effects. DJD was recorded for long bones and vertebrae in particular, as these were most meaningful for inferring labour in the skeletal population. Degenerative joint disease is multifactorial, occurring due to the convergence of numerous predisposing factors, and aggravated by lifestyle. The most important contributing factor in the incidence of osteoarthritis is mechanical stress on the joint and, by extension, the physical activity in which the individual was engaged (Larsen 2015). However, bioarchaeologists must keep in mind that age is a significant factor in the development of DJD (Cheverko 2013).

Evidence for degenerative joint disease in this study was documented according to observations of articulations of the distal and proximal ends of the clavicle, humerus, radius, ulna, femur, tibia, and fibula. In addition, I analyzed the acetabulum of the ilium, the glenoid fossa of the scapula, and the bodies and articular facets of the vertebrae. Signs of osteoarthritis discussed herein are the result of analyses of vertebral bodies and articular facets, and 17 joint surfaces. The articular surfaces were chosen particularly for their association with major functional groups that correspond to the five muscle groups analyzed for MSM. DJD was documented on all observable joint surfaces in adult remains. Due to the nature of the sample, it was not possible to distinguish between categories of adult individuals; the only exception to this is in the os coxa, which was aged according to the Suchey-Brooks method (Brooks and Suchey 1990).

Entheseal Remodeling Analysis

Entheseal changes are frequently examined as a method of elucidating activity patterns of past populations. This technique was originally developed by Hawkey and Merbs in their reconstruction of the activity patterns of Hudson Bay Inuit (1995). This study presented data collection standards for recording entheseal remodeling through the visual scoring of three types of musculoskeletal stress markers (MSM): stress lesions, increased robusticity, and ossification exostosis (the formation of bony spurs) on the bone, specifically at the site of muscle attachment (Hawkey and Merbs 1995). Stress lesions superficially resemble lytic lesions of the osseous tissue, and likely develop as a result of continual microtrauma at the attachment site due to repetitive activity. Increased robusticity of the bone at the site of muscle attachment reflects the need for a larger area of muscle-to-bone attachment to prevent the rupture of muscular tissue. Ossification exostoses usually result from an abrupt microtrauma, as opposed to the continual microtraumas which induce stress lesions; avulsion of the bone due to muscle ruptures leads to the incorporation of remodeled bone into ligament or muscle tissue. Each of these forms of stress markers are scored according to presence and severity of the lesion, robusticity, or exostosis (Hawkey and Merbs 1995).

The patterning of these lesions allows for the elucidation of frequently engaged muscles or muscle groups over an extended period of time, permitting the identification of movements which are further contextualized by archaeological, historical, or ethnographic accounts of likely activities at the site (al-Oumaoui, Jimenéz-Brobeil, and Du Souich 2004, Henderson et al. 2013). An intersectional study by Weiss compared observed musculoskeletal markers on the humerus, radius, and ulna, and compared them to both age and body size. This study found that larger individuals generally showed higher degrees of MSM; however, age was determined to be the best overall predictor of aggregate MSM resulting from the accumulation of microtrauma relating to physical activity (Weiss 2003). Conversely, when populations are controlled for body size, there appears to be no significant correlation between sex and robusticity in MSM (Molnar, Ahlstrom, and Leden 2011, Foster et al. 2013).

Due to the qualitative nature of the assessment of entheseal remodeling, several scholars have called into question the reliability and reproducibility of data resulting from analyses of entheses. Studies of interobserver error in scoring entheseal changes agree that comparison between populations should be undertaken with caution, but note that this technique remains useful for in-population comparison to reconstruct different labor patterns within a group (Davis et al. 2013). Data collected from the human skeletal remains at Santa Bárbara were documented and scored according to the scale established by Hawkey and Merbs (1995), ranging from 1 (mild expression) to 3 (severe expression) in the three categories of robusticity, stress lesions, and ossification exostoses (Figure 4.4). The occurrence of entheseal remodeling was noted at 28 muscle and ligament attachment sites to better understand the movements associated with the lesions (Table 4.1). Each attachment site was also measured as a means of comparing the relative size of the involved muscles and ligaments.

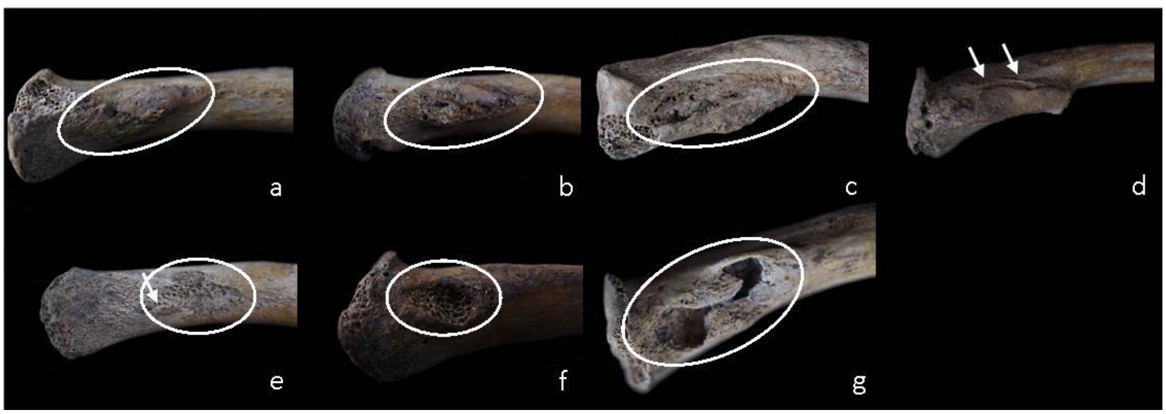

Figure 4.4 - Presentation and expression of MSM at the enthesis of the costoclavicular attachment.
(a) Mild robusticity; (b) moderate robusticity; (c) severe robusticity; (d) moderate ossification exostosis; (e) mild ossification exostosis (indicated by arrow) and mild stress lesion (indicated by ellipse); (f) moderate stress lesion; (g) severe stress lesion

Table 4.1 - Description of muscle attachment sites used for MSM analysis

Muscle Group	Bone	Muscle/Ligament	Attachment type	Type of enthesis	Function
Shoulder	Clavicle	Deltoideus	Origin	Fibrous	Shoulder abduction, extension, flexion, rotation
Shoulder	Clavicle	Trapezius	Insertion	Fibrous	Stabilizes and moves scapulae
Shoulder	Clavicle	Costoclavicular ligament	Ligament	Fibrocartilaginous	Limits excessive movement of the medial end of the clavicle
Shoulder	Clavicle	Coracoclavicular ligaments	Ligament	Fibrocartilaginous	Limits anterior movement of the scapula with respect to the clavicle
Shoulder	Clavicle	Pectoralis major	Origin	Fibrous	Shoulder adduction and medial rotation
Shoulder	Humerus	Deltoideus	Insertion	Fibrous	Shoulder abduction, extension, flexion, rotation
Shoulder	Humerus	Pectoralis major	Insertion	Fibrous	Shoulder adduction and medial rotation
Shoulder	Humerus	Latissimus dorsi	Insertion	Fibrous	Shoulder adduction, extension, and internal rotation
Elbow	Humerus	Brachioradialis	Origin	Fibrous	Elbow flexion
Shoulder	Humerus	Triceps brachii	Origin	Fibrous	Shoulder stabilization and adduction
Elbow	Radius	Biceps brachii	Insertion	Fibrocartilaginous	Elbow flexion
Wrist	Radius	Dorsal radiocarpal ligament	Ligament	Fibrocartilaginous	Resists extreme flexion of the wrist
Elbow	Ulna	Brachialis	Insertion	Fibrocartilaginous	Elbow flexion
Elbow	Ulna	Pronator quadratus	Origin	Fibrous	Rotation of the forearm
Shoulder	Ulna	Triceps brachii	Insertion	Fibrocartilaginous	Shoulder stabilization and adduction
Knee	Femur	Vastus lateralis	Origin	Fibrous	Knee extension
Knee	Femur	Vastus medialis	Origin	Fibrous	Knee extension
Hip	Femur	Gluteus minimus	Insertion	Fibrocartilaginous	Hip abduction and medial rotation
Hip	Femur	Gluteus medius	Insertion	Fibrocartilaginous	Hip abduction, extension, flexion, and rotation
Hip	Femur	Gluteus maximus	Insertion	Fibrous	Extension and lateral rotation of hip
Hip/Knee	Femur	Biceps femoris	Origin	Fibrous	Knee flexion; hip extension, lateral rotation of the leg
Hip	Femur	Adductor brevis	Insertion	Fibrous	Hip adduction and flexion
Hip	Femur	Adductor magnus	Insertion	Fibrous	Hip adduction
Hip	Femur	Pectineus	Insertion	Fibrous	Hip adduction and flexion
Knee/Ankle	Femur	Plantaris	Origin	Fibrocartilaginous	Knee flexion, ankle flexion

Ankle	Tibia	Soleus	Origin	Fibrous	Plantar flexion of foot at ankle
Knee	Tibia	Sartorius	Insertion	Fibrous	Knee flexion
Ankle	Fibula	Soleus	Origin	Fibrous	Plantar flexion of foot at ankle

Synthesis and Comparison of Labor-Related Changes

In this article, the relationship between MSM attachment site and muscle group is analyzed according to five major muscle groups involved in joint function: the shoulder, the elbow, the hip, the knee, and the ankle. These results, in turn, are compared to articulations at major joints involved in gross movements of the body related to the use of these muscle groups. While, in isolation, neither DJD nor MSM can be used to infer specific activity patterns, general trends surrounding the movements involved in habitual actions can be approximated when synthesizing these two forms of data. By using both lines of evidence in conjunction with historical data and a general understanding of activities involved in types of labor in the mining economy, it is possible to make observations of quotidian activities performed at the population level in the site.

Entheseal Remodeling Results

Types of Musculoskeletal Markers

When observing the various skeletal elements for entheseal remodeling, I observed that the majority of MSM manifested as increased robusticity at the attachment site. The radius proves to be the exception to this rule, as MSM are present primarily as ossification exostoses at the attachment of the dorsal radiocarpal ligament. Notably, the clavicle and tibia also show more elevated frequencies of stress lesions compared to the other skeletal elements (Figure 4.5).

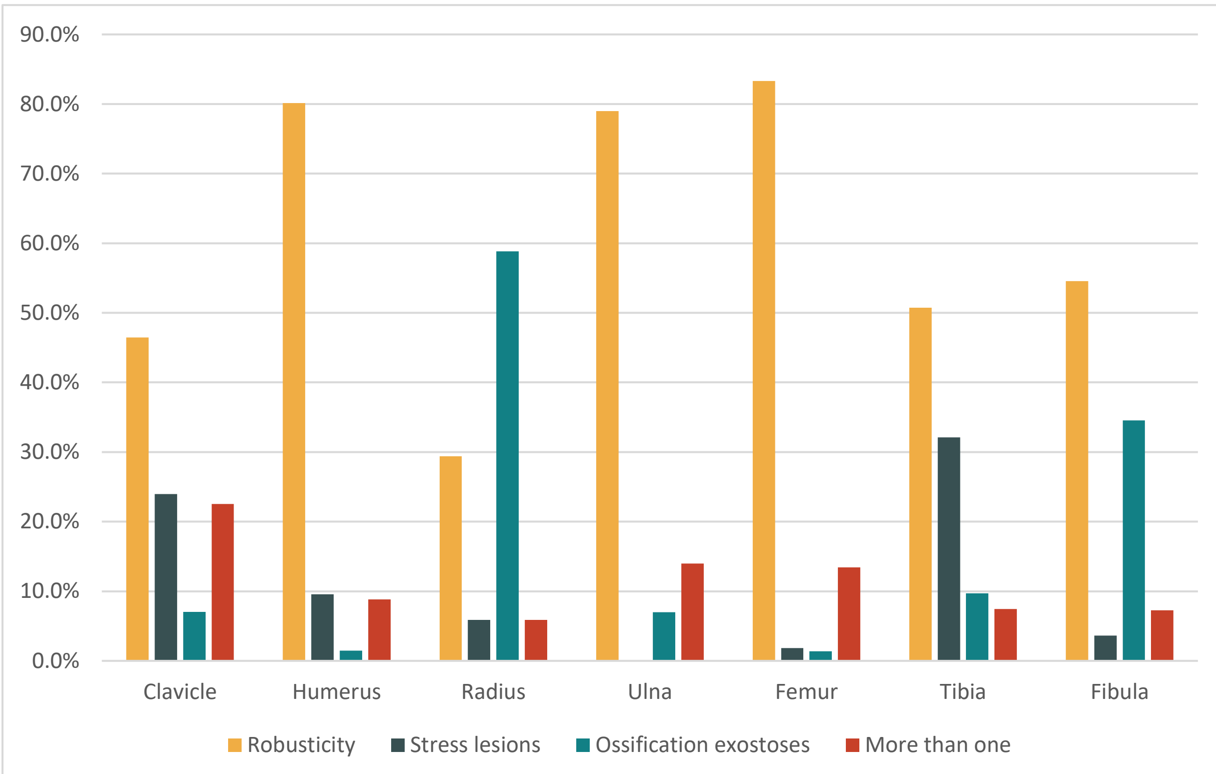

Figure 4.5 - Frequencies of MSM by element and presentation

Age-Based Differences in Entheseal Remodeling

Children show the lowest frequency of MSM, with entheseal remodeling present on 7.9% (16/203) of bones. The frequencies increase with age-at-death, with adolescents exhibiting MSM on 25.7% (27/105) of skeletal elements, adolescent to young adults at 38.9% (28/72), and adults at 45.9% (668/1454). The uptick in frequency is statistically significant (χ^2, p<0.00001), and is consistent with studies of MSM etiology which indicate a relationship with age (Figure 4.6).

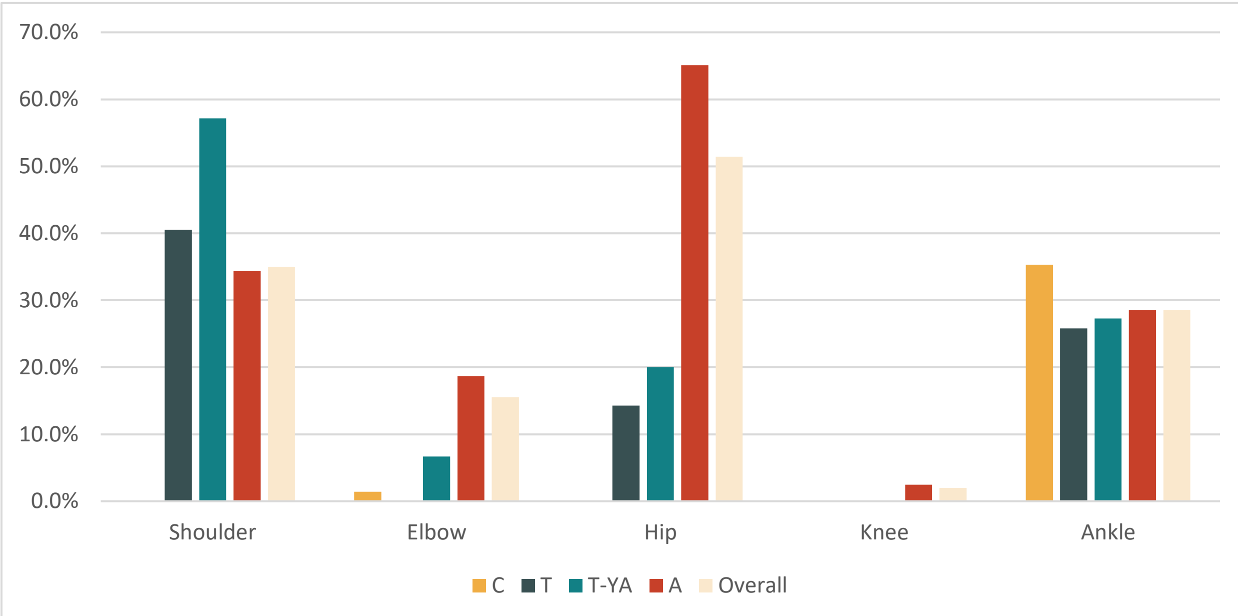

Figure 4.6 - Frequencies of MSM in major muscle groups across age categories

When observing the presentation of musculoskeletal markers, it is possible to identify two distinct trends in the manifestation of entheseal changes (Figure 4.7). Robusticity increases significantly with age across all categories (χ^2, p<0.00001); no child remains show signs of robusticity (0/16), and MSM present in this way in 14.8% (4/27) of adolescent skeletal elements with MSM, 35.7% (10/28) of adolescent to young adult remains, and 73.9% (492/666) of adult bones. Conversely, the manifestation of stress lesions decreases significantly with age (χ^2, p<0.00001); 86.7% (13/15) of child bones, 63% (17/27) of adolescent remains, and 53.6% (15/28) of adolescent to young adult skeletal elements present with exclusively stress lesions. Adult bones, however, show stress lesions in only 5.3% of observed attachment sites. The appearance of multiple types of MSM in the same attachment site is uncommon, with only 12% (88/736) of the observed elements showing evidence of two forms of entheseal remodeling. In addition, there is no correlation between age and the appearance of two or more forms of MSM at a single attachment site (χ^2, p=0.203).

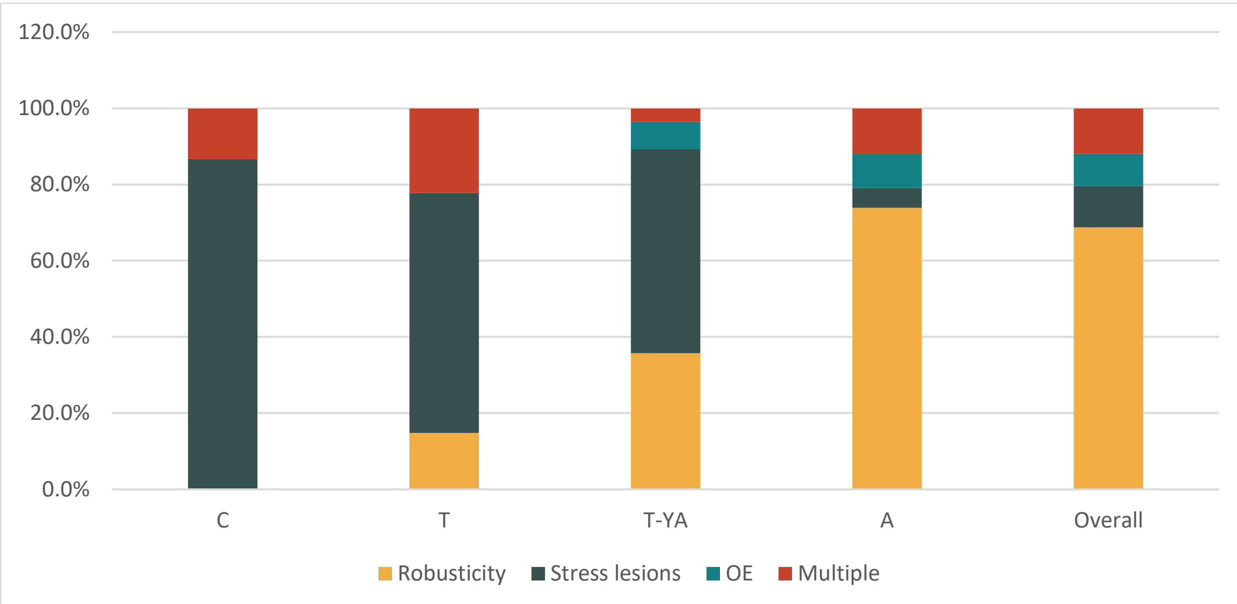

Figure 4.7 - Presentation of MSM across age categories. Child (C), Adolescent (T), Adolescent to Young Adult (T-YA), Adult (A)

Frequencies of skeletal remodeling within each muscle group is presented in Figure 4.8. Observation of the differential patterning of muscle use in the upper body suggests that as early as late childhood or early adolescent, individuals of all ages were engaging in similar types of labor, though adolescents and young adults present higher frequencies of entheseal remodeling than adults as a general category (χ^2, p=0.041). However, all groups show extensive use of the shoulders after late childhood; remodeling of attachment sites related to the shoulder (see Table 4.1) is documented in 40.5% (15/37) of older children and young adolescents, 57.1% (16/28) of late adolescents and young adults, and in 34.4% (180/524) of adults. Remodeling in the lower body—and particularly in the hip—is strongly linked to age (χ^2, p<0.00001), increasing from

14.3% (4/28) in older children and young adolescents to 20% (2/10) in older adolescents and young adults, and finally reaching 65.1% (209/321) in adults. The same general trend is observable in the elbow joint, though the frequency of remodeling in this joint is much lower, at only 1.4% (1/71) in young children, 6.7% (2/30) in older adolescents and young adults, and 18.7% (110/589) in adults. There is no statistically significant difference in MSM—and inferred muscle use—between age groups in the knee or ankle, though the occurrence of MSM in the ankle is generally elevated across the population at 28.5% (150/526).

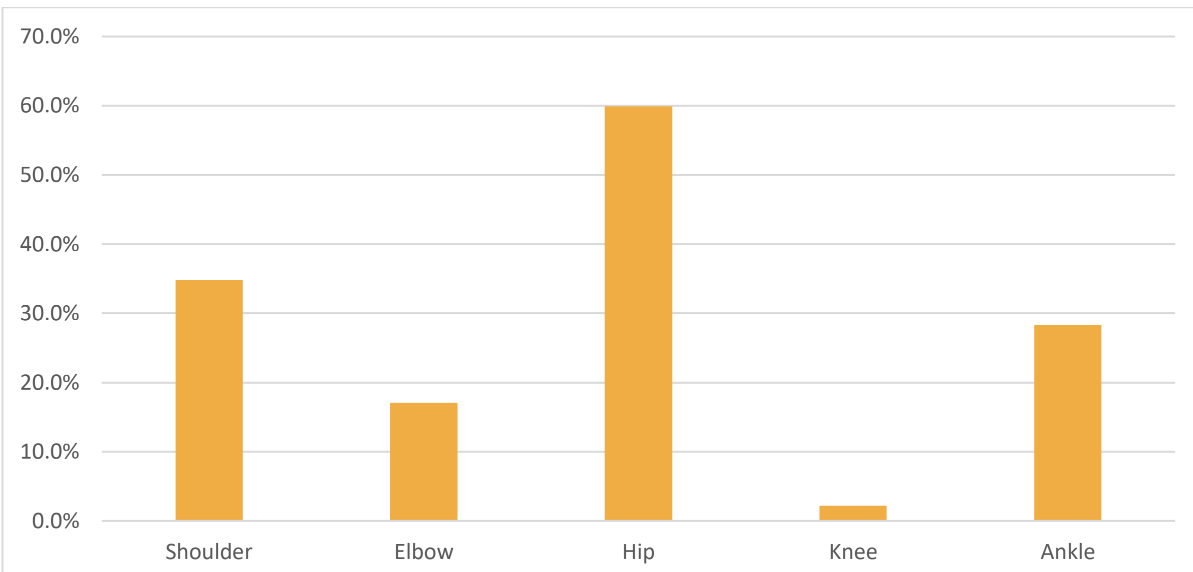

Figure 4.8 - Frequencies of MSM by major muscle group

Pattern of Entheseal Remodeling

When observing the patterning of MSM at the population level, we can see moderately high frequencies of entheseal remodeling in the shoulder (34%, n=606) and ankle (28.3%, n=509), and an elevated frequency of MSM in attachment sites related to hip function (59.9%, n=359). MSM in the elbow is low in comparison (17.1%, n=656), and negligible in the knee

(2.2%, n=641) (Figure 4.9). There is bilateral involvement of all muscle groups, and while there does appear to be slightly higher rates of MSM in the right side of the body, the difference is not statistically significant (χ^2, p=0.683). The sole exception to this is the clavicle, which exhibits much stronger remodeling in the right side of the body at 67.2% (45/67) than the left side of the body at 46.4% (26/56). Specifically, the attachment of the costoclavicular ligament presents with higher frequency of remodeling on the right side (61%, n=67) than the left side (41%, n=56) (χ^2, p<0.026) (Figure 4.10).

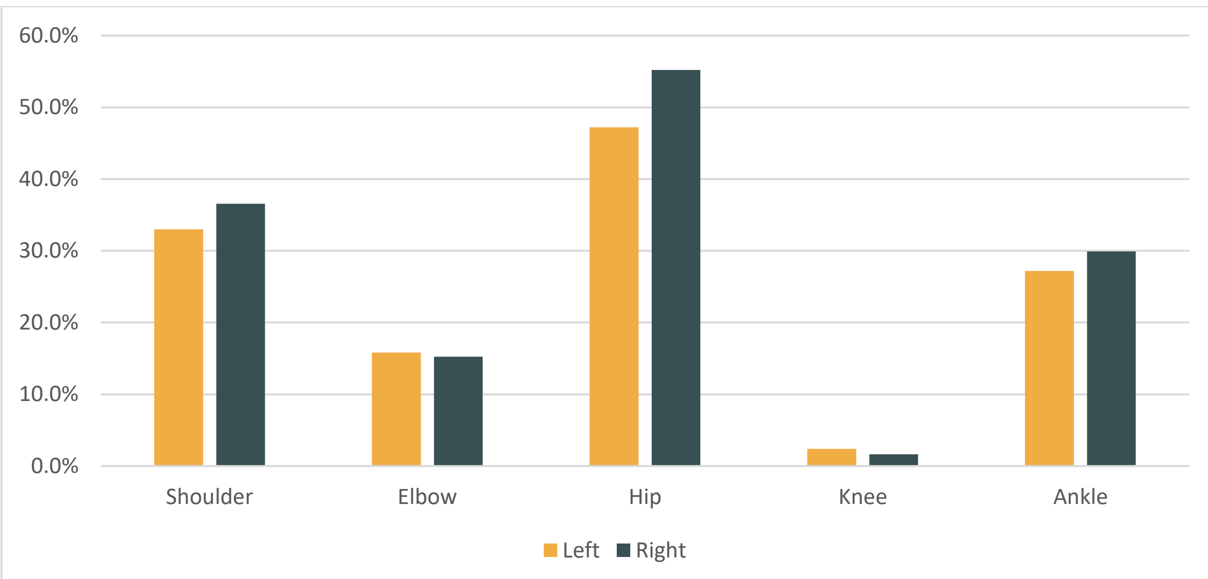

Figure 4.9 - Frequencies of MSM at attachment sites within the overall population

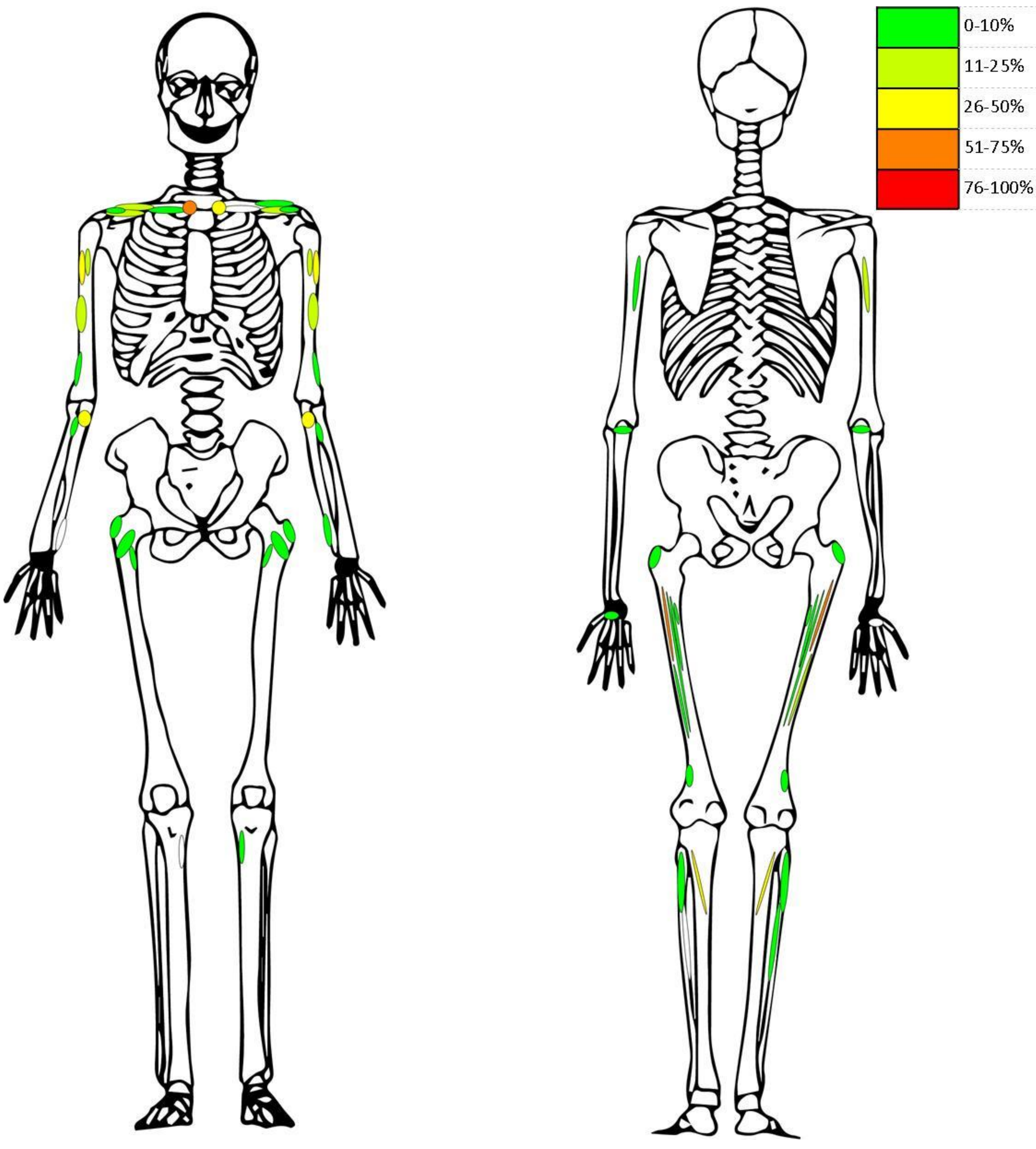

Figure 4.10 - Bilateral presentation of MSM in major muscle groups

Degenerative Joint Disease Results

Degenerative Joint Disease Location

Degenerative joint disease in the Santa Bárbara population is most frequently observed in the upper body—particularly in the mid-back, and in articulations associated with the shoulder and elbow joint (Figure 4.11, Table 4.2). The highest frequency of DJD is found in the thoracic spine, with 46% (219/471) of thoracic vertebrae showing some degree of osteoarthritic remodeling. The glenoid fossa shows the next highest frequency of DJD, with 24% (34/139) of observable surfaces showing signs of arthritic activity. The third most common surface affected is the proximal end of the ulna, with 22% (39/179) of articular faces showing signs of osteoarthritis. Finally, the proximal end of the clavicle—specifically at the sternoclavicular articulation— shows signs of remodeling in 21% (16/75) of joint facets. The complete frequencies of DJD on each surface are elaborated in

Table 4.2.

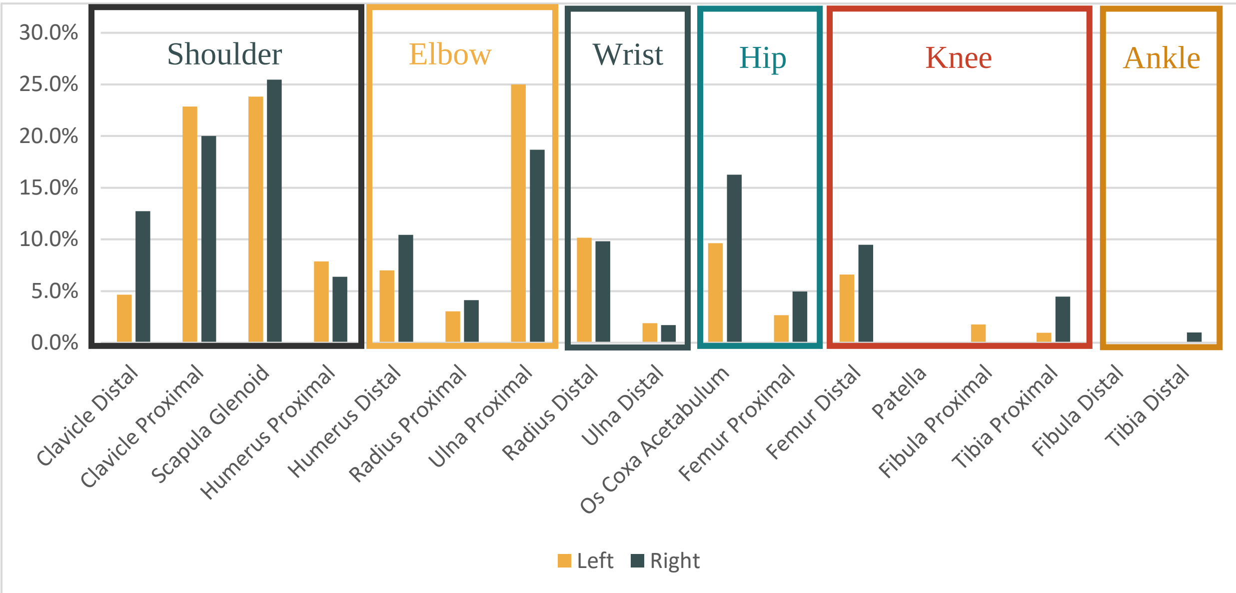

Figure 4.11 - Bilateral frequencies of DJD in analyzed articular surfaces

Table 4.2 - Frequencies of DJD in observed articular surfaces

Bone	Left	Right	Overall
Clavicle Distal	4.7%	12.7%	9.2%
Clavicle Proximal	22.9%	20.0%	21.3%
Scapula Glenoid	23.8%	25.5%	24.5%
Humerus Proximal	7.9%	6.4%	7.1%
Humerus Distal	7.0%	10.4%	8.7%
Radius Proximal	3.0%	4.1%	3.6%
Ulna Proximal	25.0%	18.7%	21.8%
Radius Distal	10.2%	9.8%	10.0%
Ulna Distal	1.9%	1.7%	1.8%
Os Coxa Acetabulum	9.6%	16.3%	13.0%
Femur Proximal	2.7%	5.0%	3.8%
Femur Distal	6.6%	9.5%	8.1%
Patella	0.0%	0.0%	0.0%
Fibula Proximal	1.8%	0.0%	0.9%
Tibia Proximal	1.0%	4.5%	2.8%
Fibula Distal	0.0%	0.0%	0.0%

There is no significant difference in patterning of DJD on either side of the body. That is, the involvement of the joints is bilaterally symmetrical. While general trends indicate slightly elevated levels of OA in the right distal clavicle (13%, 7/55) as compared to the left side (5%, 2/43), and a higher degree of remodeling in the left proximal ulna (25%, 22/88) as opposed to the right (19%, 17/91), in neither case is the difference statistically significant. The same pattern holds true when comparing the larger functional groups (Figure 4.12).

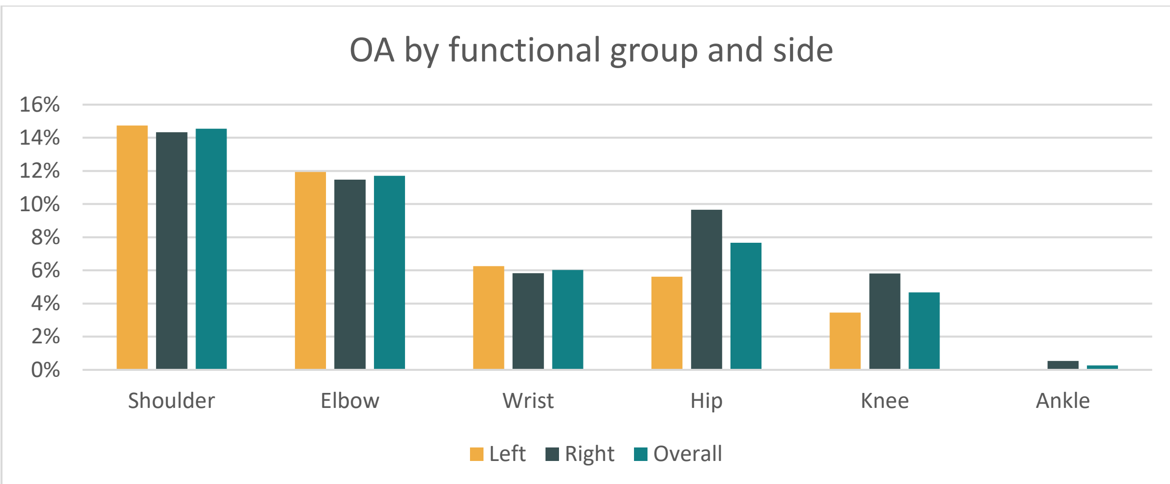

Figure 4.12 - Bilateral frequencies of DJD by major muscle group

Degenerative Joint Disease in the Spine

The presentation of DJD across the spine is highly variable. For the purposes of this analysis, the lumbar vertebrae and sacra are combined into one category—lower spine or lower back. The thoracic vertebrae will be referred to as the middle spine or upper back, and the cervical vertebrae constitute the upper spine or neck. In the neck, all DJD presents in the neural arch; remodeling is seen in 3% of observed cervical vertebrae (6/214), and is found exclusively on the superior and inferior articular facets. The same general trend is seen in the middle spine, as only 5% (20/433) of vertebral bodies show signs of remodeling, while 46% (219/473) present with signs of DJD and other activity-related remodeling. Conversely, 19% (68/364) of vertebral bodies observed in the lower spine are affected, as compared to 3% (11/397) of articular facets. These differences are statistically significant (χ^2, $p<0.00001$), and are likely related to the sorts of movements being performed in relation to the portion of the spine (Figure 4.13).

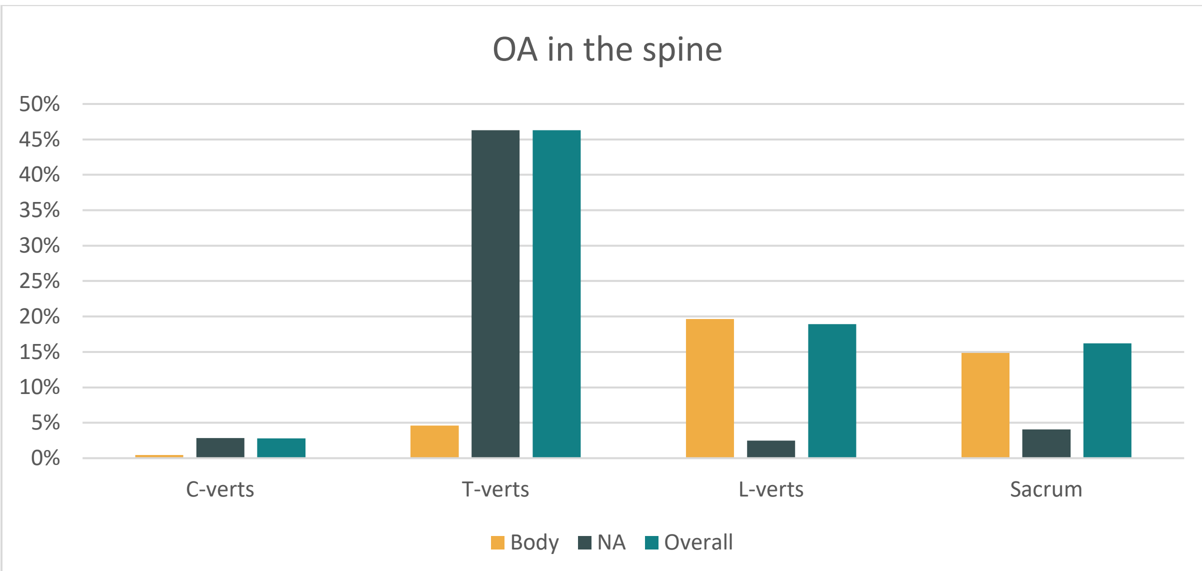

Figure 4.13 - Location of degenerative activity across the spinal column

Presentation of remodeling

Evidence for DJD was collected according to the presence and severity of four manifestations of the condition: lipping, porosity, eburnation, and osteophytes (Figure 4.14). In most cases, lipping represents the most common presentation of DJD on the articular surface (Figure 4.15); there are three exceptions to this. On both the distal clavicle and the articular facets of the cervical vertebrae, porosity is as common as lipping as a sign of DJD. Additionally, on the femoral head, porosity is the most common indicator of osteoarthritis. Eburnation is observed on 25% (5/20) of the humeral trochleae, 40% (2/5) of the radial heads, 8.3% (1/12) of the distal radii, 9.5% (2/21) of the femoral condyles, and 10% (1/10) of the superior articular facets of the sacra in cases where these articulations show evidence for DJD.

Figure 4.14 - Examples of (A) lipping, (B) porosity, (C) eburnation, and (D) osteophytes on distal humeri

Observing vertebral bodies for additional degenerative pathologies, Santa Bárbara population shows extensive evidence of Schmorl's nodes, osteophytes, syndesmophytes, and surface osteophytes (Figure 4.15). The single cervical vertebral body with pathologies has severe osteophyte formation along the margin (Figure 4.16). Among thoracic vertebrae, Schmorl's nodes and syndesmophytes are equally common, presenting in 40% (8/20, each) of affected vertebral bodies, followed by osteophytes, which occur in 35% (7/20) of cases. DJD in the lumbar spinal bodies occurs primarily in the form of osteophytes which project outward from the margin (78%, 53/68), and secondarily as Schmorl's nodes (26%, 18/68). Complete documentation of vertebral pathologies is found in Table 4.3, below.

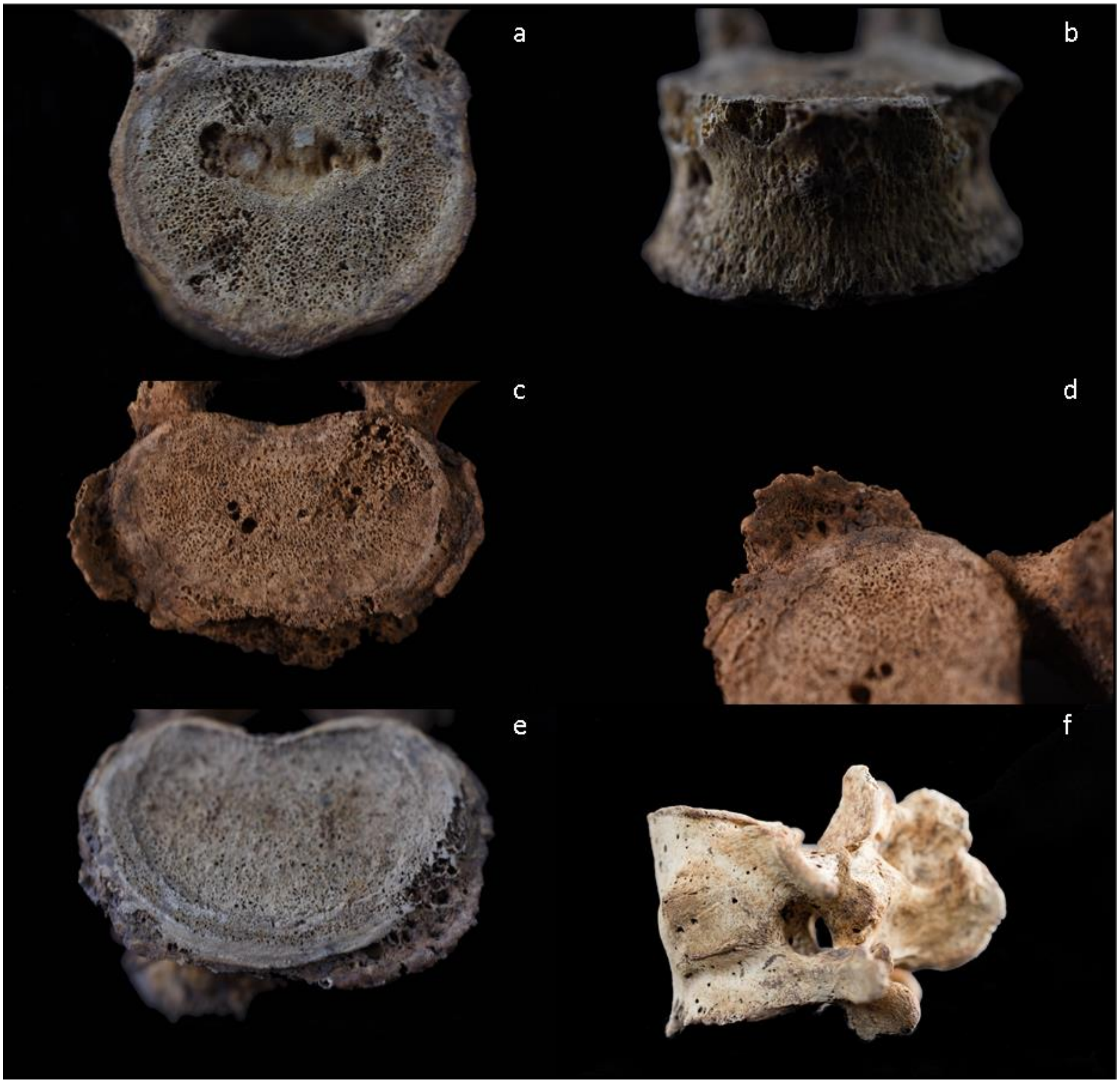

Figure 4.15 - Presentation of DJD of the vertebral body. (a) Schmorl's node; (b) surface osteophyte; (c&d) osteophyte formation; (e) syndesmophyte formation; (f) ankylosis of two lumbar vertebrae, associated with compression

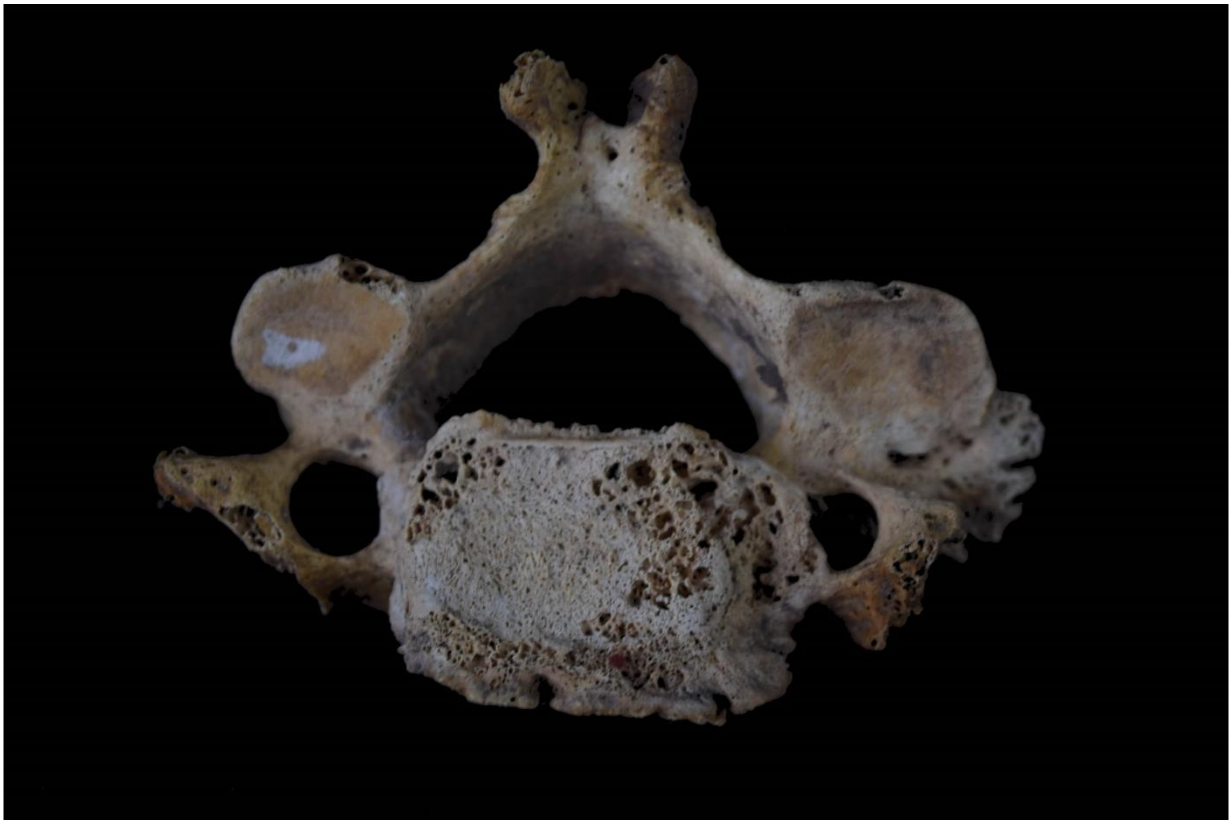

Figure 4.16 - Cervical vertebra with osteophyte formation on vertebral body

Table 4.3 - Frequencies of vertebral pathologies on cervical and thoracic vertebral bodies

	Schmorl's Nodes	**Osteophytes**	**Enthesophytes**	**Surface Osteophytes**
Cvert B	0.0%	100.0%	0.0%	0.0%
Tvert B	40.0%	35.0%	40.0%	0.0%

Severity of Remodeling

The DJD observed in the Santa Bárbara population manifested at all levels of expression (Figure 4.17). Most extreme, however, is the expression of pronounced remodeling in the thoracic vertebrae. Of all thoracic vertebrae recovered, 41.9% (198/473) show moderate remodeling in the form of lipping and porosity on the superior and inferior articular facets of the neural arch, as well as bony spicule formation at the attachment of the ligamentum flavum. This represents nearly all DJD seen in the thoracic vertebrae, with 90.4% (198/219) showing moderate degenerative activity as defined by bioarchaeological standards. Severe, marked expression of osteoarthritis is relatively rare in the population and is seen in 2.7% (2/75) proximal clavicle facets, 2.6% (6/229) of distal humeral articulations, and 1.7% (2/120) of distal ends of radii. The complete elaboration of the severity of DJD symptoms is found in Table 4.4.

Table 4.4 - Severity of signs of DJD on synovial joint surfaces (Mi = mild, Mod = moderate, Sev = severe, Ank = ankylosis)

	Lipping					**Porosity**				**Eburnation**				**Osteophytes**		
	Mi (%)	Mod (%)	Sev (%)	Ank (%)	Total (%)	Mi (%)	Mod (%)	Sev (%)	Total (%)	Mi (%)	Mod (%)	Sev (%)	Total (%)	Mi (%)	Mod (%)	Total (%)
Clavicle P	43.8	31.3	6.3	0.0	81.3	12.5	18.8	12.5	43.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clavicle D	44.4	11.1	0.0	0.0	55.6	55.6	0.0	0.0	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scapula G	76.5	20.6	0.0	0.0	97.1	0.0	2.9	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humerus P	69.2	7.7	0.0	0.0	76.9	15.4	0.0	7.7	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humerus D	50.0	15.0	25.0	5.0	95.0	15.0	5.0	20.0	40.0	5.0	20.0	0.0	25.0	5.0	15.0	20.0
Radius P	60.0	0.0	20.0	0.0	80.0	20.0	0.0	40.0	60.0	0.0	40.0	0.0	40.0	0.0	0.0	0.0
Radius D	83.3	8.3	8.3	0.0	100.0	0.0	0.0	8.3	8.3	0.0	8.3	0.0	8.3	0.0	0.0	0.0
Ulna P	56.4	33.3	2.6	0.0	92.3	7.7	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	2.6	2.6
Ulna D	50.0	50.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Os Coxa A	63.6	31.8	4.5	0.0	100.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Femur P	22.2	11.1	0.0	0.0	33.3	55.6	11.1	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Femur D	42.9	28.6	14.3	0.0	85.7	14.3	9.5	4.8	28.6	0.0	4.8	4.8	9.5	0.0	9.5	9.5
Tibia P	16.7	50.0	0.0	0.0	66.7	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tibia D	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fibula P	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cervical vertebrae (Apophyseal)	0.0	0.0	100.0	0.0	100.0	66.7	0.0	33.3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thoracic vertebrae (Apophyseal)	9.1	90.4	0.5	0.0	100.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5
Lumbar and sacral vertebrae (Apophyseal)	20.0	40.0	20.0	0.0	80.0	20.0	0.0	0.0	20.0	0.0	10.0	0.0	10.0	0.0	0.0	0.0

Figure 4.17 - Severity of DJD activity in the form of (from top to bottom): lipping, eburnation, porosity

Discussion

When examined in conjunction, DJD and MSM data present a compelling picture of exploitative laborways at Santa Bárbara, as well as provide evidence for the utility of these lines of evidence for reconstructing habitual activity patterns. Previous studies have found that age is the primary determining factor in the presence and severity of musculoskeletal markers as they become prominent in the sixth decade of life (Villotte and Knüsel 2013); the same is true for osteoarthritis (Weiss and Jurmain 2007). Schrader argues that MSM and OA, then, are useful in activity reconstruction when analyzing younger individuals, for whom the etiology is less likely to be age-related (2019). Therefore, given the young demographic composition of the Santa Bárbara population, the patterns observed at the site are all the more important for our understanding of the severity of the forced labor in these mines. Everyone, but particularly young individuals, was subject to extreme, abusive conditions.

Although, as noted earlier, fibrocartilaginous attachment sites are typically characterized by higher degrees of entheseal remodeling, the attachments for the major muscles of the humerus are all fibrous and show among the highest incidence of MSM, with high severity across age categories. While less pronounced than the remodeling at the costoclavicular ligament, for example, the extreme changes noted at the attachments of the deltoideus, pectoralis major, and latissimus dorsi denote high levels of physical activity involving the upper arm. This is particularly true for the muscles of the shoulder, but is also notable in the major muscle attachments on the femur connected to hip stabilization. Thus, I argue that high levels of activity are responsible for the remodeling seen at the fibrous attachment sites to affect the bone despite the distribution of force across the periosteum, indicating that extreme forces resulting from exhaustive and exploitative labor made motions using even large, powerful muscles painful and degraded these people's skeletons.

Entheseal Remodeling and Age

While the general trend of increased remodeling over time holds true for the MSM on the lower body (i.e., the hip and knee), the age groups of adolescents and adolescent to young adults show the highest frequency of entheseal changes in the shoulder; this is particularly notable in the clavicle. Adolescents and young adults also have high rates of MSM in the humerus compared to overall frequencies within the population. Typically, correlations between MSM and age are particularly strong in the lower body (Robb 1998, Milella et al. 2012). However, this correlation is absent in the muscle attachments of the upper body. Thus, while MSM presents at high levels in the hip, the suite of extreme entheseal changes in the shoulders of these individuals may be reliably linked to heavy labor performed by the younger members of the population.

Interestingly, in younger individuals it appears that entheseal remodeling primarily takes the form of osteolytic lesions, frequently to the point of complete destruction of the cortical bone at the attachment sites. Likely related to microtraumas to the undeveloped cortex, this is seen in both fibrocartilaginous and fibrous attachments. Conversely, older individuals primarily exhibit rugosity and osteophytic reactions at attachment sites (Figure 4.18). It is unclear whether this means that older individuals had not been performing these activities from a young age—suggesting that they were brought to the site in adulthood—or whether the growths are also a sclerotic reaction indicative of simultaneous healing and degeneration at the site of the muscle attachment.

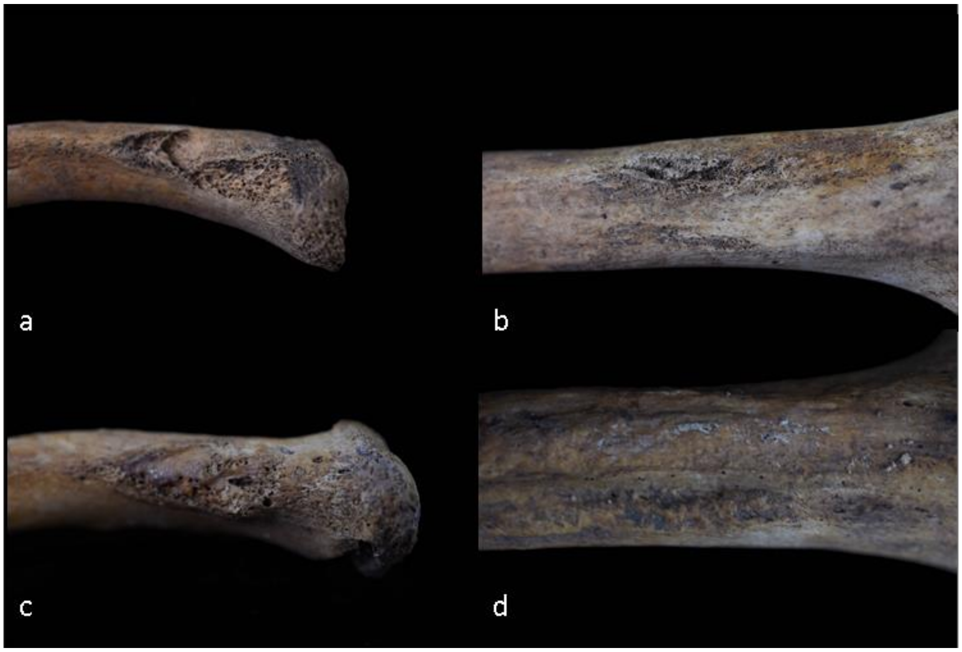

Figure 4.18 - MSM in teens and adults. (a) Stress lesion at fibrocartilaginous attachment in an adolescent clavicle; (b) stress lesion at fibrous attachment in adolescent humerus; (c) robusticity at fibrocartilaginous attachment in adult clavicle; (d) robusticity at fibrous attachment in adult humerus.

Degenerative Joint Disease and Age

Similar patterns of DJD are also unsurprising given the etiology of osteoarthritis in the body. Particularly, DJD is closely linked with age, as joints degrade over time. This, however, holds true mostly in the lower body, while arthritis of the shoulder and elbow present a more accurate picture of habitual activities. Within the Santa Bárbara population, DJD does indeed occur for the most part in joints associated with the shoulder and elbow. Young individuals show signs of osteoarthritis only in the acetabular articulation; all other signs of DJD occur exclusively in adults. While a more fine-grained analysis is difficult to do given the commingled nature of the remains, we can indeed use a more nuanced scale when observing DJD in the hip. As I noted earlier in the paper, osteoarthritis of the hip is most pronounced in individuals belonging to the category of young adult to middle adult, though its absence in old individuals is likely due to the small sample size of old individuals.

Degenerative Joint Disease in the Spine

Turning to the spine, interesting patterns emerge. DJD is almost non-existent in the cervical vertebrae, which is generally unsurprising given the lack of etiological connection between physical labor and remodeling on these apophyseal facets. Indeed, changes to the cervical articular facets is most strongly correlated with age (Gellhorn, Katz, and Suri 2013); this is consistent with the general youth of the Santa Bárbara population. However, 46% (219/473) of observed thoracic vertebrae show changes—not on the body of the vertebrae, but at the apophyseal joints and the attachments for the ligamentum flavum. The ligamentum flavum itself serves to connect the laminae of adjacent vertebrae; its primary purpose is to return the vertebral column to its appropriate curvature following extreme flexion, as well as resist excessive separation of the laminae during extension.

Additionally, remodeling of the apophyseal joints of the vertebrae reflects a shift in load-bearing to the facets as opposed to the vertebral bodies. That is, in the case of spinal compression, this capsular joint takes on a large portion of the overall pressure. This joint functions to stabilize the spine and resist planar movement across multiple axes under conditions of heavy and complex loads (Laplante and DePalma 2012, S29). Brown and colleagues. note that bony changes in these facets is much more severe when they are subject to over 50% of the compressive load of the spine, which dominates during vigorous activities wherein tension occurs in the paraspinal muscles (2008, 322). Interestingly, this type of arthritic condition is usually most severe in the T10-T11 and L2-L5 regions; however, in the Santa Bárbara population, it is most commonly observed in the upper and middle thoracic vertebrae (Figure 4.19).

Figure 4.19 - DJD on apophyseal facet of upper thoracic vertebra

While less common in typical observations of the human spine, a similar pattern is seen in Sofaer's study of individuals from the 16th-19th century site of Ensay in the United Kingdom, particularly among females. Sofaer argues that this may be due to the use of creels by women to carry large loads; these baskets change the curvature of the spine, putting more pressure on the apophyseal joints of the upper and middle thoracic vertebrae (2000). Merbs (1983) has also argued that carrying heavy loads on the upper chest leads to an increase of thoracic arthritis. Perhaps, then, the remodeling at Santa Bárbara is related to the use of large slings worn across the forehead and over the shoulders to carry loads of ore, as depicted in the statue at the city's Ovalo de Tres Esquinas, or similar to modern *mantas* used by modern populations in the Andes

(Figure 4.20). In the lower spine, there is almost no remodeling of the apophyseal joints, reflecting a lack of compressive loading of these vertebrae. This is biomechanically consistent with a load that causes a forward flexion in the mid-back, relieving pressure from the lumbar area.

Figure 4.20 - (Left and middle) Statue located at Huancavelica's Ovalo de Tres Esquinas depicting a man carrying ore. Images taken from Google Maps; (right) A Quechua woman using a manta while tending sheep. Photo by Blaine McKinney on Unsplash

Remodeling in the lumbar vertebrae manifests primarily in the form of vertebral osteophytosis, with a general lack of any remodeling on the apophyseal joints. This is also similar to Sofaer’s (2000) findings. She notes that despite a reduction in pressure on the thoracic vertebral bodies, high loads remain on the lumbar region—now increased by the lack of curvature in the lower spine. The remodeling in the Santa Bárbara population also appears to occur more frequently on the anterior and right portions of the vertebral body. The former of these is consistent with a forward flexion of the body, related either to ore carrying or to hunching in shafts while mining. A similar pattern was observed by Lawrence (1955), who noted an increase in the prevalence of disc disease in the lower portion of the spine among miners. The pattern of osteophytosis in the Santa Bárbara population suggests increased pressure on the lower back through the straightening of the normal curvature of the vertebral column.

The presence of these indicators of disc degeneration is significant in this population not only due to the severity of the observed lesions, but also simply by virtue of its high incidence among such a young population. Typically, osteophytosis begins to show in some individuals around twenty years of age, increasing in frequency over time; moderate to severe remodeling is seen primarily between forty and fifty years old. This is because the primary antagonist in the development of osteophytosis is pressure on the spinal column over time, as ageing leads to the collapse of the intervertebral disc (Shore 1935, Maat, Mastwijk, and van der Velde 1995, Van der Merwe, Işcan, and L'abbé 2006). As Stirland and Waldron (1997) note in their study of the crew of the *Mary Rose*, changes like these in young individuals must be due to a “semi-permanent, professional crew, many of whom must have been recruited as adolescents” (335). Indeed, the long period necessary for the development of this condition implies that the individuals at the Santa Bárbara encampment were engaged in strenuous labor consistently over a span of years, beginning at a time when the vertebrae were still in the process of development. This is further supported by intrusive lesions into the vertebral body.

The occurrence of Schmorl’s nodes in the Santa Bárbara population is generally consistent with the typical distribution of this condition across the spine. That is, Schmorl’s nodes appear more frequently in the T7-L1 region. Across the excavated individuals, most exhibit this pathology in the lower thoracic and upper lumbar vertebrae. What is notable, however, is what this suggests about the age at which these individuals became engaged in strenuous activity. Dar and colleagues hypothesize that the occurrence of Schmorl's nodes is related to a high amount of stress and activity beginning in adolescence. They posit that stress on the endplate of the vertebra—prior to complete fusion of the epiphyseal ring at about 25 years old—results in micro-fissures in the vertebral body. This is especially true when the motion itself takes the form of repetitive rotational movements. The intervertebral disc then intrudes into these micro-fissures and form a small cavity which, in time, leads to the formation of a dense bone wall—in other words, a Schmorl's node (Dar et al. 2010). This suggests that individuals were indeed engaging in strenuous labor—particularly rotational—beginning in adolescence. The rotation of the spine is just one part of the compound movements involved in picking.

Copresentation of Degenerative Joint Disease and Entheseal Remodeling

As I argue earlier in the paper, a holistic picture of labor patterns in which these individuals engaged requires the synthesis of these two lines of evidence. As Schrader demonstrates in her study of the quotidian experience in Kerma, these techniques provide strong lines of evidence for reconstructing lifeways (2019, 2012); in the case of Santa Bárbara, I build a picture of lived experiences under often fatal labor practices. In their study of post-medieval Dutch rural villagers, Palmer et al. (2014) note a low correlation between DJD and MSM, leading them to the conclusion that the correlation between the two is not important despite its statistical significance. Their study is limited to the upper limbs of the population due to the confounding factor of mobility in understanding the causes of degeneration and remodeling in the lower limbs. However, I argue that accounting for the varied etiologies of these two pathological conditions enables us to reconstruct generalized activity patterns. The patterns observed at Santa Bárbara may be confounded by the lack of sex data in relation to entheseal changes, as well as degenerative changes outside of the acetabulum, which show no statistically significant differences between the sexes. We are, however, able to account for age in our discussions of these changes. Though the difference in the incidence of entheseal remodeling is statistically significant, the high levels of MSM in young individuals underscores the importance of strenuous activity in the osteological changes observed in the population.

Age-Related Patterns

Synthesizing MSM and DJD data shows that the individuals at Santa Bárbara were engaged in hard labor practices specifically related to mining and hauling ore from the deep galleries of the mines. When we account for age-related changed and generally higher activity levels in the lower limb, we can begin to see unique patterns emerge from an analysis of the Santa Bárbara inhabitants. Elevated levels of entheseal changes in the shoulder are associated with the presence of osteoarthritic changes in the glenoid, while MSM on the brachialis attachment of the ulna co-occurs with increased degenerative activity in the trochlear notch. This remodeling in the upper limbs is unlikely to be less related to age, and more linked to strenuous activity. The severe lesions present on the costoclavicular ligament, deltoid attachments, and pectoralis major attachments suggest—in conjunction with apical activity in the glenoid—that individuals were engaging in activities that involved repeated rotational and abductory motions of the arms, with an emphasis on the right shoulder joint. Conversely, DJD remodeling has a higher incidence in the left elbow. Taken together, these seem to indicate a repetitive motion akin to kayaking (Hawkey and Merbs 1995)—or rather, pickaxeing—with high levels of resistance leading to frequent microtraumas at the muscle insertions as well as at the joint. The people of Santa Bárbara were engaged in long-term, extremely strenuous labor that completely changed their joints and bones from a young age.

Changes to the Spine

In addition, data from the spine helps to elucidate repetitive labor at the site. Specifically, this may reflect carrying large loads of ore on the back and held across the chest—as I previously suggested—but may also be connected to a weight pulling the upper body forward, as in carrying heavy burdens in front of the body or wielding weighty instruments. The evidence of strain on the ligamentum flavum articulates with the degenerative changes on the thoracic apophyseal joints and increased osteophytic activity on the lumbar vertebrate to illustrate an individual who was frequently hunched over and highly burdened. Furthermore, the presence of Schmorl's nodes on the vertebral bodies of such a high proportion of the population can be viewed as additional evidence visible in the elevated incidence of entheseal remodeling in young individuals. The suite of changes suggests a prolonged life history characterized by heavy labor beginning in early adolescence, leading to the extreme lesions seen in young bones due to a weak and underdeveloped osteological integrity. Osteolysis of the costoclavicular ligament and intrusions into the vertebral bodies belie the torturous nature of the labor performed by extremely young people. This likely led to a great deal of pain in the early stages of these conditions. Painful symptoms of osteoarthritis in the spine are often recurrent—resurging every two to four years—and get worse as the afflicted individual ages (Bick 1956, Aggrawal et al. 1979, Laplante and DePalma 2012).

Conclusion

The description of mining labor in colonial documents presents an entirely false view of the realities of the lifeways of the individuals who were brought to Santa Bárbara. These data show that the town's inhabitants were subject to extensive mining-related labor for long periods of time at a young age. These activities include pickaxeing or hammering hard surfaces, resulting in remodeling and lesions on the clavicles and humeri; carrying heavy loads in front or around the neck, resulting in advanced vertebral degeneration; and osteoarthritis in individuals much too young to suffer from such a condition. It is nigh impossible that such extreme remodeling and degeneration of the skeleton could be seen in such young individuals who had not been subject to abusive levels of labor for a period of years. Even accounting for the later use of semi-permanent wage laborers at the site, the youth of the workers directly contradicts supposed Viceregal policies that workers were to be men between the ages of 18 and 50. Rather, it seems that young adolescents at Santa Bárbara were recruited as laborers, whether by force or by necessity to allay debt pressures accrued by their fathers over the course of their labor term. It is obvious that this blatant use of child labor is—in itself—violent. The destruction of indigenous bodies, young and old, speaks to a colonial extraction project that treated its population as a disposable and renewable resource.

Disregard for human life is indispensable in the manifestation of structural violence. Those in power mobilize culturally defined social categories that position them as the inevitable caretakers of society and all who inhabit it, legitimating systems of abuse and violence. The reconfiguration of entire groups of people into inferior social categories is informed by policies inherent to societal structures, and as assigned categories become embedded in identity, so too are they embodied in the physical form. This untenable cycle forms the basis of generations of trauma in the Andes—both physical and mental—as Indigenous social identity and policies of extraction became inextricably intertwined. The designation of Indigenous people as lesser-than in the colonial order gave those in power implicit permission to mobilize the oppressed in the name of progress, destroying their bodies and communities in the process. The pervasive nature of structural violence in the colonial mining economy had lasting and pernicious effects on Indigenous bodies as programs of forced labor and the systematic exploitation of men, women, and children contributed to an ongoing program of physical and cultural erasure in the Spanish colonies.

CHAPTER 5:
Colonial Era Diets among Indigenous Andean Laborers at the Mercury Mine of Santa Bárbara, Huancavelica, Peru: Insights from Stable Isotope Analysis

Introduction

The Spanish Crown's quest for silver was insatiable. It funded Spain's colonial exploits, their wars on the European continent and elsewhere, and their growing dependence on imported manufactured goods. The wealth in natural resources that they drained from across the New World helped them gain dominance in the global economy as silver became central for currency and as the primary trade good for acquiring exotic imports from Asia. The Spanish Colonial mining project consumed not only the mineral resources from the Americas but consumed lives through programs of forced labor and relocation. In the Colonial Period (16^{th} – 19^{th} centuries CE), projects of mass resettlement swept across the Viceroyalty of Peru, uprooting Indigenous Andean communities, and imposing new sociopolitical structures as part of a policy of resource extraction and religious conversion (Gose 2008, Wernke 2013, Mumford 2012). The vast riches that Spain exploited in the Americas were acquired through a labor tax called the *mita*, which reportedly sent adult men on work projects for the Spanish Crown, though in practice women were often laboring in these mines too (Romano 2020). These could include any number of projects that needed a source of human labor, but most of the individual *mitayos*[31] were sent to the silver mines of Potosí, Bolivia, and the mercury mines of Huancavelica, the focus of this study. The site of Santa Bárbara is associated with the infamous Huancavelica mercury mines. These quicksilver mines were extremely dangerous, so labor rotations were to be relatively short—two months as compared to 12 months at Potosí (Robins 2011). Furthermore, although

[31] Individuals selected for *mita* service

the Spanish chroniclers note that the laborers were to be men primarily, analysis of the human skeletons from the site of Santa Bárbara show that men, women, and children were all resettled there and labored in those mines and in associated mining camp activities (Proctor 2019, Proctor nd, Smit and Proctor 2020). However, analysis of the individuals from the site show that, they were forced to labor for years at a time, suffering violent attacks from Spanish officials and the slow destruction of their bodies through the disintegration of their joints and constant over-exertion of their muscles (Proctor n.d., Smit and Proctor 2020). In this chapter, we add to these understanding of Indigenous lifeways at the mercury labor camps by using stable isotope analysis to document their diet and foodways, and we explore how those dietary practices were tied to tensions and negotiations regarding resource access and the distribution of food among the laborers.

Santa Bárbara was a central locus in the colonial apparatus, constituting a key cog in the machine of extraction, and indispensable in the extraction of material wealth. Inherent in this project were socio-political frameworks that functioned to create a system of structural violence that harmed Indigenous peoples. However, those policies did not operate in isolation; Andean laborers and others in the Andean communities played a role in shaping the conditions and influencing colonial policy in some arenas. Nonetheless, when we examine the ways that structural violence operates, we must add a new lens to broaden our conceptions of what we normally understand as violence (Farmer 1996, Farmer et al. 2004, Galtung 1969). Spanish colonial policies created a system predicated on subjugation and violence; they were baked into the societal cake, such that violence—in its many manifestations—was insinuated into the various facets of social, political, and economic life (Tung 2021). With this more deeply contextualized lens, we can see how physical violence against Indigenous Andeans was a result of the structures of violence created by Spanish colonial policies and practices. Additionally, we can explore the other ways that structural violence operated there, evaluating how physiological and other needs of individuals were systematically denied (Galtung 1969, 1990). That too is a form of violence (Farmer et al. 2004). These needs vary and are not restricted to basic necessities of survival and physical well-being. Instead, denial of self-identity and preventing freedom of Indigenous practices (e.g., mortuary practices, traditional religious practices, and foodways) is at the root of colonial projects of conversion and resettlement, and they lay the scaffolding for creating the structures of violence that profoundly shaped Indigenous Andeans' lives.

While structural violence sometimes manifests in traumatic injury, it also affects access to dietary and other resources, limits residential mobility, impinges on religious and mortuary practices, and can prevent the formation of kinship ties and familial responsibilities of reciprocity. Foodways and diet—the topic explored here through stable isotope analysis—is a powerful way to enact one's social identity. What foods did Indigenous Andeans have access to, and how were those dietary resources distributed among those who were forced to labor in the mercury mines for the Spanish Crown? Did the laborers have similar diets, or was there internal variation? Asking questions like these show how structural violence can be far reaching, variable within a group, and potentially deeply harmful. The Spanish colonial project, particularly as tied to resource extraction, not only resulted in direct violence and poor health from toxic mercury exposure, it also affected diet, (mal)nutrition, and cultural foodways. These latter points illustrate Galtung's (1969) point that the deleterious effects of structural violence can be indirect, insights that inform this current study.

Producing Silver and the Demand for Mercury

As the Spanish plundered the vast resources of precious metals across Central and South America, their rapacious extractivism rapidly led to the exhaustion of the continent's mines. Potosí, the largest source of silver in the Spanish Empire, was no longer producing the vast quantities of metal needed to fund Spain's military campaigns and demand for import goods. The Spanish needed a new way to refine the silver-poor ores being carried out of the mountain, and the solution came in the form of mercury amalgamation (Assadourian 1992, Robins 2011). Practiced in New Spain since the 1550s, this process allowed mine contractors to extract every bit of silver found in the rocks. This process called for laborers to crush the rock into smaller chunks and mix it in a solution of liquid mercury, water, salt, and iron. This toxic slurry was poured onto large, outdoor patios and walked on by Indigenous laborers in Potosí, who waded through the toxic amalgam that went as high as their thighs. After sometimes days of mixing, the amalgam was rinsed in large troughs and squeezed into bags to extract mercury for possible re-use. The resultant product was then burned in a large ceramic oven where it would volatilize and produce a small mass of pure silver (Robins 2011, 83-88). With this new amalgamation process, the Spanish needed a large and continuous supply of mercury. Initially, they imported mercury from the Almadén mine in Spain, hauling tons of it on ships across the Atlantic to Central and South America. But trans-Atlantic shipping proved prohibitively expensive and time consuming; thus, the Spanish needed to find mercury in the New World.

In November of 1563, this was accomplished when Spanish colonist Amador de Cabrera stumbled into mercury in the Andes. As the story goes, when the son of local *kuraka*[32], D. Gonzalo de Navincopa, lost Cabrera's hat, Navincopa—as a gesture of either goodwill or

[32] Local ruler of an Andean community

penance—brought Cabrera to the site of a large cinnabar deposit in the hills of Huancavelica and Chaclatacana. Cabrera registered the deposit as his own on New Year's Day 1564 and began the first Spanish mercury mining activity in Huancavelica. The Spanish Crown promptly expropriated the mines from Cabrera and others who had registered claims on the area (Eguren, de Belaunde, and Burga 2005, Lohmann Villena 1949, Montesinos 1906 [1566], Robins 2011).

To secure ongoing production of silver, the Crown needed a way to supply the new mercury mines with a steady flow of labor. Thus, in 1570, the new Viceroy Toledo implemented the Spanish *mita*, a form of rotational labor tax that would send adult men to Huancavelica for two months every seven years. In practice, Indigenous people fled what would become known as a death sentence in the Huancavelica mercury mines, copying the practice of the many others who fled forced service in the Potosi silver mines (Premo 2000). Nonetheless, thousands were forced to labor in the darkness beneath the mountain filled with mercury (Bakewell 1984b, Brown 2001, Montero 2011, Rivera 1990, Robins 2011, Wiedner 1960). The expansion of the mine, and the construction of a horizontal access tunnel that travelled perpendicular to the mining shafts further down the slope, eventually led to the growth of the settlement of Santa Bárbara, a small community built by and for the miners (Lohmann Villena 1949, Smit 2018).

Figure 5.1 - Detail of Santa Bárbara mining galleries from 1742 oil on canvas map entitled *La mapa Real Mina de Azogue de Huancavelica* by Juan Estevan de Oliva y Jofre, reproduced in color in Wise and Féraud (2005). The adit of Nuestra Señora de Belén can be seen traveling from the upper right to the lower right corner of the image (used with permission from the authors).

The Mercury Mining Site of Santa Bárbara

Santa Bárbara is located in the Department of Huancavelica in central highland Peru at 3972 masl (Figure 5.2). It was first excavated in 2014 as part of an investigation into the role of Santa Bárbara and its inhabitants within the colonial market (Smit 2018). Survey and household excavations revealed that Santa Bárbara was occupied continuously from the early 17th century through modern times, until Shining Path and Peruvian state violence in the region led to the abandonment of the town in the 1980s (Smit 2018). The town of Santa Bárbara was constructed in three phases, the first two of which are relevant to this study of the colonial period at the site (Smit 2018). In the nascent period of the settlement, a Catholic church was constructed for the inhabitants of the small encampment turned town. On the southeastern side of the church is a small plaza, measuring approximately 9 meters by 13 meters. In 2014, Smit excavated a series of primary burials (n=8) and uncovered three commingled burial deposits which were left *in situ*.

There is another cemetery area, adjacent to the church on the northwest side, and it has been in use for the last two centuries. The burials discussed here derived from the southeastern churchyard.

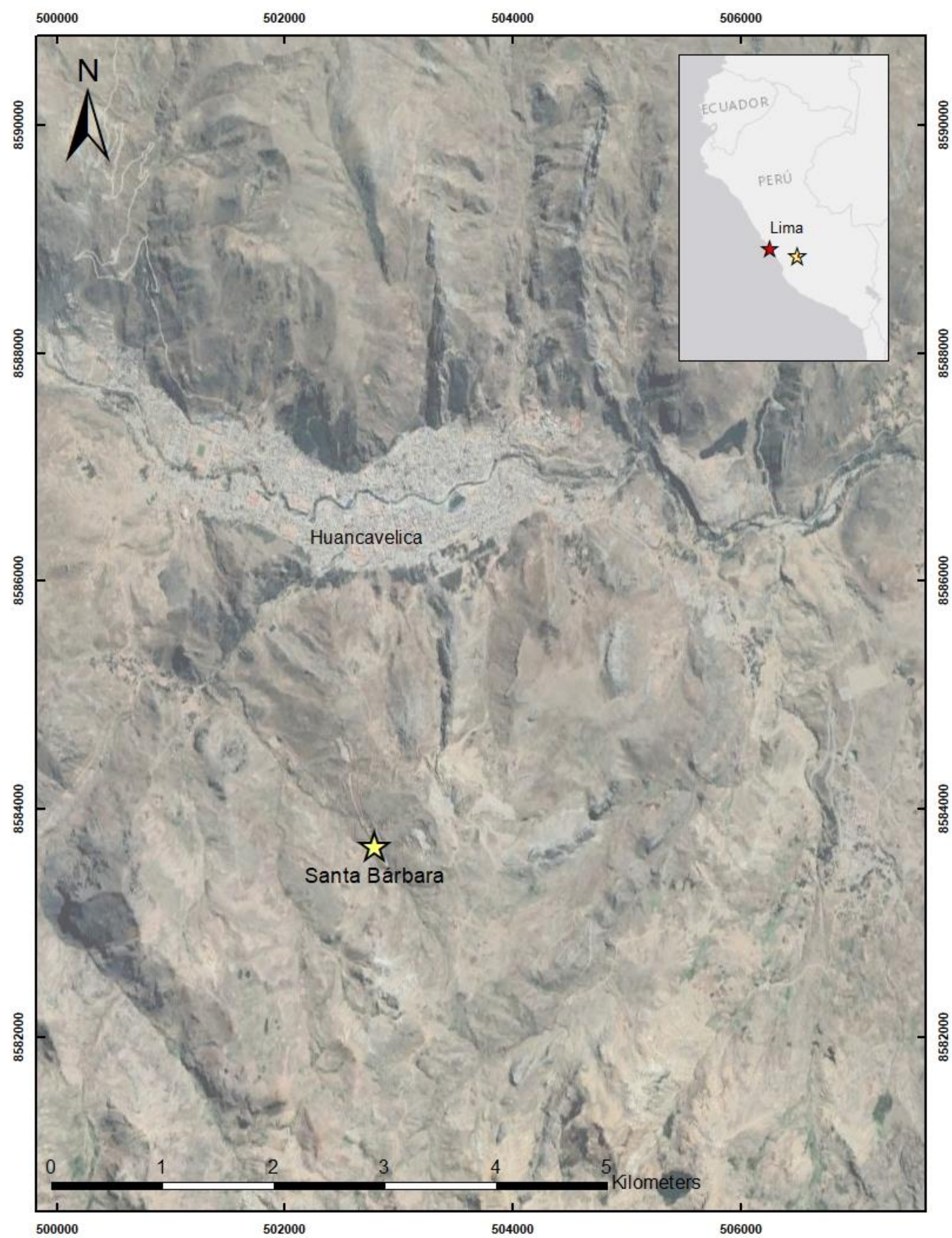

Figure 5.2 - Map of the location of Santa Bárbara in relation to the highland city of Huancavelica

The secondary burial deposits discussed here consist of disarticulated human remains and one primary interment. The individuals in the secondary burials were buried following extensive decomposition in most cases, as the vast majority of the skeletal elements are not in anatomical position, nor are they articulated. There are ten instances of articulated remains, such as an articulated vertebral column, a forearm, a cranium with two cervical vertebrae, and an os coxa with a femur and two lumbar vertebrae, among others (Figure 5.3). These individuals were likely moved to this churchyard space to make room in the crowded formal cemetery on the northwest side. Relocating burials occurred with some frequency on the European continent in the medieval and post-medieval periods (Anthony 2015, Kenzler and Tarlow 2015), and it appears that they transferred that custom to the Spanish colonial Andes as they evangelized native Andeans to Catholic practices. Six of the seven deposits of bones ranged from about 0.40 to 0.70 meters deep; the remaining context was very small and only 0.10 meters in depth. All deposits ranged in area from 0.16 square meters to 1.18 square meters, with a median size of 0.96 square meters (Figure 5.4). The burial deposits from the 2018 excavations consist of the commingled remains of at least 217 individuals based on counts of complete right femurs. There were three mostly complete primary burials; two of these were not sampled due to missing crania. The primary burial discussed herein was oriented approximately east-west in an extended pose.

Figure 5.3 - a) Articulated femur, os coxa, and lumbar vertebrae from commingled context, b) Articulated sacrum and lumbar vertebrae from commingled context.

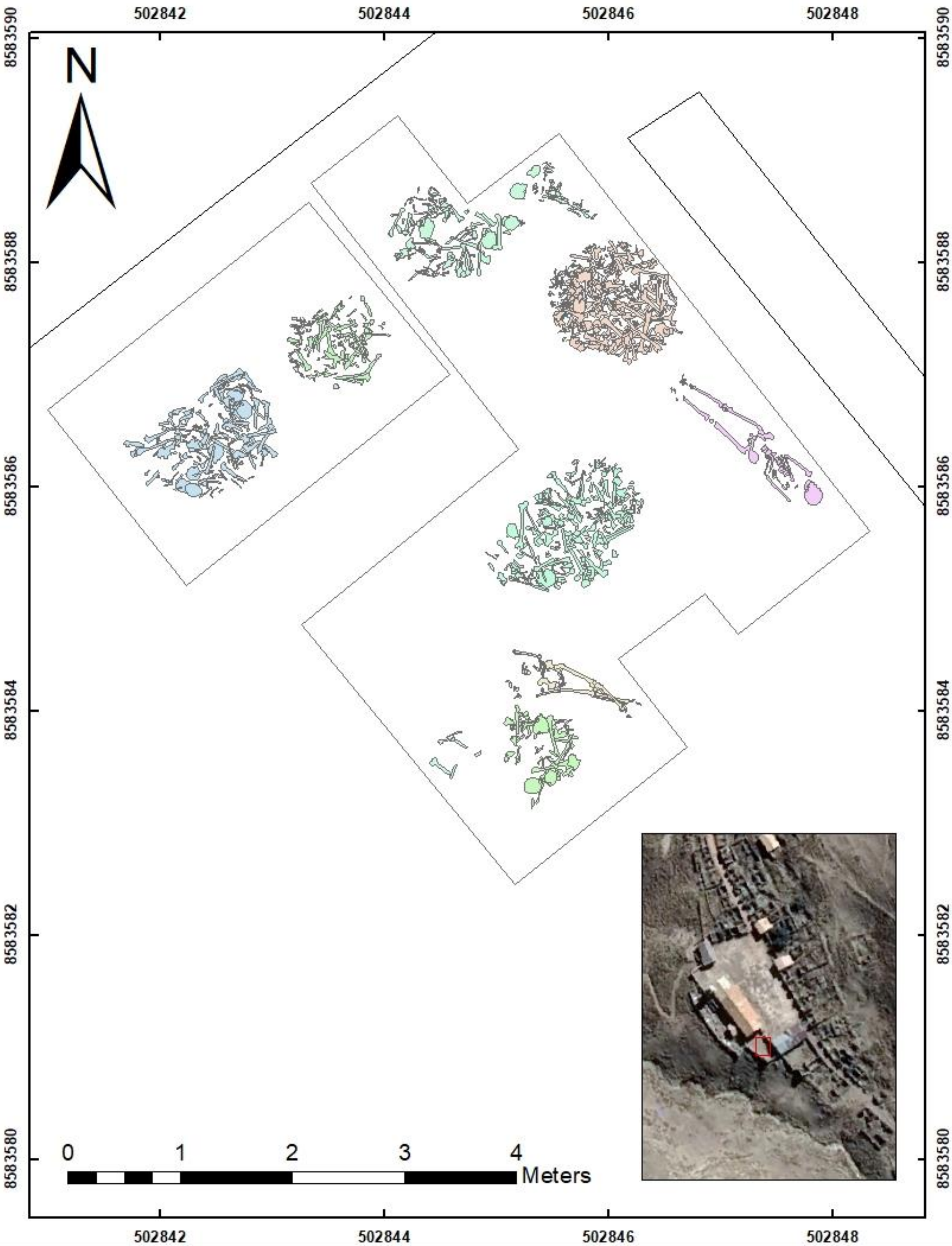

Figure 5.4 - Map of excavation units and secondary burial contexts

The few artifacts recovered with the burials indicate that they are from the Spanish Colonial Period (16th to early 19th century), though they may have been reinterred in the early Republican Period as evidenced by the presence of British transferware in the layer above the remains. Associated artifacts include typical colonial-era ceramics in both local and imported styles, including painted Panamanian and Peruvian *majolica*, and lead- and tin-glazed ceramics (Figure 5.5). Fragments of imported *botijas* that would have been used to transport a number of goods, though most typically wine, suggest that the inhabitants of the town of Santa Bárbara had some access to the trade goods that flooded the nearby metropolitan center of Huancavelica, located 2.5 kilometers away down the steep slope. Additional sherds of mercury *ollas* evince on-site production and refinement of extracted cinnabar ore, suggesting that the camp was home to individuals who labored in multiple stages of the mercury mining and refining process.

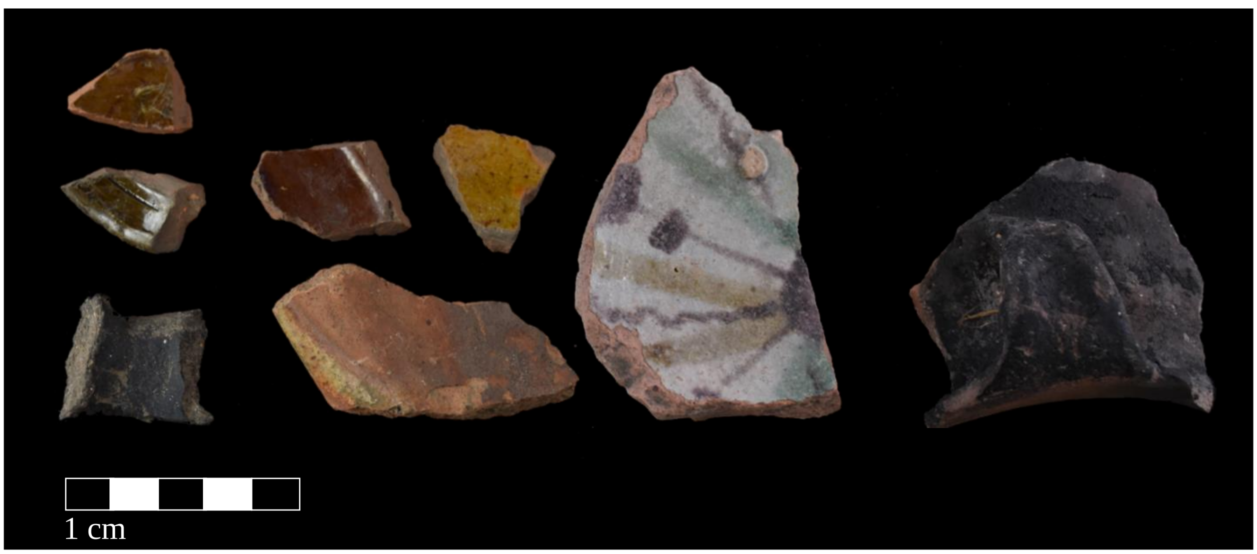

Figure 5.5 - Lead-glazed, majolica, and olla ceramic sherds from Santa Bárbara

Prior to the initiation of construction of the Santa Bárbara church and household structures around 1606, the plateaued hillside was home to a smaller occupation (Smit 2018). A large structure in what became the plaza may have been an earlier church, but was instead likely a residential structure, whether for indigenous laborers, mine overseers, or both (ibid).

The burial deposits also contained broken bones from large fauna, such as camelids, a native animal long relied upon as a food source in the Andes. The excavations in the domestic sectors show that both New and Old-World fauna were consumed, namely camelids, cows, and sheep (Smit 2018), indicating that the Spaniards introduced new animals and food types to this Andean region. However, camelids and bovids cannot be distinguished in the stable isotope analysis, but these faunal data do indicate that terrestrial protein resources were available at least to some of the mine workers. No botanical remains were recovered in either household or burial excavations.

Methods: Stable Isotope Analysis

To document the specific categories of foods consumed by the inhabitants of Santa Bárbara, we used well-established methods of stable carbon and nitrogen isotope analyses. Isotopes are different forms of the same element with varying numbers of neutrons; this makes some isotopes lighter and others heavier. When examining ratios of stable carbon isotopes for dietary reconstruction, we are documenting the proportion of the more common ^{12}C to the rarer ^{13}C and then comparing that to a standard (Vienna PeeDee Belemnite), which is a material established in Vienna to replace the original reference material—a Belemnite fossil from the PeeDee Formation in South Carolina (Gonfiantini, Stichler, and Rozanski 1995). This is then expressed as $\partial^{13}C$ in parts per mille (‰). In most cases, the $\partial^{13}C$ value permits us to differentiate between plants with distinct photosynthetic pathways (Chisholm, Nelson, and Schwarcz 1982, DeNiro and Epstein 1978, Schoeninger and DeNiro 1984, Walker and DeNiro 1986). Most plants, including tubers, legumes, and most fruit use a C_3 (Calvin-Benson) photosynthetic pathway, yielding low (more negative) $\partial^{13}C$ values. These typically range from -20‰ to -35‰, with an average value of -26.5‰ (Benson and Calvin 1948). Plant species which fixate carbon using the more efficient C_4 (Hatch-Slack) photosynthetic pathway show $\partial^{13}C$ values ranging from -9‰ to -14‰, with an average of -12.5‰ (Hatch, Slack, and Johnson 1967, Hatch and Slack 1966). Traditionally, C_4 signatures have been used in the Andes to identify the consumption of prestigious maize—and more infrequently kiwicha. But in the Colonial Andes, we must account for the introduction of sugarcane, another C_4 plant. The Crassulacean Acid Metabolism (CAM) pathway is used by plants like cacti and succulents and leads to values that fall between the ratios of the C_3 and C_4 pathways, though it overlaps with C_4 signatures (Ranson and Thomas 1960, Smith and Epstein 1971, Ting 1985). In addition, $\partial^{13}C$ values may help to distinguish between the consumption of terrestrial and marine resources, particularly when combined with stable nitrogen isotope values (discussed below).

Carbon isotopes are incorporated into various body tissues as they are consumed. Organic tissues in the body—such as bone collagen—derive their carbon primarily from the protein component of diet, be it animal or vegetable (Ambrose and Norr 1993). Conversely, the carbon found in hydroxyapatite (and the carbonates within), is taken up from all macronutrients in the diet (fats, carbohydrates, protein) and thus is more reflective of the whole diet (Ambrose and Norr 1993, Kellner and Schoeninger 2007, Krueger and Sullivan 1984). As carbon isotopes fractionate across trophic levels, the lighter isotopes react more readily in biochemical processes and are thus “lost”, leading to an enrichment of approximately 4‰-5‰ in bone collagen and about 10‰ in bone apatite (Ambrose 1993, Lee-Thorp, Sealy, and Van der Merwe 1989, Tykot 2004).

Stable nitrogen isotope analysis is used to determine the trophic level of foods consumed: for example, plants versus terrestrial animal meat. That is, as we move up the food chain, there are more enriched nitrogen isotopes (proportionately more ^{15}N). The result is reported as the ratio between ^{15}N and ^{14}N, expressed in $\partial^{15}N$ in parts per mille (‰). In much the same way as stable carbon isotopes, nitrogen fractionates in consumers' tissues, leading to a $\partial^{15}N$ ratio that is approximately 3‰-5‰ higher in bone collagen than in the source of the nitrogen (Hedges and Reynard 2007, Minagawa and Wada 1984, Schoeninger and DeNiro 1984). This allows us to identify individuals with more plant-based diets relative to those who consume more terrestrial meat. Nitrogen isotope ratios are also particularly useful for identifying marine resources in diet, due to the relative enrichment in ^{15}N of marine plants compared to terrestrial plants and for the top feeders in the marine ecosystem, the longer food chain there contributes to higher $\partial^{15}N$ (Schoeninger, DeNiro, and Tauber 1983). There are other factors that can result in higher $\partial^{15}N$, such as breastfeeding (Wright and Schwarcz 1999), starvation (Mekota et al. 2006), and fertilization of crops (Szpak et al. 2012).

Colonialism, Foodways, and Diet

By examining the diet of the Indigenous inhabitants at Santa Bárbara, we consider how the selective adoption or rejection of European goods helped to shape social and community identities, and how colonial enforcers undermined autonomy of Indigenous food choice. Indeed, the construction of identity through foodstuffs extends to the Spanish mine overseers who hitherto have been assumed to have managed the majority of the *mitayo* access to foodstuffs.

This speaks to practices of consumption (sensu Dietler 2005), wherein social relations are centered in the intentional adoption or incorporation of the material culture (or food) of another cultural group—in this case, the Spanish. As the Spanish and Indigenous people lived together in the city of Huancavelica and possibly at the site of Santa Bárbara[33], foodways reflected and produced ethnic difference, contributing to the definition of "*indio*,"[34]"*español*,"[35] and "*criollo*"[36] . But food was also used as payment; laborers who were paid below-subsistence wages were often paid in goods, including food. Bradby (1982: 246) argues that their diet could therefore be restricted to food items "defined as 'Indian'": *chicha* (maize beer), maize, camelid meat, and "aguardiente [alcohol] from sugar[cane] rather than from grapes" (1982, 246). Notably, sugar itself was an import, though it may have held less cultural capital than wine (Borrero 2021). However, others have noted that the Spaniards sought to restrict *chicha* consumption by Indigenous Andeans as they believed that it undermined the religious project and contributed to laziness among the laborers (Robins 2011).

Clearly, food can be an important marker to express and produce one's social identity, status (Dietler 2010), gender (Tung 2021), and political access (Hastorf 2018), among other aspects of social life. This highlights the importance of studying diets among Indigenous Andeans, particularly at a time of immense socio-political change, when the Spanish Crown was forcibly relocating people to labor at the mercury mines. How did this profound transformation in lifeways contribute to similarities and differences in the diet and foodways of Indigenous Andean laborers? This also lays the foundation to interrogate how food access (and food

[33] While Santa Bárbara was primarily a town for the Indigenous laborers at the site, it may also have been occupied by Spanish mine overseers in addition to members of the clergy (Smit 2018)
[34] Spanish term meaning Indian (used to refer to Indigenous Andeans)
[35] Spanish term for an individual from Spain
[36] Spanish term for an individual of Spanish descent born in the Viceroyalty

restrictions) contributed to (mal)nutrition, proper growth and development, and one's ability to recover from illness and injury.

Exploring how diet and foodways can contribute to identity formation and boundary maintenance is a central focus of many anthropological and archaeological studies (see Caplan 1997, Dietler 2010, Dietler and Hayden 2010, Hastorf 2016, Holtzman 2006, Mintz and Du Bois 2002, Twiss 2007). This is particularly relevant in instances of colonial imposition. The introduction of alternate forms of material culture—and by extension, foreign foodstuffs—has long been part of the colonial project (Dietler 2005, 2010). However, the negotiation related to the selective consumption of colonial products by the colonized, either because of personal preference, inadequate access to certain food items, or laws and social rules that made some foods available to some, but not others, is worthy of bioarchaeological inquiry. The availability and perhaps even the imposition of food items does not necessitate the adoption and consumption of these products by the colonized (see Appadurai 1996, Bourdieu 1984, Dietler 1990). When they are adopted, it often occurs in a hybridized form: the incorporation of foreign foodstuffs into traditional foodways and modes of preparation (Dietler 2010). The persistence of foodways is deeply entrenched in the practice of identity and the performance of social distinctions such as gender, age, and relational personhood. Certain foods or preparations may serve to delimit these other social categories; this is rooted in what is appropriate for someone to eat (Hastorf 2016). Though wheat and barley grew readily in the Andes, wheat bread was initially seen as something fundamentally Spanish—and particularly Christian—and served as a delimiter of this social identity, while maize bread persisted in Indigenous communities (Covey 2021). By the 18th century, however, wheat bread was consumed by the entire population of Huancavelica (Povea Moreno 2012).

As much as food does the work of creating and marking identity, and as an extension, can divide people into various social categories, the food we eat and how we prepare it and share it is also fundamental to building shared community identity. In the face of colonialism, foodways may serve as a way of building community identity and teaching community values, which can also be deployed as a form of resistance, as Alcántara-Russell (2020) has shown in the context of Tlaxcalan peoples facing successive waves of Aztec and Spanish colonialism. By investigating diet at both community and individual levels at Santa Bárbara, we elucidate how food and consumption practices were negotiated to create rigid and/or permeable boundaries between social subgroups at Santa Bárbara. Evaluating foodways and colonialism's impact on these practices requires a greater understanding of the ways in which dietary resources were similarly or differently consumed by Indigenous Andeans in the Colonial Period.

Locating Food in the Colonial Andes

Located in the *puna* ecological zone (3972 masl), a limited number of crops can be grown in Huancavelica. Local cultigens are restricted to quinoa and a large variety of tubers that include potatoes, olluco, and oca. As such, C_4 plant (e.g., maize, sugarcane, kiwicha) contributions to the diet are necessarily the result of trade with lower ecological zones. Larson's (1998) investigations of the shift in agrarian production at Cochabamba, Bolivia in response to demand for agricultural products at the silver mine of Potosí may provide a comparison for the resources that circulated in Huancavelica, as both flourished as rich mining centers of the Viceroyalty. With most of its population laboring in the mining economy, the primary source of foodstuffs for Huancavelica was trade with the surrounding regions. Spanish products, including wheat and other grains, came from Acobamba and Huanta, while sugar, fruit, and vegetables were brought from Angaraes, Tayacaja, and Abancay, and maize made its way to the puna from the Mantaro Valley in Jauja (Povea Moreno 2012, Robins 2011) (Figure 5.6).

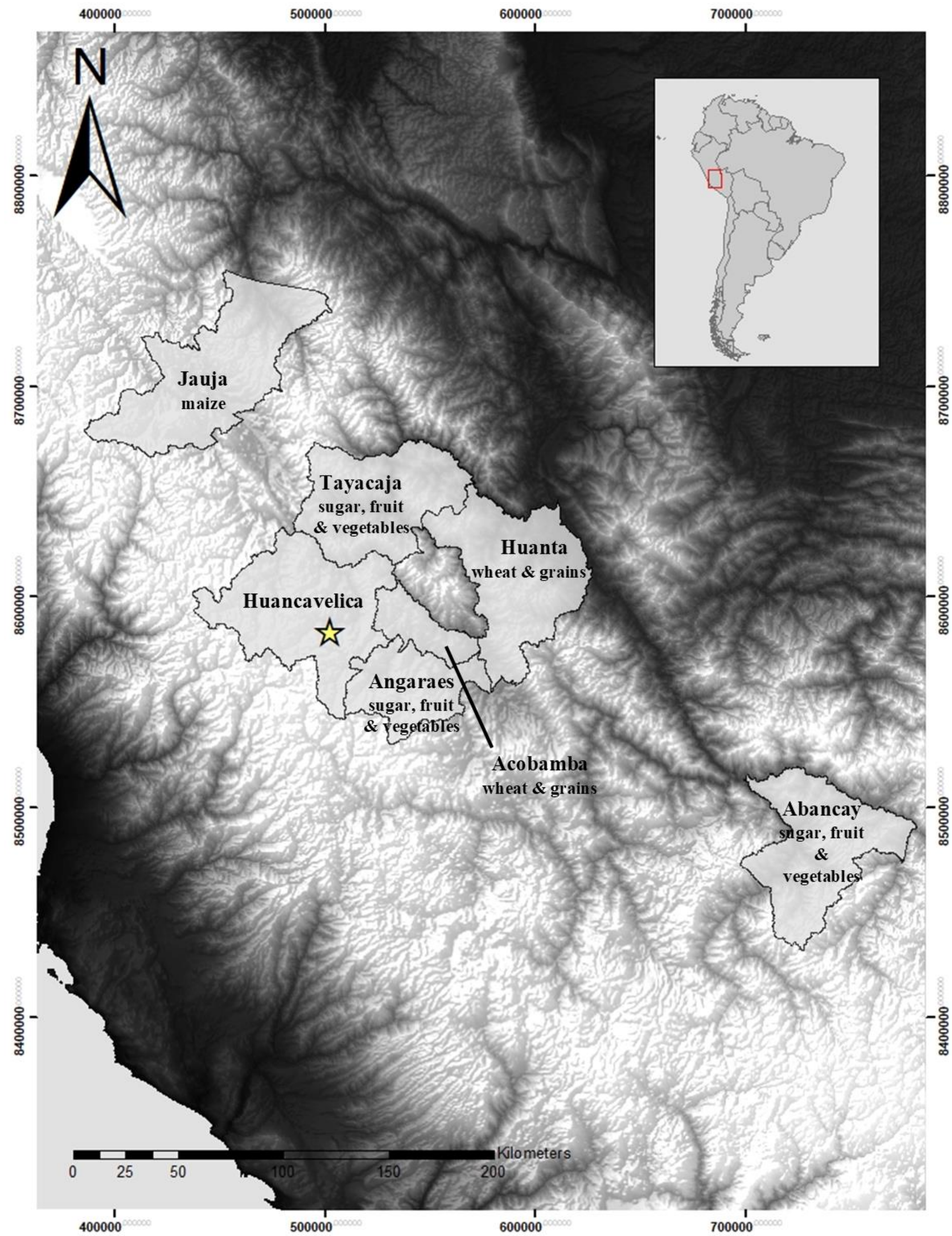

Figure 5.6 - Map of trade market for goods imported to Huancavelica.

Occupied by Spaniards, enslaved Africans, and Indigenous Andeans, the city of Huancavelica would have demanded a supply of culturally important wheat for consumption by European elites for whom the crop held higher status as a food source (Covey 2021). Maize, on the other hand, was viewed as a food source for Indigenous people. This could be partly due to an effort by the Spanish to distinguish themselves culturally and maintain status through access to European crops; in contrast, pre-Hispanic Andeans viewed maize as a crop of great socio-cultural and political significance (Earle 2012, Happel 2012), and this perception likely persisted into the colonial era, as it is still seen as a significant and valuable crop today. The significance of maize is tied to the production of *chicha*, a maize beer traditionally produced by Indigenous women in domestic contexts (Hayashida 2008), and consumed in households and in ritual and political events. In Inka times, *chicha* was produced by a special class of *acllacuna*[37] and consumed at ritual events and large, commensal feasts (Weismantel 1991). Throughout the Colonial Period, Spanish and criollo colonists first attempted to stem *chicha* production, positioning its consumption as a moral failing of Indigenous Andeans (Borrero 2021, Jennings 2018). However, in other urban centers, Spaniards attempted to wrest control of *chicha* production from households and control its distribution (Mangan 2005). The Indigenous inhabitants of Huancavelica consumed *chicha*, as described in colonial documents as well as in depictions of Indigenous women sitting at the mouth of the Huancavelica mercury mine selling the fermented beverage. Indeed, colonial policy implemented in 1683 aimed to prevent women from selling *chicha* by the mouth of the mine for fear of making the laborers in the mine tired (Smit 2018) (Figure 5.7). However, it is impossible to distinguish the isotopic signature of the maize beer from that of aguardiente, an alcohol made from sugarcane, which the

[37] Social class composed of select young women in the Inka Empire

Spanish Crown promoted by the seventeenth century to the profit of tavern keepers, hacienda owners, and the colonial government (Jennings 2018).

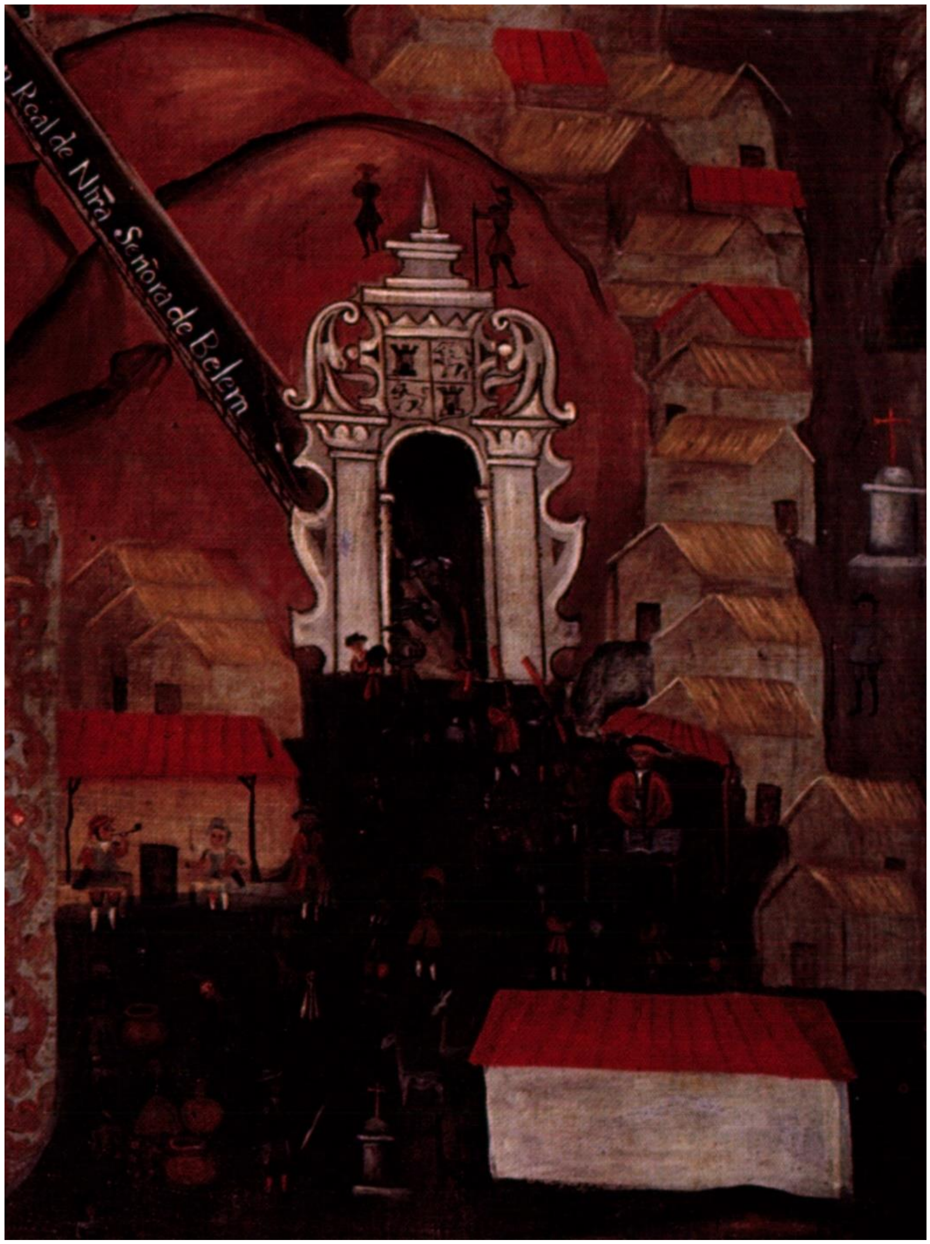

Figure 5.7 - Detail of Santa Bárbara mining galleries from 1742 oil on canvas map entitled La mapa Real Mina de Azogue de Huancavelica by Juan Estevan de Oliva y Jofre, reproduced in color in Wise and Féraud (2005). Figures around the entrance way are engaged in selling locally produced goods, including *chicha* and *coca* (used with permission from the authors).

Emergent foodways brought about by the selective adoption of goods is seen in wheat bread becoming a staple in the Andes by the 18th century; this points to wheat replacing corn or yucca in bread (Povea Moreno 2012). And yet, maize retained at least some importance for individuals at Santa Bárbara; maize persisted as an important source of not only calories, but community identity, despite maize's decline in political capital with the imposition of Spanish values (Jennings and Bowser 2009, Turner and Klaus 2020). Based on isotopic data alone, we cannot determine whether people at Santa Bárbara incorporated European foods into their diets, as has been seen in some other areas of the colonial Andes (DeFrance 2003, Kennedy and VanValkenburgh 2016), with exceptions in places like the highland Colca Valley (Defrance, Wernke, and Sharpe 2016). However, the presence of bovid and ovine faunal remains at Santa Bárbara suggests that foreign food sources were indeed present, perhaps as a signifier of status, as seen at Tarapaya (DeFrance 2003).

This pattern of consumption documented at the mining encampment of Santa Bárbara may vary in part from the subsistence patterns in the town of Santa Bárbara itself, where the miners and their families lived. However, the inhabitants of the Santa Bárbara encampment would have made their way down the mountain to the city regularly; they may even have maintained households in both the urban center as well as by the mine (Robins 2011). Fragments of *botijas* used to transport wine from the coast are ubiquitous across the site and suggest that even those individuals living in the satellite community had access to trade goods. Alternately, it is possible that consumption of C_4 plants such as maize (likely in the form of *chicha*) were supplemented at Santa Bárbara by locally produced goods from the surrounding lands, suggesting practices of food sovereignty to supplement a limited diet reliant on meager wages for mining labor. While some Indigenous people of higher status—such as mining overseers and merchants—may have indeed enjoyed access to prestigious European goods, it is plausible that indentured laborers were reliant on products that could be cultivated in the lands surrounding the small town.

Materials and Methods

Sample Selection

Due to the commingled nature of the sample, it was important to ensure that multiple samples were not obtained from the same individual. To avoid this, bone and dental samples were taken exclusively from complete crania, which could also be assessed for age-at-death and estimations of skeletal sex.[38] There were 176 crania recovered from the excavations, and we obtained viable samples from 88 individuals, representing 50% of the mortuary population. To minimize damage to the cranial vault and comply with Ministry of Culture methods of best practices, bone samples were taken from the sphenoid, vomer, and/or nasal conchae, such that each individual was represented by a bone sample weighing 2-3 grams. We analyzed bone carbonates from 60 of the individuals for whom stable isotope data could be obtained from collagen.

Chemical Preparation

All bone samples were chemically prepared at the Vanderbilt University Bioarchaeology and Stable Isotope Research Lab (BSIRL). All mass spectrometric analysis was conducted at the Yale Analytic Stable Isotope Center (YASIC) using a Thermo Delta Plus Advantage with a Costech ECS 4010 Elemental Analyzer with Conflo III interface. The replicates of international standards show a reproducibility of ±0.3‰ for $\partial^{15}N$ and ±0.2‰ for $\partial^{13}C$, but also see Results below for the 31 duplicates

[38] Samples were exported from Peru to the United States with permission from the local authorities in Huancavelica and the Ministry of Culture in Peru under Viceministerial Resolution No. 121-2019-VMPCIC-MC

that we ran on samples with low collagen yields. All carbon and nitrogen isotope ratios are reported relative to the VPDB (Vienna PeeDee belemnite) and AIR standards, respectively, and reported in per mille (‰) in standard delta notation (Coplen 1994, Craig 1961, Katzenberg 2008).

$$\partial \text{ in ‰} = (R(sample)-R(standard)/R(standard)) \times 1000$$

For the purposes of collagen extraction from the bones, samples were crushed and approximately 100 mg of sample was taken for preparation. The samples were sonicated in ultrapure water for 30 minutes to remove surface dirt and contaminants. Samples were then placed in 0.5M hydrochloric acid for 24 hours to begin the demineralization process and subsequently rinsed with ultrapure water five times. Samples were then placed in a 1.0M sodium hydroxide solution for half an hour to remove humic contaminants and then rinsed five times with ultrapure water. Lipids were extracted using a solution of 1 mL:2 mL:0.8 mL chloroform, methanol, and ultrapure water for multiple rounds (6 to 8 rounds) until the solution was clear following sonication, and then rinsed five times with ultrapure water. The samples underwent a second round of demineralization in 0.5M hydrochloric acid for 30 minutes at room temperature, and then placed in a dry bath at 58°C for 16-18 hours in a weak hydrochloric acid solution (0.01M) to extract the collagen. The resultant product was collected through vacuum filtration. The samples were frozen for 24 hours, and then lyophilized.

Bone carbonates were extracted from 60 archaeological bone samples with successful collagen yields. Approximately 100 mg of bone was taken from the sample using a diamond tipped Dremel drill. A solution of 1-1.5% sodium hypochlorite was added to the powdered bone to remove organic contaminants. Uncapped samples were then placed in a dessicator for 48 hours, with bleach and organic contaminants removed and replaced three times with a new solution of sodium hypochlorite. After rinsing, the samples were processed in a solution of 1M acetic acid buffered with calcium acetate to remove exogenous carbonates. Finally, the samples were dried in a dry bath, and subsequently analyzed on a Thermo DeltaPlus XP IRMS with a GasBench interface at YASIC. Long-term replicability is $\pm$.2‰ for $\partial^{13}C$. Carbon isotope ratios ($\partial^{13}C$) are reported relative to the V-PDB (Vienna PeeDee belemnite).

Statistical Methods

Normality of data distribution was assessed using a Shapiro-Wilk test to the full dataset as well as subgroups of at least 30 individuals. Stable carbon isotope data was abnormally distributed across all categories except adult males (Figure 5.8). Given the non-normal distribution of the stable carbon isotope data, we used the nonparametric Mann-Whitney u-test to compare group medians for two groups (e.g., males vs. females). Stable nitrogen isotope data was normally distributed overall and across all categories (Figure 5.8). When at last 30 samples were being compared, we used a parametric t-test for two subgroups; for smaller subgroups, we again used the Mann-Whitney u-test. For analyses involving more than two groups, a Kruskal-Wallis test was done. Significance for these tests is reported at ($p<0.05$). All statistics were conducted using RStudio 1.4.1103.

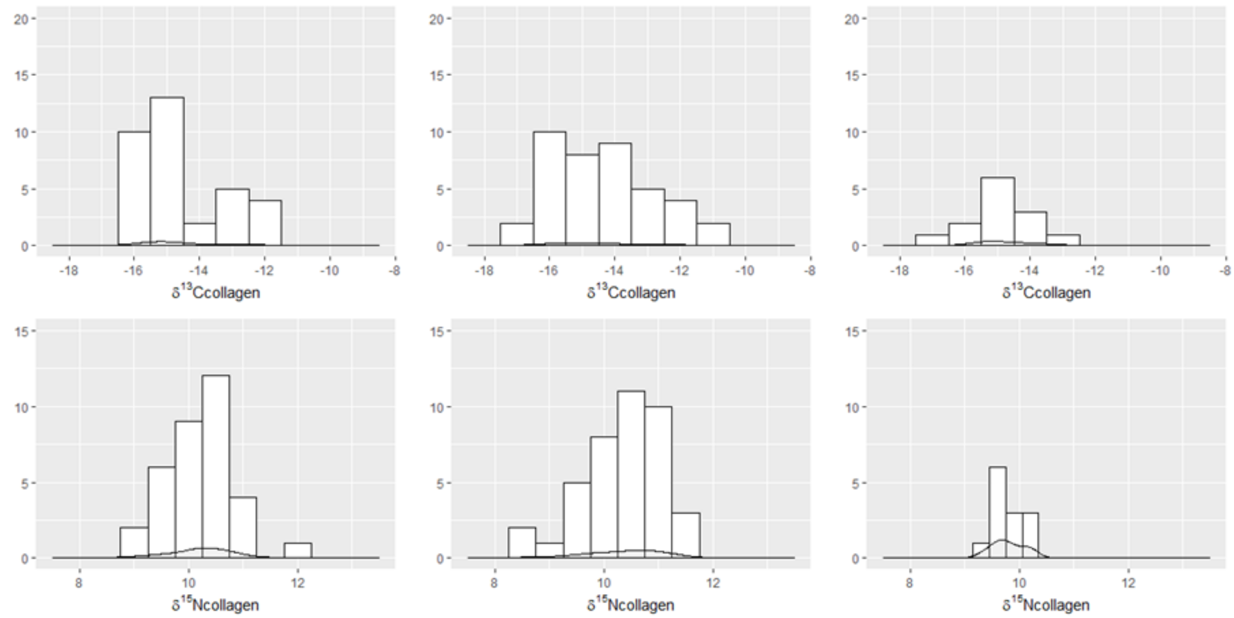

Figure 5.8 - Histograms of normality distribution for (top left to right) ∂13Ccollagen for females, males, and juveniles; and (bottom left to right) ∂15Ncollagen for females, males, and juveniles.

Results

Bone Diagenesis

Diagenetic carbonates were removed from bone samples using an acetic acid (CH_3COOH) treatment (see above), as well as mechanical cleaning of the materials (Garvie-Lok, Varney, and Katzenberg 2004, Koch, Tuross, and Fogel 1997, Lee-Thorp and van der Merwe 1991). Diagenesis of the collagen samples used in this study was assessed using atomic C:N values (Ambrose 1993, DeNiro 1985). Reliable data was obtained from 88 individuals; among these, we ran 31 duplicates when collagen yield was low. Duplicated samples were averaged to obtain a single data point for each individual; no duplicate varied by more than 0.3‰ for ∂N_{AIR} or 0.4‰ for ∂C_{VPDB}. Within the 88 samples, the mean C:N atomic ratio is 3.15 and the values range from

3.1 to 3.2. These are within the acceptable range of atomic C:N = 2.9 to 3.6 for samples that are not degraded according to DeNiro (1985). Two samples fell short of the acceptable standards of weight percent for preserved collagen of at least 13‰ and 4.6‰ for carbon and nitrogen, respectively, but both had an atomic C:N ratio of 3.2 and were thus included in this study (Ambrose 1990, 447) (Table 5.1).

Table 5.1 - Percent weight of carbon and nitrogen, atomic C:N for the 88 bone collagen samples and the stable isotope results from bone collagen and bone carbonates.

Sample Code	Bone Code	Sex	Age Dev	$\partial^{13}C$ carbonates	$\partial^{15}N$ collagen	$\partial^{13}C$ collagen	%N	%C	Atomic C:N
SB18-001	II.G.CS4.CR.007	M	T-YA	-8.9	10.8	-13.9	15.7	41.7	3.1
SB18-005	II.G.CS5.CR.012	F	T-YA	-9.6	10.5	-15.5	15.2	41.1	3.2
SB18-009	II.G.CS4.CR.008	M	T-YA	-10.1	11	-15.9	15.6	42	3.1
SB18-013	II.G.CS4.CR.009	M	YA-MA	-8.9	10.3	-14.4	13.9	38	3.2
SB18-017	II.G.CS4.CR.011	M	YA	-8.1	10.9	-13.3	13.5	36.5	3.2
SB18-020	II.G.CS5.CR.016	M	YA	-7.1	10.2	-15.4	14.6	39.8	3.2
SB18-024	II.G.CS4.CR.012	M	T-YA	-9.5	10.6	-14	13.5	36.7	3.2
SB18-027	II.G.CS4.CR.013	F	YA	-10	11.1	-14.9	13.5	36.2	3.1
SB18-030	II.G.CS4.CR.014	M	T-YA		11.5	-14.3	15.7	41.9	3.1
SB18-036	II.F.CS3.CR.007	M	MA-OA	-5.5	10.7	-10.9	12.8	34.2	3.1
SB18-042	II.G.CS4.CR.006	M	MA	-9.5	10.8	-14.2	15.3	41	3.1
SB18-045	II.G.CS5.CR.009	M	T-YA	-7.4	10.6	-13.1	12.9	34.4	3.1
SB18-049	II.G.CS5.CR.010	F	YA	-7	10.5	-15.5	13.4	36.6	3.2
SB18-053	II.G.CS5.CR.012	F	T-YA	-8.5	10.6	-15.7	13.4	35.7	3.1
SB18-054	II.G.CS5.CR.013	F	T-YA		10.2	-11.7	9	23.8	3.1
SB18-060	II.G.CS4.CR.007	M	T-YA		9.9	-14.1	11.4	30.8	3.2
SB18-067	II.G.CS4.CR.010	F	YA	-10.4	10.7	-15	12.3	32.8	3.1
SB18-071	II.G.CS4.CR.015	M	T-YA	-7.3	9.3	-12.4	10.9	29	3.1
SB18-072	II.G.CS4.CR.016	M	T-YA	-10.8	9	-16.5	12.2	33.3	3.2
SB18-075	II.G.CS4.CR.017	M	T-YA		8.6	-11.9	14.6	38.7	3.1
SB18-076	II.G.CS5.CR.017	M	YA-MA		11	-15.5	10.5	27.9	3.1
SB18-077	II.G.CS4.CR.018	M	YA-MA		10.3	-15.7	15.8	42.4	3.1
SB18-078	II.G.CS4.CR.019	F	T-YA	-7.3	10.9	-13.1	10.4	28.2	3.2
SB18-087	II.G.CS7.CR.002	F	T	-9.5	9.4	-14.9	6.5	17.6	3.2
SB18-088	II.G.CS7.CR.003	F	YA-MA	-10.8	10.3	-15.6	8.3	22.7	3.2
SB18-093	II.G.CS5.CR.018	U	T	-8.7	10.1	-14.3	12.2	33.3	3.2
SB18-096	II.G.CS4.CR.031	U	C	-8.8	9.7	-14.1	13.8	37.1	3.1

SB18-100	II.G.CS5.CR.019	M	T-YA	-7.1	10.9	-12.7	9	24.6	3.2
SB18-103	II.G.CS4.CR.032	U	C	-8.7	10.2	-13.9	13	34.7	3.1
SB18-107	II.F.CS3.CR.009	F	T-YA		10.6	-16.4	15.3	40.7	3.1
SB18-111	II.G.CS4.CR.036	F	T-YA		10	-14.3	16	42.9	3.1
SB18-119	II.G.CS5.CR.028	M	YA-MA		11.1	-12.7	10.7	28.6	3.1
SB18-120	II.F.CS3.CR.012	M	T-YA	-10.7	10.5	-15.2	13.4	35.9	3.1
SB18-124	II.H.CS7.CR.003	M	MA	-9.8	10.4	-16.2	14.9	40	3.1
SB18-129	II.F.CS3.CR.014	F	MA-OA	-10.3	10.2	-15.5	13	34.9	3.1
SB18-130	II.G.CS4.CR.037	M	T-YA	-9.8	9.9	-15	10.8	29	3.1
SB18-131	II.E.CS6.CR.008	U	C	-10.2	10	-17.3	15.7	41.9	3.1
SB18-134	II.H.CS7.CR.004	F	MA-OA	-7.1	10.7	-12.1	14.4	38.8	3.1
SB18-135	II.F.CS3.CR.020	U	C	-10.2	9.7	-15.3	13.7	36.5	3.1
SB18-138	I.D.CS1.CR.018	M	T-YA	-10.4	11	-16.2	9.3	25.3	3.2
SB18-142	II.G.CS5.CR.030	U	C-T	-8.5	9.7	-14.7	14.5	38.6	3.1
SB18-146	II.F.CS3.CR.031	U	C		9.6	-15.5	4.5	12.4	3.2
SB18-150	II.F.CS3.CR.032	U	C		9.8	-15.4	10.4	28.1	3.2
SB18-155	II.G.CS4.CR.024	F	T-YA	-7.9	11.8	-12.7	15.8	42.6	3.2
SB18-156	II.G.CS7.CR.004	F	MA-OA	-9.9	10.1	-14.6	9	24.5	3.2
SB18-157	II.G.CS5.CR.019	M	T-YA	-6.6	11.2	-12.4	11.3	30.4	3.1
SB18-158	II.F.CS3.CR.001	M	MA-OA	-10.6	10.7	-14.9	11.6	31.4	3.2
SB18-159	I.D.CS1.CR.003	F	YA		10.3	-15	6.6	17.8	3.1
SB18-162	II.E.CS3.CR.001	F	MA	-10.9	9.3	-15.4	14	38.4	3.2
SB18-166	II.E.CS3.CR.002	M	YA	-7.2	10.6	-12	13.2	36	3.2
SB18-171	II.F.CS3.CR.002	F	T-YA	-7.3	10.3	-13	13.2	36	3.2
SB18-179	II.F.CS5.CR.001	F	T-YA	-9.7	10.3	-15.5	15.2	41.4	3.2
SB18-182	II.F.CS3.CR.003	F	YA	-9.8	9.4	-14.7	11.8	32.1	3.2
SB18-186	II.G.CS4.CR.001	M	YA-MA	-10	9.8	-15.7	9.8	26.4	3.1
SB18-190	II.F.CS3.CR.005	U	C	-9.8	10.2	-15	9.5	26.1	3.2
SB18-193	II.G.CS5.CR.002	M	YA-MA	-10.4	10.1	-15.1	5.8	15.6	3.2
SB18-200	II.G.CS4.CR.054	U	C	-9.3	10.2	-13.7	15.8	42.4	3.1
SB18-201	II.G.CS4.CR.055	M	T-YA		8.6	-16.9	6	16.2	3.1
SB18-202	II.G.CS4.CR.056	F	T	-7.4	10.2	-13.2	14.5	39.4	3.2

SB18-205	II.F.CS3.CR.061	M	T-YA		11.5	-15.6	12.6	33.7	3.1
SB18-209	II.G.CS4.CR.057	F	T-YA	-10.4	8.8	-15.6	14.3	38.8	3.2
SB18-215	II.G.CS4.CR.060	F	T-YA		10.7	-14.6	15.9	42.5	3.1
SB18-218	II.G.CS4.CR.061	F	T-YA		10.6	-14.6	12.7	33.7	3.1
SB18-222	II.G.CS4.CR.062	M	YA	-10.4	11	-14.7	12.2	33.1	3.2
SB18-229	II.G.CS4.CR.064	F	T	-9.9	9.7	-15.7	14.8	40.1	3.2
SB18-233	II.G.CS4.CR.065	F	T-YA	-6.2	9	-11.5	9.6	26.2	3.2
SB18-236	II.G.CS4.CR.066	M	T-YA		9.3	-13.5	11	29.5	3.1
SB18-239	II.G.CS4.CR.068	M	YA-MA		9.5	-15.1	6.6	18	3.2
SB18-240	II.G.CS4.CR.075	U	C	-9.8	9.3	-15.3	7.4	20.3	3.2
SB18-243	I.D.CS1.CR.022	M	T-YA	-7.9	9.7	-11.3	10.8	28.8	3.1
SB18-247	I.D.CS1.CR.023	U	C-T	-8.5	9.5	-13	10.4	27.7	3.1
SB18-253	I.D.CS1.CR.025	M	MA-OA		10.5	-16.2	14.8	40.1	3.2
SB18-258	II.F.CF10.CR.001	M	T-YA	-11.1	11.3	-15.5	4.6	12.8	3.2
SB18-267	II.E.CS5.CR.004	F	T-YA		11.2	-11.6	13.1	35.3	3.2
SB18-268	II.F.CS5.CR.002	F	T	-8.2	9.8	-13.8	8.1	22.1	3.2
SB18-274	II.G.CS4.CR.004	U	C		9.5	-15.6	8.4	22.8	3.2
SB18-275	II.G.CS5.CR.006	M	MA	-9.3	10.1	-13.9	8.7	24	3.2
SB18-277	II.E.CS5.CR.005	F	MA	-10.1	10.1	-15.1	6.9	19.1	3.2
SB18-279	II.G.CS4.CR.005	F	MA-OA		9.7	-15.4	7	19	3.2
SB18-284	II.H.CS8.CR.002	M	MA		9.8	-15.8	8.9	24.2	3.2
SB18-285	II.E.CS5.CR.001	M	YA-MA		10.4	-12.8	13.1	35.3	3.2
SB18-288	II.F.CS3.CR.007	M	YA		9.6	-14.3	10.4	28.3	3.2
SB18-291	I.D.CS2.CR.005	F	T-YA	-9.1	9.7	-15	11.2	30.9	3.2
SB18-296	II.G.CS4.CR.002	U	C		9.9	-14.6	9.8	26.4	3.1
SB18-299	II.E.CS5.CR.003	F	YA	-6.6	10.8	-13.3	15.1	41.2	3.2
SB18-301	II.G.CS5.CR.005	F	YA		10.1	-14.8	15.2	40.8	3.1
SB18-303	II.G.CS5.CR.003	M	T-YA	-8.2	9.9	-15	7.8	21.3	3.2
SB18-306	II.F.CS3.CR.008	F	MA		10.1	-15.5	15.8	42.4	3.1

Stable Carbon Isotope Analysis: Mixed C_3 and C_4 Plant Diet at Santa Bárbara among Men, Women, and All Age Groups

The $\partial^{13}C_{VPDB}$ values from bone collagen suggest that the Santa Bárbara laborers consumed a diet composed of C_3 and C_4 protein sources. The $\partial^{13}C_{collagen}$ from all individuals ranges from -17.3‰ to -10.9‰ and the mean equals -14.5‰ (SD=1.37; N=88) (Table 5.2). Among adolescent and adult bone collagen samples only, the mean $\partial^{13}C$ is -14.4‰ (SD=1.42; N=75) and the values range from -16.9‰ to -10.9‰. The bone collagen samples from children (12 years and younger) exhibit a $\partial^{13}C$ range of -17.3‰ to -13‰ and the mean $\partial^{13}C_{collagen}$ = -14.9‰ (SD=1.05; N=13). The $\partial^{13}C_{collagen}$ values are not statistically significantly different between the adolescents/adults and the children (W=555, p=0.535; N=88) (Figure 5.9). When the $\partial^{13}C_{collagen}$ values are compared across eight discrete age categories[39] (Buikstra and Ubelaker 1994), there is no significant difference (χ^2=6.6874 df=7, p=0.4621). These data and statistical analyses suggest that the aspect of diet revealed through $\partial^{13}C$ was generally homogeneous between the age groups and apparently did not change significantly through the life course.

Similarly, there are no statistically significant differences in $\partial^{13}C_{bone\ collagen}$ between the sexes (W=757, p=0.720; N=74) (Figure 5.9). Among females, the mean $\partial^{13}C$ = -14.4‰ (SD=1.34; N=34), with a range of -16.4‰ to -11.5‰, while the males exhibit a mean of -14.4‰ (SD=1.50; N=40) and a range of -16.9‰ to -10.9‰. Given the statistical similarities in $\partial^{13}C$ between the age groups and sexes, the diversity of $\delta^{13}C$ values (-17.3‰ to -10.9‰) appear to be shaped by other factors that are not yet clear from current datasets. Overall, the $\delta^{13}C$ values suggest a diet of mixed C_3 and C_4 foods; this will be evaluated more fully with the $\delta^{13}C$ values obtained from bone carbonates (see below).

[39] The eight age categories are: child, child/adolescent, adolescent, adolescent/young adult, young adult, young adult/middle adult, middle adult, middle adult/old adult

Table 5.2 - Summary of ∂13Ccollagen data for adults, juveniles, females, and males

	$^{13}C_{collagen}$ mean (‰)	$^{13}C_{collagen}$ SD	Mann-Whitney u-test
Adults (N=75)	-14.4	1.42	W = 555, *p* = 0.535
Juveniles (N=13)	-14.9	1.08	
Females (N=34)	-14.4	1.34	W = 757, *p* = 0.720
Males (N=40)	-14.4	1.50	

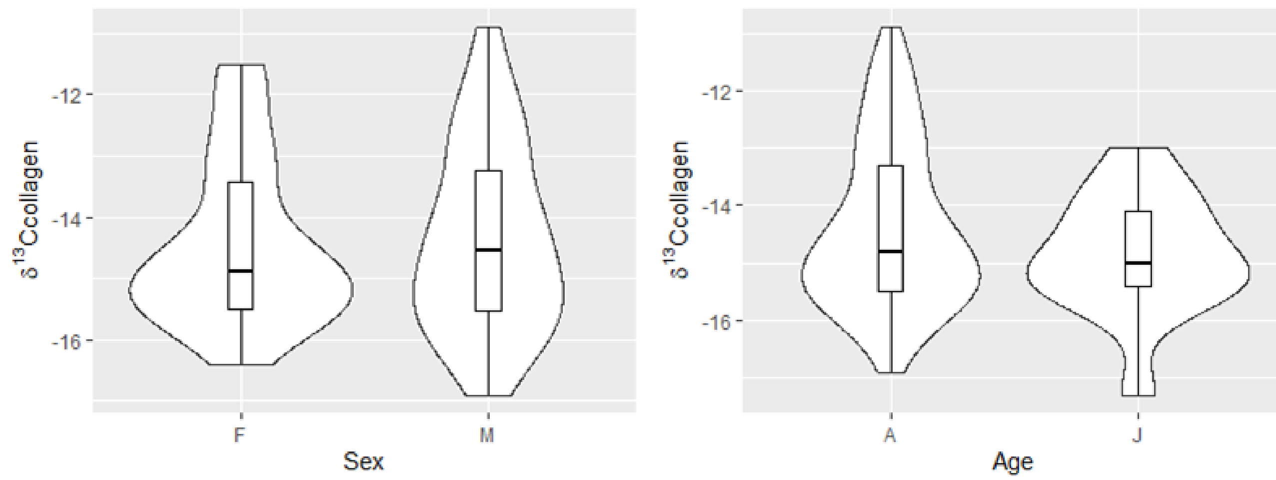

Figure 5.9 - Violin boxplots of ∂13Ccollagen values for (left) females (N=34) and males (N=40) and (right) adults (N=75) and juveniles (N=13).

The $\partial^{13}C_{VPDB\ bone\ carbonate}$ from all individuals ranges from -11.1‰ to -5.5‰ and the mean equals -9.0‰ (SD=1.39; N=60) (Table 5.3). Among adolescent and adult bone carbonate samples only, the mean $\partial^{13}C$ is -8.9‰ (SD=1.48; N=51) and the values range from -11.1‰ to -5.5‰. The bone carbonate samples from children (12 years and younger) exhibit a $\partial^{13}C$ range of -10.2‰ to -8.5‰ and the mean $\partial^{13}C_{carbonate}$ = -9.3‰ (SD=0.71; N=9); the difference between the adults/adolescents and the children is not significant (Z=.033; P=.74). Among females, the mean $\partial^{13}C_{carbonate}$ = -8.9‰ (SD=1.47; N=24), with a range of -10.9‰ to -6.2‰, while the males exhibit a mean of -9.0‰ (SD=1.54; N=26) and a range of -11.1‰ to -5.5‰. The sexes show statistically similar $\partial^{13}C_{VPDB\ bone\ carbonate}$ values (Z = -0.16, *p* = 0.87). The stable carbon isotope data from bone carbonates are discussed in conjunction with collagen data in the Froehle model to clarify food sources in the diets of the laborers (see below).

Table 5.3 - Summary of $\partial 13C_{VPDB}$ bone carbonate data for adults, juveniles, females, and males

	$\partial^{13}C_{carbonate}$ mean (‰)	$\partial^{13}C_{carbpmate}$ SD	Mann-Whitney u-test
Adults (N=75)	-8.9	1.48	Z = 0.33, *p* = 0.74
Juveniles (N=13)	-9.3	0.71	
Females (N=34)	-8.9	1.47	Z = -0.16, *p* = 0.87
Males (N=40)	-9.0	1.54	

Stable Nitrogen Isotope Analysis: Children Eat Less Protein than Adults

The $\partial^{15}N_{AIR\ bone\ collagen}$ values suggest that the Santa Bárbara laborers consumed a diet composed primarily of terrestrial protein. The $\partial^{15}N_{bone\ collagen}$ from all individuals ranges from 8.6‰ to 11.8‰ and the mean equals 10.2‰ (SD=0.66; N=88) (Table 5.2). The range, means, and standard deviations for males and females is shown in Table 5.4 and Figure 5.10. There is no statistically significant difference between the sexes (t = 0.05, p=0.96; N=74). For juveniles, the range is 9.3‰ to 10.2‰ with a mean of 9.8‰ (SD=0.29*;* N=13), while for adolescents/adults, the mean $\partial^{15}N_{bone\ collagen}$ is 10.3‰ (SD=0.68*;* N=75) and the values range from 8.6‰ to 11.8‰. Although these are significantly different (W=737.5, p=0.003) (Figure 5.10) the difference in mean $\partial^{15}N$ values between juveniles and adults is only .5‰. Nonetheless, the range of values for juveniles and adults and the significant difference between them hints at the practice of adults consuming slightly more protein than children.

Table 5.4 - Summary of ∂15Ncollagen data for adults, juveniles, females, and males

	$\partial^{15}N_{collagen}$ mean (‰)	$\partial^{15}N_{collagen}$ SD	Mann-Whitney u-test
Adults (N=75)	10.3	0.68	t = 0.05, *p* = 0.96
Juveniles (N=13)	9.8	0.29	
Females (N=34)	10.2	0.63	W = 737.5, *p* = 0.003
Males (N=40)	10.3	0.72	

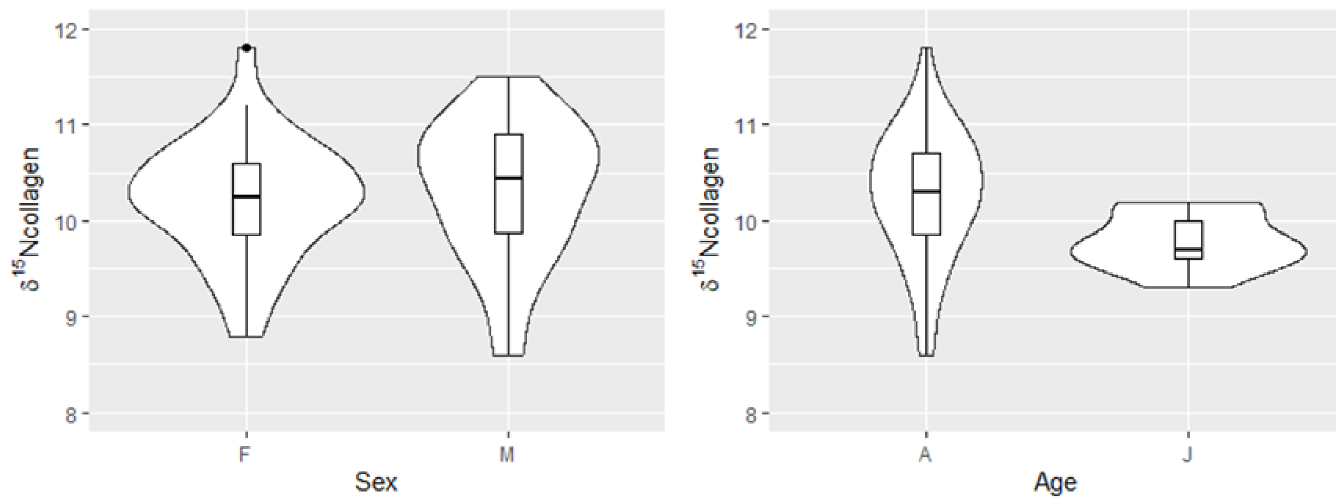

Figure 5.10 - Violin boxplots of ∂15Ncollagen values for (left) females (N=34) and males (N=40) and (right) adults (N=75) and juveniles (N=13).

No Correlation Between Violence Risk and Diet

Cranial trauma affected 22% of all individuals excavated from Santa Bárbara (N=175) (Proctor 2019). To compare the relationship between resource access and risk of violence, we compared the $\partial^{13}C_{bone\ collagen}$ and $\partial^{15}N_{bone\ collagen}$ values between those with cranial fractures and those without. Overall, there were 38 crania with either an antemortem or perimortem fracture, and we obtained isotope data from 24 of them (63%), and there were 137 crania without fractures, and we examined 64 (47%) of them for stable isotope data.

Individuals with cranial trauma exhibit a $\partial^{13}C_{bone\ collagen}$ range of -16.9‰ to -11.9‰ and a mean of -14.5‰ (SD=1.47, N=24), and the individuals without trauma have a $\partial^{13}C_{collagen}$ mean of -14.5‰ (SD=1.35), with a range of -17.3‰ to -10.9‰. There is no significant difference between these two groups (W=778, p=0.902) (Figure 5.11). The crania exhibiting trauma had a $\partial^{15}N_{collagen}$ range of 8.6‰ to11.1‰ and a mean of 10.1‰ (SD=0.70), while samples from individuals without trauma have a mean $\partial^{15}N_{collagen}$ of 10.3‰ (SD=0.64), with a range of 8.8‰ to 11.8‰. This is not a significant difference (W=691.5, p=0.361) (Figure 5.11) (Table 5.5).

Table 5.5 - Summary of ∂^{13}Ccollagen and ∂^{15}Ncollagen data for individuals with and without trauma

	$^{13}C_{collagen}$ mean (‰)	$^{13}C_{collagen}$ SD	Mann-Whitney u-test	$\partial^{15}N_{collagen}$ mean (‰)	$\partial^{15}N_{collagen}$ SD	Mann-Whitney u-test
Individuals with trauma (N = 24)	-14.5	1.47	W = 778, *p* = 0.90	8.6	0.70	W = 691.5, *p* = 0.36
Individuals without trauma (N = 64)	-14.5	1.35		10.3	0.64	

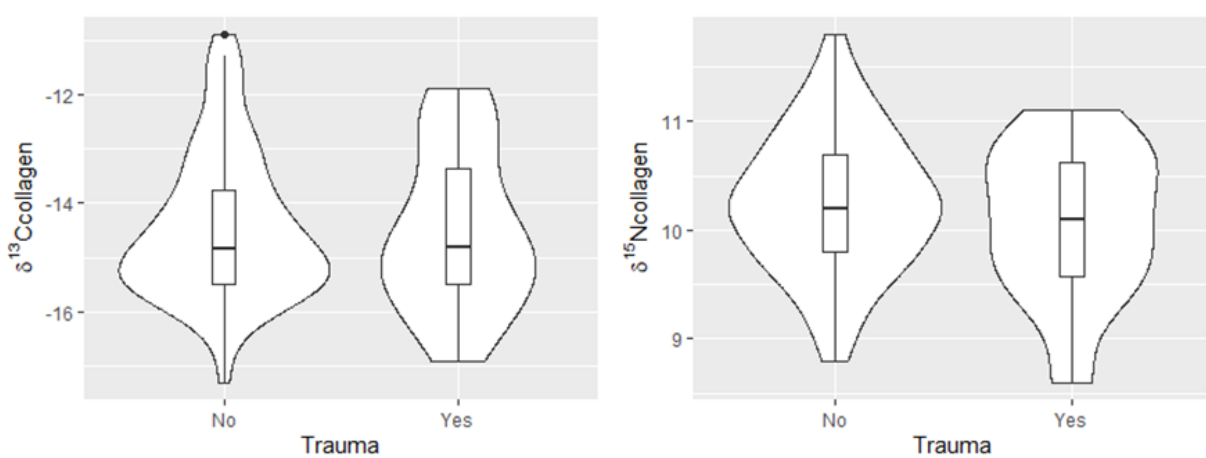

Figure 5.11 - Violin boxplots of (left) ∂13Ccollagen values and (right) ∂15Ncollagen values for individuals with (N=24) and without trauma (N=64)

Childhood Stress Does Not Predict Diet

General stress indicators in the form of *cribra orbitalia* or porotic hyperostosis were found in 56% of all individuals excavated from Santa Bárbara for whom the conditions could be observed (N=171). While these pathological conditions are multifactorial in their etiology, their high frequency in the population is uncommon in pre-Columbian highland populations, and may point to childhood malnutrition or illness brought on by poor living conditions. To compare the relationship between resource access and general childhood stress, we compared the $\partial^{13}C_{collagen}$ and $\partial^{15}N_{collagen}$ values between those with either cribra orbitalia or porotic hyperostosis (or both) and those without any of those lesions. Overall, there were 98 crania with either cribra orbitalia or porotic hyperostosis, and we obtained isotope data from 55 of them (56%), and there were 73 crania without those lesions, and we examined 31 (42%) of them for stable isotope data. There are no statistically significant differences in $\partial^{13}C_{collagen}$ or $\partial^{15}N_{collagen}$ between those with evidence of childhood stress and those without (Figure 5.12) (see Table 5.6).

Table 5.6 - Summary of $\partial^{13}C_{collagen}$ and $\partial^{15}N_{collagen}$ data for individuals with and without cribra orbitalia (CO) and/or porotic hyperostosis (PH).

	$^{13}C_{collagen}$ mean (‰)	$^{13}C_{collagen}$ SD	Mann-Whitney u-test	$\partial^{15}N_{collagen}$ mean (‰)	$\partial^{15}N_{collagen}$ SD	Mann-Whitney u-test
Juveniles with CO/PH (N = 4)	-15.0	1.86	W = 19, p = 0.877	9.7	0.22	W = 23.5, p = 0.390
Juveniles without CO/PH (N = 9)	-14.8	0.67		9.8	0.32	
Adults with CO/PH (N = 51)	-14.6	1.32	W = 642.5, p = 0.327	10.3	0.69	W = 576, p = 0.857
Adults without CO/PH (N = 22)	-14.2	1.50		10.3	0.70	

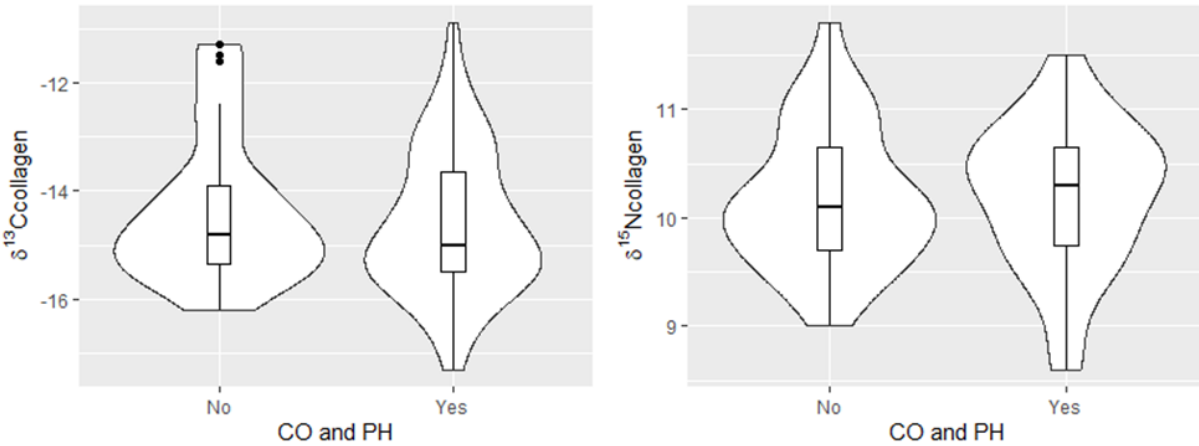

Figure 5.12 - Violin boxplots of (left) $\partial^{13}C_{collagen}$ values and (right) $\partial^{15}N_{collagen}$ values for individuals with (N=55) and without (N=31) cribra orbitalia and/or porotic hyperostosis.

Discussion

Diet Composed of C_3 and C_4 Foods, and Varied Access to Terrestrial Protein

The stable carbon isotope ratios observed in the Santa Bárbara population indicate a diet that was composed of both C_3 and C_4 protein sources. There does not appear to be any structuring of access to dietary resources along lines of bioarchaeologically detectable social identities (i.e., age and skeletal sex). Rather, it appears that the population in general was eating a diverse diet that included both C_3 and C_4 foods. Based on the range of $\partial^{15}N$ values, the community overall has access to terrestrial protein. Relative to pre-Hispanic communities in the Andes, the Santa Barbara population exhibits similar or higher average $\partial^{15}N$ values. For example, at the Early Intermediate Period (1 – 600 CE) and Middle Horizon (600 – 1000 CE) site of Beringa in the southern Peruvian valley of Majes, the mean $\partial^{15}N$ is 10.6‰ (Tung and Knudson 2008) and at sites in the Nasca region, the mean $\partial^{15}N$ is 8.8‰ (Kellner and Schoeninger 2008). At other colonial era communities, such as San Pedro Mórrope and Eten in the north coast, the mean $\partial^{15}N$ values are 13.1‰ and 13.0‰ respectively. Thus, the Santa Barbara community overlaps (and exceeds) stable nitrogen isotope values relative to several other non-marine Andean communities, but has lower values than coastal communities with access to marine resources (Turner and Klaus 2020). At Santa Barbara there is some heterogeneity in protein consumption that ranges across one trophic level (~3‰), with adults consuming slightly more meat relative to juveniles. This may suggest that there were social norms regarding who had access to protein-rich animal meat, and that it was generally more reserved for adults.

Dietary Carbon and Nitrogen Sources: Modeling Foodways

To clarify the proportions of general food categories in the laborers' diets, we used two models developed by Kellner and Schoeninger (2007) and Froehle et al. (2012). The first takes the $\partial^{13}C_{collagen}$ and $\partial^{13}C_{carbonates}$ to generate regression lines that reflect C_3, C_4, and marine dietary proteins and C_3 and C_4 energy sources. The second uses $\partial^{13}C_{collagen}$, $\partial^{13}C_{carbonates}$, and $\partial^{15}N_{collagen}$ to create a multivariate isotope model and make more specific inferences about ancient human diets, particularly as related to proportion of C_3 vs C_4 foods and protein sources.

The Kellner and Schoeninger (2007) model reveals that the dietary protein of individuals at Santa Bárbara primarily falls between the C_3 and C_4 lines (Figure 5.13). Moreover, the individuals cluster in the middle, and none are near the ends of the C3 or C4 energy sources. This further suggests the consumption of C_3 and C_4 foods that were more protein-rich than carbohydrate and lipid rich. That is, no one is near the top end of the 100% of the C_4 energy diet, suggesting that no one in our sample had a diet composed primarily of maize or sugarcane.

The Froehle et al. (2012) model shows the somewhat varied nature of the diet across the population (Figure 5.14). A number of individuals fall into Cluster 4, which indicates a diet composed of about 70% C_3 plants and over 50% C_4 protein sources (see Froehle et al 2012). This suggests that those laborers consumed a significant quantity of tubers and other C_3 plants (perhaps including European C_3 plant foods), and little maize or sugarcane. The animal meat that they consumed, however, was likely fed on C_4 plants; it is also possible that the protein-rich C_4 plant, kiwicha, was a part of their diets.

There are 14 individuals in Cluster 2 (none of them juveniles), a diet composed of about 70% C_4 plants and over 65% C_3 protein (see Froehle et al 2012). This is nearly the opposite of the Cluster 4 diet; these Cluster 2 individuals had diets with high proportions of maize and sugarcane, and they consumed C3 plants that are high in protein, such as beans, and likely animal meat that was fed on C3 plants.

The remaining individuals do not fall into any particular cluster but are spread between Clusters 2 and 4. There are no individuals in Cluster 3 (the marine protein diet), and although the Kellner and Schoeninger (2007) model showed a few people near the marine protein line, the more robust Froehle et al (2012) model reveals that no one at Santa Barbara was consuming a marine-based diet. Nonetheless, the spread of individuals from Clusters 4 to 2 (and in between) leads us to assert that the diet of Santa Bárbara inhabitants was not homogeneous. There are clusters of individuals eating similar diets, but which differ from other clusters of individuals. The heterogeneity in diet that we detect through stable isotope analysis is not structured along age or skeletal sex, nor are groups in the clusters characterized by the presence of cranial trauma or general stress indicators (i.e., cribra orbitalia and porotic hyperostosis). If diet is not structured by age, sex, exposure to violence, or childhood physiological stress, there could be other markers of distinction that we are simply unable to detect with traditional bioarchaeological analyses.

It is important to consider that these are not discrete, isolated clusters, but that there is a range of people eating 70% C_3 plants and 50% C_4 protein and others eating 70% C_4 plants and more than 65% C_3 protein—and then several in between. How might we explain the very distinct diets of the people at the extremities of the Froehle model? Perhaps these individuals maintained local food consumption patterns after migration. It is unclear whether these individuals were recent migrants to the site, though bioarchaeological studies of bone remodeling suggest that they had been there for a significant length of time before death (Proctor n.d.). Nevertheless, traditional foodways may become entrenched within a community and this may represent a persistence of consumption patterns across generations.[40]

It is also possible that food consumption was more opportunistic, related to what food could be acquired. If the latter, then it may be that the horrendous conditions of forced resettlement and coerced labor in the mercury mines created conditions in which daily food consumption or feasting activities were overtly controlled, or at the least, certain foods were not readily available for the Santa Barbara inhabitants, such that food consumption practices were more contingent, and thus unpredictably variable. This new colonial context of coerced labor may have created conditions in which food access was opportunistic; it may also mean that diet and foodways were more circumscribed, and thus not as deployable as key markers of social identity. If this is the case, this reveals a crucial, yet subtle way, that Galtung's notions of structural violence was at play in the realm of foodways. Practices that may have served to forge community ties and identity were restricted and likely altered relative to what the Santa Bárbara inhabitants had previously done in their home communities. This is not meant to imply that food—the selection, preparation, and sharing—was no longer deployed as a performative practice that extended beyond caloric substance; however, the empirical data presented here open up the possibility that foodways as a socio-cultural and political marker may have been transformed. The manifestation of this phenomenon is an example of what Galtung refers to as penetration—the imposition of foreign foodways or consumption patterns—and fragmentation—preventing the community from cementing ties through foodways (1990: 294).

[40] Future stable oxygen and strontium isotope analysis may help to clarify this, though if these are second generation families, we of course could not detect their "non-local" status.

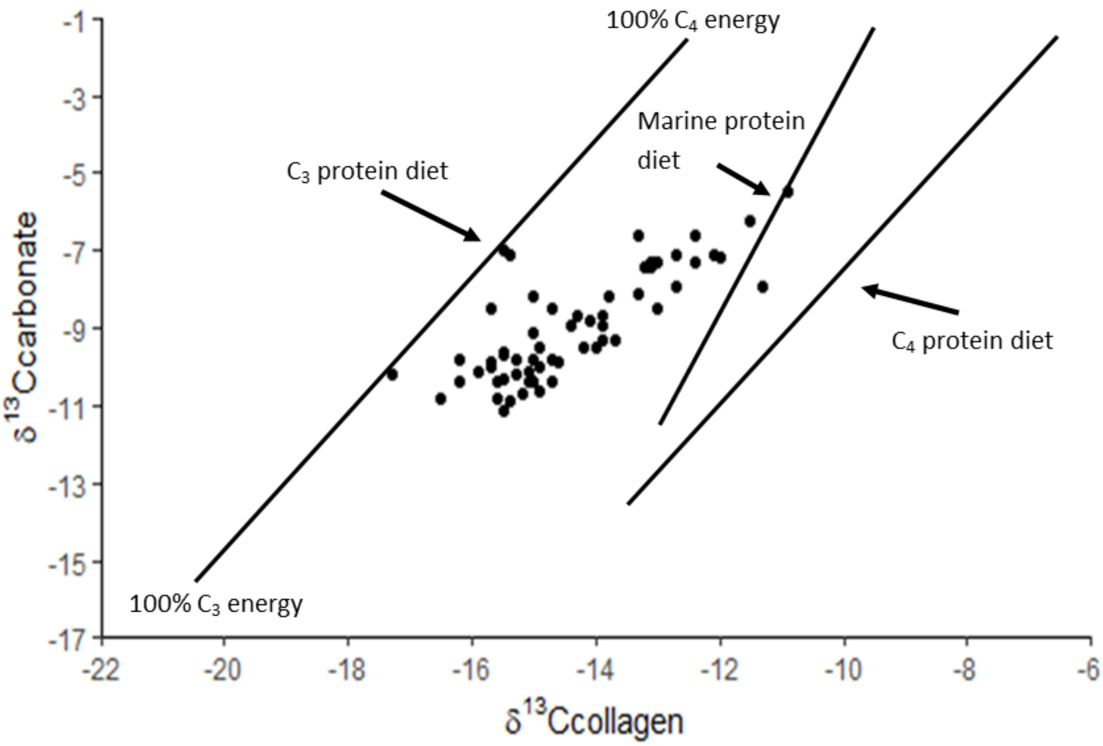

Figure 5.13 - Kellner and Schoeninger (2007) model of ∂^{13}C data for Santa Bárbara

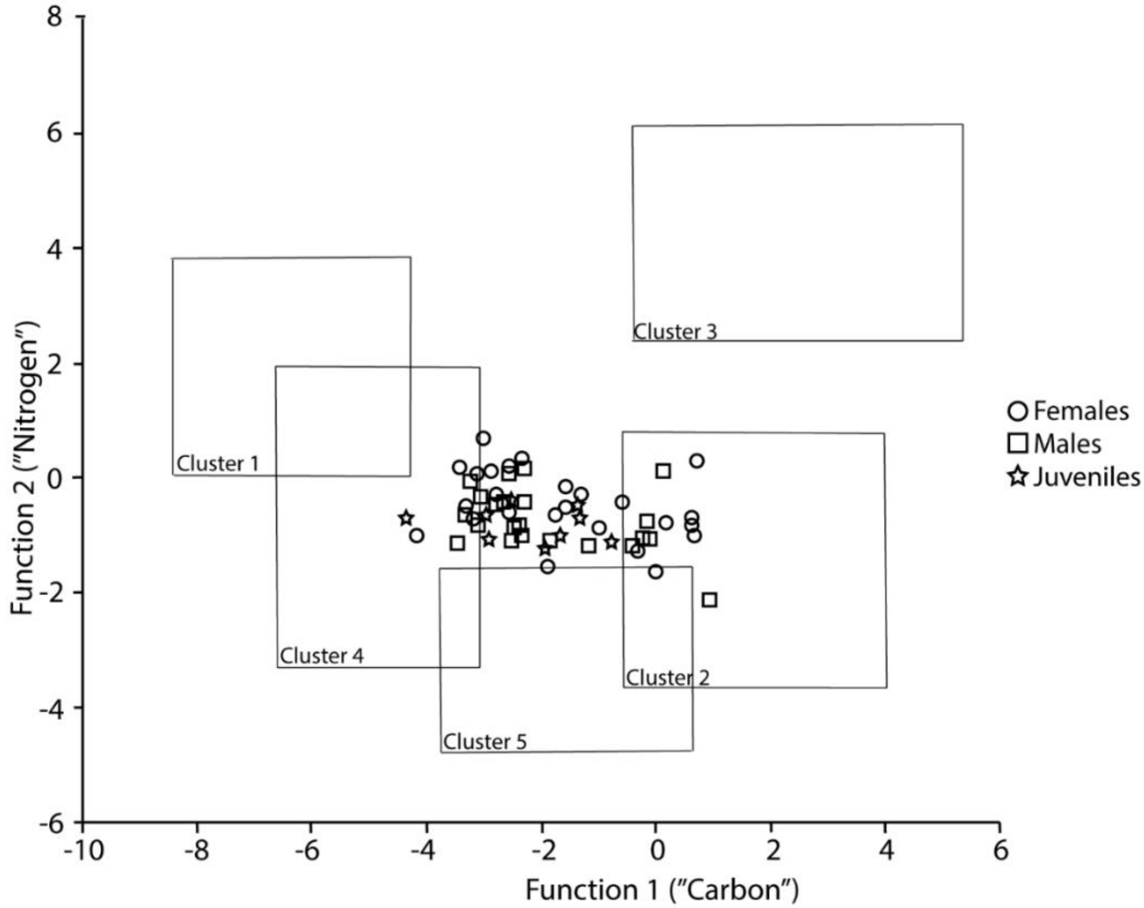

Figure 5.14 - Froehle et al. (2012) model of dietary isotopes for Santa Bárbara.
Cluster 1 = 100:0 C_3:C_4 diet, C_3 protein; Cluster 2 = 30:70, >50% C_4 protein; Cluster 3 = 50:50 C_3:C_4 diet, marine protein; Cluster 4 = 70:30 C_3:C_4 diet, ≥65% C3 protein; Cluster 5 = 30:70 C_3:C_4 diet, ≥65% C3 protein

Family Meals and Feeding Children

While there has been substantial work examining the foodways of the Andes both in the pre-Columbian and Colonial periods (see Defrance, Wernke, and Sharpe 2016, Garavito and Mendives 2019, Kennedy, Chiou, and VanValkenburgh 2019, Staller 2021, Turner et al. 2018), intrahousehold food sharing is difficult to see archaeologically. Commensal feasting can be seen in the form of large serving vessels (see Bray 2003, Hardy 2019, Sutherland et al. 2020) and preferential access to maize by one subgroup might be identified through significantly different stable isotope signatures (see

Somerville et al. 2015, Tung 2021). Understanding the way that colonial-era households distributed food would benefit from ethnographic analogy. At Santa Barbara, a lower level of meat consumption among children at first glance seems to be related to intrahousehold food allocation privileging older members. This may seem to run contrary to contemporary studies of food distribution among Andean households. In surveys conducted across the region, scholars have found that instead, children have preferential access to calories to mitigate sickness and weakness (Gittelsohn and Mookherji 1997, Graham 1997, Leonard and Thomas 1989). However, there are several reasons that children may show lower access to this important macronutrient. While children are fed to prevent severe hunger, it may be that the lack of animal protein seen in children's diets is reflecting the relative instability of this source of food. Rather than relying on animal products, children may have been provisioned primarily on more dependable caloric sources in the form of agricultural products, with only occasional access to animal proteins. In contrast, adults may have had access to this rarer, and presumably more expensive, type of calories. This may also reflect an understanding of the need for protein sources for the long-term, intensive, physical labor that these individuals were engaging in (Proctor 2016, Proctor n.d.), in addition to the carbohydrate and lipid loads that would have provided quick energy for other forms of labor.

Consumption Not Shaped by Gender

When examined in conjunction with age- and sex-based comparisons in $\partial^{13}C_{collagen}$ signatures, a picture emerges wherein dietary differences are not obviously structured by age and skeletal sex. The similarities in diet between those identified as skeletally male and skeletally female is a significant insight because it shows that they likely had similar access to (different) food resources. There are both males and females in Clusters 2 and 4 and in between. This provides a foundation for considering gender norms and gender roles among the Santa Bárbara laborers during this time of Spanish colonialism. And while the presumptive leap from skeletal sex to socially constructed gender is a tenuous one (Geller, Geller, and Krauß 2017), it can provide some basic insights into how what we identify as skeletal sex gives hints into how gender roles and norms might have been expressed. At Santa Barbara, the stable isotope data do not detect consumption patterns that are overtly linked to distinguishing the performance of distinct genders. Instead, the diets are overlapping (though variable), hinting at some other factors that are driving the dietary distinctions.

As seen in historical documents, women's role selling chicha and other goods may have positioned them as providers of food, giving them equal access to protein when compared to their male counterparts. Conversely, the local practices of animal husbandry in the region, including European cattle and sheep, as well as the ever-important camelids (llamas and alpacas) may have provided enough protein to sustain the adult population at Santa Bárbara, supplementing a dearth in the distribution of meat by Spanish mine owners. In either case, it would seem that women's role in the economy provided them access to the same goods as men, diverging from pre-Columbian practices of preferential consumption of high-status goods such as chicha and meat by males (Somerville et al. 2015).

Among age groups, children had less access to protein relative to adults, but some children had similar access to plant foods, and while no children are in Cluster 2, there are some near that cluster, suggesting consumption of C_4 foods such as maize or sugarcane. Unfortunately, we cannot distinguish maize from sugarcane isotopically, so it is unclear if children (and adults) are continuing to consume maize—a food that has long held high political and social capital in the Andes—are if they are shifting to sugarcane consumption, a new European import. Nevertheless, the isotope data presented here imply the construction of a different kind of individual identity and personhood, built less upon social categories tied to age and gender, and more along lines of where one was originally from and what it meant to become part of the Santa Bárbara community.

Drink Your Dinner: Chicha and Aguardiente Consumption

The lack of differentiation in $\partial^{13}C$ sources between adults and juveniles also suggests that consumption of maize and sugar products was common across much of the population. In addition to *chicha* (maize beer), in the late Colonial Period, some children (e.g., in this study, it could be those who appear between Clusters 2 and 4) and older individuals often consumed a by-product of *chicha* production, known as *ticti*, a thick, maize-based porridge—which may contribute to those more elevated stable isotope ratios (Borrero 2021). In his account of the markets of Potosi, Friar Lizarraga wrote that "even children six or seven years old, chew corn to make [chicha]" (cited in Robins 2011, 41). Globally, children often consume small quantities of fermented beverages such as beer, and this may indeed be the case in Huancavelica as well. As noted earlier, the isotopic signatures of sugarcane and maize cannot be parsed, but fermented beverages were the most accessible form of these products. In addition to their high carbohydrate (sugar) content, it may be that alcohol consumption was used to mitigate the harmful effects of mercury poisoning. Indeed, the absorption of mercury vapors in the lungs is reduced when ethanol is bound to blood, as they affect red blood cells in the same way. As such, consumption of chicha, aguardiente, and possibly wine, may have diminished damage to the central nervous system by limiting the oxidation of mercury in the bloodstream (Robins 2011, 143).

Finding Agency through Practice

When we examine the Santa Bárbara community through the intersecting lenses of food as a means to construct identity and also as a tool within the social scaffolding known as structural violence, we can speak more meaningfully about the community that labored in the mercury mines. Though food distributed to the *mitayos* was often a deduction from their paltry wages, even this form of payment was frequently withheld by Spanish overseers (Smith 2004). Yet, the variability in the diet of the Santa Bárbara inhabitants, coupled with availability of European foods and associated trade systems may also speak to the presence of personal preference as a factor in consumption and the negotiation of food consumption practices (Dietler 2010, Robins 2011, Smit 2018). The entanglement of limited food access, as structured by colonial policies and practices, and the act of food choice, reveal the complex and creative ways that Indigenous Andeans negotiated new socio-political and cultural contexts that were not entirely of their making. As discussed earlier, the ability to self-identify is a fundamental aspect of freedom that is often violated through the structural violence of colonial policy (Galtung 1990); yet, we see that at Santa Bárbara, prescriptive diets as mandated by colonial authorities must not have been stringently enforced as depicted in the historical record (Bradby 1982, 246), nor were homogeneous diets inadvertently created by severely limited foodstuffs. While it is impossible to determine whether they were consuming local foods or imported foods, they must have been consuming foods that they deemed appropriate among the somewhat diverse array of options, ranging from C_3 to C_4 food crops to C_3- or C_4-fed animals. The simple act of choosing what to have for dinner may seem banal on the surface, but ask any head of household how truly complex the decision (and workload) is. Indeed, the notion of what you and your family eat reveals complex ties to political and economic frameworks, social and gender norms, trade infrastructure, and local ecology and weather patterns. In the context described here, we also see something quite meaningful: the potential for resilience as performed through personal food preferences in the context of oppressive colonialism. Though the laborers of Santa Bárbara were subject to abuse, illness, forced labor, unstable and insufficient wages, their lives were not determined in totality by the Spanish colonists. Rather, the realities of quotidian life were negotiated through individual and community praxis.

The proposed explanations for the variability seen in the diet of the people of Santa Bárbara exist in tension with each other, much as do theories of structural violence and of agency. Evidence of Spanish abuses upheld by colonial policy within the context of the *mita* may lead us to conclude that this pattern is revealing opportunistic feeding on the part of the individuals at the site, supplementing food denied by the Spanish with withheld wages. The structural violence of the colonial economy may indeed have penetrated this aspect of life and denied community and individual practice of their own foodways. However, we must not discount the persistence and resilience of community food practices in the face of oppressive structures of power. While considering questions of structural violence, we must also acknowledge the individuals living under that structure, and the ways that they may have exercised their limited power through the intentional consumption of foods brought from their own communities or according to personal preferences. To assert that any of these is definitely true—or even that these practices did not co-exist—is impossible with this dataset. However, by holding all of these possibilities in mind, we can imagine a complex lifeway, navigated by individuals in a world structured by inequalities.

CHAPTER 6:
Conclusion

Cada día no se hazia nada, cino todo era pensar en oro y plata y rriquiesas de las Yndias del Pirú. Estauan como un hombre desesperado, tonto, loco, perdidos el juicio con la codicia de oro y plata […] A cido como un gato casero quando tiene el rratón dentro de las uñas

Every day nothing was done but think about gold and silver and wealth from the Indias of Peru. [The Spaniard] was like a desperate, foolish, mad man, out of his mind with the lust for gold and silver […] like a housecat when he has the mouse between his claws.

— Felipe Guaman Poma de Ayala (1980, /376/)

This dissertation explored how the different forms of violence inherent in the Spanish colonial mining economy from the 16th-19th centuries CE were embodied by the Indigenous people of Santa Bárbara who labored in the mercury mines. I demonstrated this through the analysis of human skeletal remains from a series of burial pits in the churchyard of the colonial Santa Bárbara mining encampment. In the introduction, I proposed a synthesis of theories of direct and indirect violence and embodiment to better understand how structural and direct violence indelibly transformed the skeletons of individuals who lived under these formalized systems of oppression. A bioarchaeological approach to investigations of embodiment rests upon the premise that structural violence can be seen in the slow destruction of bodies through policies which deny well-being needs, freedom needs, and eventually survival needs. This exhibits in a mutually constitutive practice of direct assaults on Indigenous people by the Spanish colonists that serve to strengthen control through the policing of bodies.

In Chapters 3-5, I used three types of bioarchaeological evidence to parse different aspects of the colonial experience and the way that it structured daily lived experiences. These focused on examining trauma resulting from direct violence, labor-related changes to the body, and stable isotope analysis of carbon and nitrogen in bone collagen to detect variations in food consumption and access to resources across different potential social divisions in light of the transformations wrought by Spanish colonialism. I demonstrated that those structures of inequality inherent in the colonial project transformed the bodies of those who labored at Santa Bárbara. I also unraveled narratives of the experience of the miners as presented by the Spanish in historical documents.

In this chapter, I integrate the results of osteological and isotopic analyses in pursuit of a more complete view of the lifeways of the Indigenous inhabitants of Santa Bárbara. I discuss the denial of some needs and the success at maintaining other forms of agency within the context of forced labor and attempted cultural erasure. Specifically, the results of this dissertation are positioned in relation to the prevailing accounts in the historical record and used to understand how these structures came to be enforced, maintained, and reproduced. What follows is a discussion of how cultural violence was mobilized to uphold structures of violence and acts of direct violence through racialized identities and reified in popular ideologies in the Colonial Period with regards to the place of Spanish and Indigenous people in colonial society.

Summary of the Results

In Chapter 3, I showed the importance of direct violence in enacting of colonial policies in the mines of Santa Bárbara. Evidence of trauma among the population buried at the site show that the inhabitants were all at risk of lethal violence from the Spanish mine authorities. Patterns of abuse that show direct encounters are seen across all members of the population, and wounds can be readily compared to Spanish weaponry in the Colonial Period. Despite a wide range of age groups and the presence of individuals from multiple sex-based categories, there was no obvious delineation of who it was appropriate to injure or murder. That is, being an Indigenous laborer was a sufficient precondition alone for being subject to direct—and often lethal—violence from Spanish officials.

In Chapter 4, I demonstrated that the eligibility of individuals for mining labor was misrepresented in historical documents, whether intentionally or through ignorance of practice. Young adolescents worked in the mine alongside adults. Individuals across the spectrum of skeletal sex engaged in similar practices that degraded their bodies. I showed that these people were engaged in activities that directly correlate with labor in mines, including pick-axeing and ore carrying. In addition to drastic remodeling of bones in the forms of bony growths and lesions to the skeletal tissue, the high levels of degenerative joint disease are seen even in young individuals, suggest a strenuous workload from a very young age. The people at Santa Bárbara would have been forced to continue work, even as they were plagued by the pain of destroyed joints and overworked muscles. This also means that everyone who shows these signs of labor were also at constant risk of mercury poisoning inside these mines. Their constant exposure to toxic fumes and elemental forms of mercury and lead would have made them ill and weak as their bodies were continuously pushed to the limit. Furthermore, they worked in unsafe conditions that put them at risk for injuries due to collapsing galleries and tunnels, or falls from the top of mineshafts. The policies and practices that forced Indigenous laborers to work for long periods of time in such unsafe conditions created a form of structural violence that crosscut the social identities of those who lived and worked at Santa Bárbara.

Chapter 5 presented the results of stable isotope analysis of bone collagen sampled from the human remains recovered at Santa Barbara. Contrary to colonial accounts of a homogenous diet predicated on what was “appropriate” for the Christianized *indio* to eat, the people at Santa

Bárbara appear to have consumed a variety of foods. The relative diversity of the diet consumed among the entire population suggests either differential access to resources or the expression of personal preference for different kinds of food; that is, it is unclear whether we are witnessing opportunistic feeding in response to restricted food access or individual practices of consumption that assert community or individual identity. Resource access is not structured along lines of skeletal sex, though juveniles had slightly less access to meat protein in their diet. The presence of isotope ratios indicative of C_4 plants in the diet indicates that people at the site had access to foods with traditionally higher social capital, like the historically important maize, and perhaps imported sugar. At least some of these foods were likely consumed in the form of alcohol, which was simultaneously encouraged by Spanish tavern owners in the cities and maligned by Spanish officials as an immoral practice.

Locating Violence with Bioarchaeology

Overall, the bioarchaeological data reconstruct a nuanced view of the application of violence at the site. As discussed in Chapter 1, structural violence is predicated on the denial of four types of needs: survival needs, well-being needs, freedom needs, and identity needs. The violation of freedom needs is easy enough to find even in the historical record. The Count of Chinchón writes in his 1630 letter to the King that "they take these miserable Indians by force against all their will from their houses and take them in iron collars and chains more than 100 leagues to put them in this risk, ... and from this has resulted their own mothers maiming and crippling their sons to preserve them" (Chinchón 1630, cited in Brown 2001:474). The forced displacement of groups of Indigenous people to the mines and policies leading to destitution and debt to Spanish *mineros* drastically restricted the freedom of the Indigenous individuals who labored within the mining economy, while circumventing the charge of formal slavery. The institution of forced labor was characterized as a form of work for bettering oneself, so as not to undercut Spanish claims to be converting Indigenous people into Christianized subjects of the Crown. Of course, some fled, sacrificing their connections to their home communities and their land and becoming *forasteros* vying for their freedom. These restricted assertions of agency saved individuals but contributed to the slow destruction of indigenous communities (Robins 2011).

The violation of survival needs and well-being needs are found both using bioarchaeological data and historical accounts of the mining economy. The prevalence of lethal trauma at Santa Bárbara is the most obvious denial of survival needs. The imminence of the threat of force at Santa Bárbara would have created a "culture of terror" that is inherent in the exercise of colonial power (Taussig 1987).

As we have seen, survival needs were also threatened by illnesses brought on by mercury exposure and the harmful effects of mining. We can locate well-being needs within this realm, too: labor practices resulted in the pain and slow destruction of the bodies of the Indigenous inhabitants of Santa Bárbara in ways that transcended gender and age. Guaman Poma laments the effects of the mines on the young men of the Indigenous communities, pleading to the Spanish king:

> Your Majesty must order with expressed pain that one must not mistreat the leaders nor the *indios*, and that young *indio* boys—until they are older than twenty years old—will not enter any shaft of the mercury, silver, and gold mines, nor will they smelt, in the quicksilver furnace, because they are of a tender age and later he will become sick from mercury, and there is no healing and he dies, and this is the end of the *indios*.[41] (Guaman Poma de Ayala 1980 /970[988])

[41] Author's translation. Original text: Vuestra Majestad debe mandar con expresa pena que no maltrate a los principales ni a los indios, y que los indios muchachos hasta llegar de más de veinte años su edad que no entren a ningún socavón de las minas de azogue, y de plata, oro, ni al fundir, y al horno de azogue, porque como son tierna edad y muchacho luego le da azogado, y no hay sanar y muere, y acaba los indios.

This rare hint at the exploitation of children in the mines is obfuscated by the official colonial polices surround the *mita* and the mining economy at Huancavelica which assert that only adult males were to labor there. However, the extensive remodeling of the bones of young individuals in the population support Guaman Poma's characterizations of child labor in the mines. These conditions undermine not only the well-being of the majority of the population, but of the community as a whole. The process of depopulation of Indigenous communities through the deaths of their youngest members is but one aspect of the precipitous population decline in the Viceroyalty of Peru.

The denial of identity needs is more difficult to parse bioarchaeologically. Galtung notes that the most representative form of denying identity needs under systems of structural violence is seen in the form of penetration, wherein elements of Spanish identity and ideology are forcibly introduced into Indigenous lives and practices (1990). What does this mean, though, in the context of embodiment? To investigate this, we must shift the focus of the discussion to the level of the community and what shapes identity. As discussed in Chapter 5, consumption—and in particular food consumption—is deeply entrenched in community and individual praxis. The selective consumption of foods and the way that they are consumed form strong bonds within a community while simultaneously drawing thoroughly embodied contrasts with the practices of non-community members. The patterning of diet at Santa Bárbara does not necessarily give a transparent picture of what was being consumed specifically, but it suggests that diet may have come down—at least in part—to individual choice. While diet likely was penetrated by Spanish dietary practices and resources, consumption of socially important foods, remained a part of Indigenous dietary and social practices.

I have outlined the ways that needs were violated or fought for in the context of the Santa Bárbara population, and now I shift to examining the structures themselves. Structural violence is based in structures of inequality; as I explained in the introduction to this dissertation, by design the society must be strongly hierarchical. Over the course of the dissertation, I have shown time and again the lack of differentiation of Indigenous individuals across categories of sex (as a proxy for gender) and age in relation to the lived experience of violence at the mines. The indiscriminate application of force against all individuals at the site; the evidence of grueling, unending labor by the Indigenous people at Santa Bárbara; and a general—though incomplete—homogenization of diet of the population show that this hierarchy was constructed along one primary distinction: that of race, between Spanish and Indigenous.

While there seems to be a general agreement that race is an invention of modernity (e.g. Foucault 2016), others argue that prejudice stemming from different skin colors existed already in the ancient world, where racist expressions occurred in India, China, and Egypt (Orser 2013). As we move towards the modern era, we find that questions of *generación* (descent) were already important in conceptions of identity in the Iberian Peninsula, where *limpieza de sangre* (clean blood) was linked to Christianity and Christian ancestors, whose faith was untainted by the blood of Jewish or Muslim ancestors. In the 13th century in Spain, Jews were forced to wear distinctive dress and identifying badges as Christianity abandoned the idea of inclusiveness (Hirschman 2004). Even conversion would not wash away the stains of the *mala casta* (bad caste). The purity of one's blood was based upon mostly fictive genealogies indicating *generación* that would come under question in the Inquisition beginning on the European continent in the 1480s (Hirschman 2004, Whitten 2007).

In this understanding, race-thinking has its roots in the 14th century, prior to the arrival of the Spanish in the Americas. Silverblatt, however, argues for the 16th century origins of a modern concept of race, stemming from the colonization of the New World by the Spanish (2004). She posits that the consolidation of colonial power in the Americas was conducted in a manner never before seen on the European continent. The bureaucratic scaffold of colonial Peru was race thinking. This began with the introduction of two unequal republics within the Viceroyalty: one for the Indians, and one for the Spanish, each with their own legal and administrative systems[42] (Carrera 1998, Silverblatt 2004).

This division of people was enforced by laws that differentiated the groups, bestowing different associated rights, privileges, and obligations. This device of political order was, at its heart, a legal and social construct based on questions of ancestry that merged biological characteristics with ideas of innate qualities. In the solidification of this new method of controlling bodies, ideas of innate abilities and characteristics became part of the package of traits that constituted the categories of *indio* and *español*. The social relations inherent in this division of colonizer and colonized led to a discursive slippage which changed social relations into color categories: white and brown.

The power of the construction of racial categories was in its ability to uphold the unequal institutions that defined Spanish colonial rule. This structural violence was, in turn, justified and naturalized through the systematic application of a program of cultural violence. Cultural violence itself is pervasive and insidious: it worms its way into the common imagination through collective ideologies of religion, language, art, education, and science. The progenitor of

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[42] For a discussion of the elaborate racial categories and associated legal institutions constructed by the Spanish throughout the colonies, including enslaved Black people and people of mixed descent, see Silverblatt (2004), O'Toole (2012), Kicza (1997), among others.

biological anthropology—physical anthropology—was an overt manifestation of the power of cultural violence to invade the supposedly empirical project of scientific investigation. Though the practice of craniometry did not arise until centuries later, "scientific" modes of classification found their genesis with colonial expeditions. The people encountered by Europeans were used as the base classifications of man into separate categories that were later cemented into scientific thought through the beginning of the 20th century. In the Colonial Period, the reification of racial constructs took the form of "blood purity" in a form of proto-pseudoscience. Questions of racial passing plagued the Spanish elite; even Guaman Poma, who was partly Indigenous, advocated the use of blood purity cards to keep track of one's position within the hierarchy (Silverblatt 2004). The Spanish encountered a deeply rooted problem, though, when classifying the Indigenous people as "lesser-than" or "Other", because the Spanish colonial project had always justified itself as a mission of conversion and civilization.

Religion was the most powerful tool for enforcing cultural violence available to the Spanish. In order to convert Indigenous people to Christianity, they had to be capable of being converted, and thus had to remain at least somewhat human in the eyes of society; however, their inferiority had to be unquestionable. Questions surrounding the legitimacy of forced labor in *encomiendas* had led to the polarizing Valladolid polemic between Juan Ginés de Sepúlveda and Fray Bartolomé de las Casas in 1551. This thrust the debate surrounding the morality of forced labor in the Americas into the realm of public conversation (de las Casas and Perez de Tudela y Bueso 1958). Given the claims of the Spanish Crown that the Conquest was, above all else, a Christianizing mission, the Spanish began to call into question whether enslaving Christians – or those in the process of conversion – could be considered acceptable in the eyes of God. Indeed, several clergymen petitioned the Crown to disavow this practice, reminding the Crown that "the ‘poor natives’ were ‘innocent Christian sheep’ who should not be enslaved” (O’Toole 2012). In light of the punishing labor to which Indigenous people remained subject, the Spanish Crown was forced to find a way to find ways to demonstrate that the *indio* was a citizen of the colony. Once again drawing upon racialized ideas, the Spanish reimagined the Indigenous people of the Viceroyalty “like children, Andean commoners did not know their own best interests” (Mumford 2012, 104). Thus, the picture of the Indigenous individual became that of a child who must prove their moral character through work, and to show themselves worthy of salvation. The *mita* was thus necessary not only for the Spanish to maintain their project of extraction, but immanent in the conversion project. However, in practice, the pretense of salvation in this moral coupling was often dropped or ignored by Spanish officials.

At Santa Bárbara, we can see the rupture between popular discourse and practice. The paternalistic rhetoric employed to justify conversion, relocation, and forced labor did not match the actual violence enacted against Indigenous communities. While Indigenous people were infantilized in the Spanish imagination, literal children were put to labor in the mines of Huancavelica. The application of cultural violence through religious ideologies and an emergent pseudoscience outlining racial differences girded the violent structure of the colonial project and the colonial mining economy in particular. This structure was enforced, in turn, by the direct violence – the indiscriminate physical abuse and frequent murder of the Indigenous people of Santa Bárbara – that served as a lynchpin making possible the enactment of the interrelated forms of violence undergirding the Spanish colonial project.

That project was itself predicated on highly unequal and oppressive hierarchies structured primarily by race. Race – as a justification for forced labor, unjust social stratification, and the application of different legal norms – infected the Spanish consciousness as thoroughly as the desire for precious metals and indifference to Indigenous suffering. Yet race thinking did not constrain itself to the Spanish consciousness; rather, as the wealth brought by Spain's endeavors in the New World flooded into Europe and spurred the ambition of other Western European powers to launch their own colonial projects, race thinking spread across the whole of Europe. It contributed to the extraction, exploitation, and the "civilizing mission" of European colonialism in the Americas, Africa, and Asia. It shaped the underlying principles of the colonial encounter across the world, from abstract legal structures and policies to the embodied experiences of those who felt – literally – the realities of structural violence in their bones. Socially constructed categories of blood purity, phenotypic races, and associated ideas of innate humanness defined projects of colonialism, enslavement, and systematic cultural erasure for centuries, forming the scaffolding upon which the "modern era" was built. While the experiences of Indigenous laborers at Santa Bárbara is but one early case study, it is firmly emplaced in the genesis of modern conceptions of race, the effects of which continue to reverberate across the world today.

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APPENDIX A:
Excavation Results

Excavation Methods

The excavation was carried out following standard archaeological methods. Four excavation units were established, which were placed following the orientation of the surrounding walls and adjacent church. These units were changed after the approval of the Lic. Fredy Huaman Lira of the Ministry of Culture of Huancavelica. Changes to the planned units were due to the discovery of several communal graves in Unit II; the unit was expanded to follow these deposits. According to permissions obtained from the Ministry of Culture of Peru, we had to maintain the same total excavation area; therefore, the shape of the units was changed and Units 3 and 4 were eliminated in favor of six test pits. These searches were aimed at locating other burials within the churchyard. These test pits were distributed using stratified random sampling to ensure general coverage of the rest of the churchyard.

The excavation of the units was carried out by lifting natural and cultural layers; excavations continued until a sterile soil layer was reached to rule out the existence of previous occupations. The excavations were carried out with conventional archaeological tools (hand pickaxes, buckets, scoops, and brushes). The excavation of human remains was carried out with small wooden tools. Four data points were defined for the site. During the excavation process, the description of each of the layers and levels was recorded by the supervisor of each unit in detailed field notebooks as well as in standardized recording sheets. The identification of the formal characteristics of the earth matrices was done using the Munsell color chart and following the standardized terms for natural inclusions and soil textures.

All soil removed during excavations was screened using ¼-inch sieves and all cultural materials recovered during excavation and sieving were collected. The material remains were classified according to material (human bone, animal bone, diagnostic and non-diagnostic ceramic, lithic, metal, textile, glass) and separated by unit, layer and level. All material was placed in plastic bags with identification cards and recorded into separate inventories for each material. The material was washed, labeled, and analyzed in a rented laboratory in Huancavelica by the bioarchaeological director.

During the excavation, the general plans, sections, and stratigraphic profiles were recorded using overlapping photographs. The photographs of each unit and layere were assembled into orthomosaics and 3D models using Agisoft Metashape, and vectorized using the Autocad and ArcMap programs. Each layer and feature was recorded using digital photographs that were placed in a general database. The photographs were taken with and without an identification board, with and without a scale, and with and without a north arrow.

When the excavation was completed and the written and photographic record was finalized, all the excavated units were filled in with the same soil that had been excavated from them. A secondary burial was left unexcavated in the Unit 2 profile due to concerns about the structural integrity of a nearby wall. This deposit was covered with a plastic tarp before the unit was filled with soil.

To carry out the site survey, a Topcon GPT-3100W total station with a prism was used. Sketches of the units in the churchyard were used to guide the total station survey work. The total station was calibrated using a reference point and datum established in the 2014 excavations along the perimeter wall of the plaza. The points taken were recorded in the sketches and in a digital database. The plan drawings of the units were made in ArcMap.

Lab Methods

Faunal Bone Analysis

Faunal bones and bone fragments were washed using soft brushes and purified water and allowed to airdry. The bones were classified into size categories (larger animal and smaller animal) and recorded according to count and weight in a separate inventory. The materials were bagged according to the archaeological source information, including layer and feature, along with identification labels. The bags were placed in large plastic containers separated by material.

Ceramic Analysis

The ceramics were washed with brushes and purified water, and the sherds from each bag were classified into diagnostic sherds, non-diagnostic sherds, and *botijas*. The diagnostic sherds were photographed and weighed separately. The total weight and count were taken for each bag. These bags were classified according to provenance information and identified with labels. The bags were stored in large plastic containers separated by material.

Analysis of Other Materials

Other materials were classified according to type (metal, glass, textile, lithic) and placed in bags according to material and provenance. The bags were identified by labels with the archaeological context, and the count and weight of each bag was taken.

Sample Selection

The samples were taken only from osteological material for isotopic analysis. Due to the commingled nature of the excavated remains, only skull samples were taken to avoid overestimating the number of burials. To obtain a diachronic view of health and diet through isotopic analysis, a small portion of bone (vomer, nasal conch, or sphenoid) and as many different types of molars as were available in the maxilla were taken. Each sample was photographed and weighed before being placed in a small plastic bag labeled with identifying information about the provenance, as well as a unique sample code. These samples were stored in a plastic container and submitted for approval to the Ministry of Culture in Lima.

Unit Characteristics

Unit Selection

The first two excavation units were selected with the objective of excavating three secondary burial deposits discovered in the 2014 excavation season by Dr. Douglas K. Smit. Our first two units were:

Unit I: Located in the churchyard to the southeast of the Santa Bárbara church, approximately 0.5m from the same church and 2.6m from the entrance to the churchyard. The main objective of this unit was to excavate the Secondary Contexts 1 and 2 discovered in the 2014 season.

Unit II: Located in the churchyard to the southeast of the Santa Bárbara church, approximately 3.4m from the church and 2m from the northeast wall of the yard. The primary objective of this unit was to excavate Secondary Context 3 discovered in the 2014 season.

Upon excavation of these two units, however, we discovered additional secondary burials in the northeast profile of Unit II. We expanded from $2m^2$ to the northeast to create Extension 1. Next, we discovered human remains in the northeast profile of Extension 1 and expanded Unit II by $1m^2$ to the northeast to create Extension 2. Following the discovery of a funerary context in Extension 2, we expanded from $0.75m^2$ southeast of Extensions 1 and 2 to search for the skull of said burial (Extension 3). During the excavations in the south of Unit II, we discovered another burial and expanded by $1m^2$ to the southeast and southwest of said corner (Extensions 4 and 5). During the excavations of extensions 1 and 2, to the northwest we found another secondary burial and we expanded by $1m^2$ to the northwest of said corner. Following the discovery of another deposit to the northwest of Extension 4, we expanded by $1m^2$ (Extension 7). We found another secondary context in the southwest profile of Extension 6, and we expanded from $1m^2$ to the southwest (Extension 8). In the northwest profile of Extensions 6 and 8, we discovered a continuation of a mass grave, and we expanded the two extensions by $2m^2$ (Extension 9). To follow another visible mass grave in the northwest profile of Extension 9, we enlarged by $1m^2$ to create Extension 10. Finally, we discovered a mass grave that was and in the southeast profile of Extension 4 and in the southwest profile of Extension 5. Then, we enlarged of $1m^2$ to connect these units (Extension 11). During the excavations of Unit II and its extensions, we also excavated six $1m^2$ test pits in the plaza.

Table A-1 - GPS coordinates, area, and perimeter of excavation units

Excavation Unit	**UTM_E**	**UTM_N**	**Area (m^2)**	**Perimeter (m)**
Unit I	**502842.784**	**8583586.845**	**6**	**10**
Unit II (Original)	**502845.457**	**8583585.246**	**4**	**8**
Unit II – Extension 1	502846.612	8583586.161	2	6
Unit II – Extension 2	502847.203	8583586.647	1	5
Unit II – Extension 3	502847.615	8583585.353	0.75	4
Unit II – Extension 4	502844.626	8583585.931	1	4
Unit II – Extension 5	502846.022	8583583.776	1	4
Unit II – Extension 6	502846.085	8583587.658	1	4
Unit II – Extension 7	502843.974	8583584.696	1	4
Unit II – Extension 8	502845.292	8583587.043	1	4
Unit II – Extension 9	502845.067	8583588.143	2	6
Unit II – Extension 10	502844.045	8583588.626	1	4
Unit II – Extension 11	502845.250	8583583.162	1	4
Unit II (with Extensions)	**502845.577**	**8583585.936**	**16.75**	**22**
Test Pit 1	**502847.426**	**8583582.659**	**1**	**4**
Test Pit 2	**502840.922**	**8583583.327**	**1**	**4**
Test Pit 3	**502848.772**	**8583581.110**	**1**	**4**
Test Pit 4	**502848.851**	**8583584.046**	**1**	**4**
Test Pit 5	**502849.719**	**8583578.404**	**1**	**4**
Test Pit 6	**502844.748**	**8583582.159**	**1**	**4**

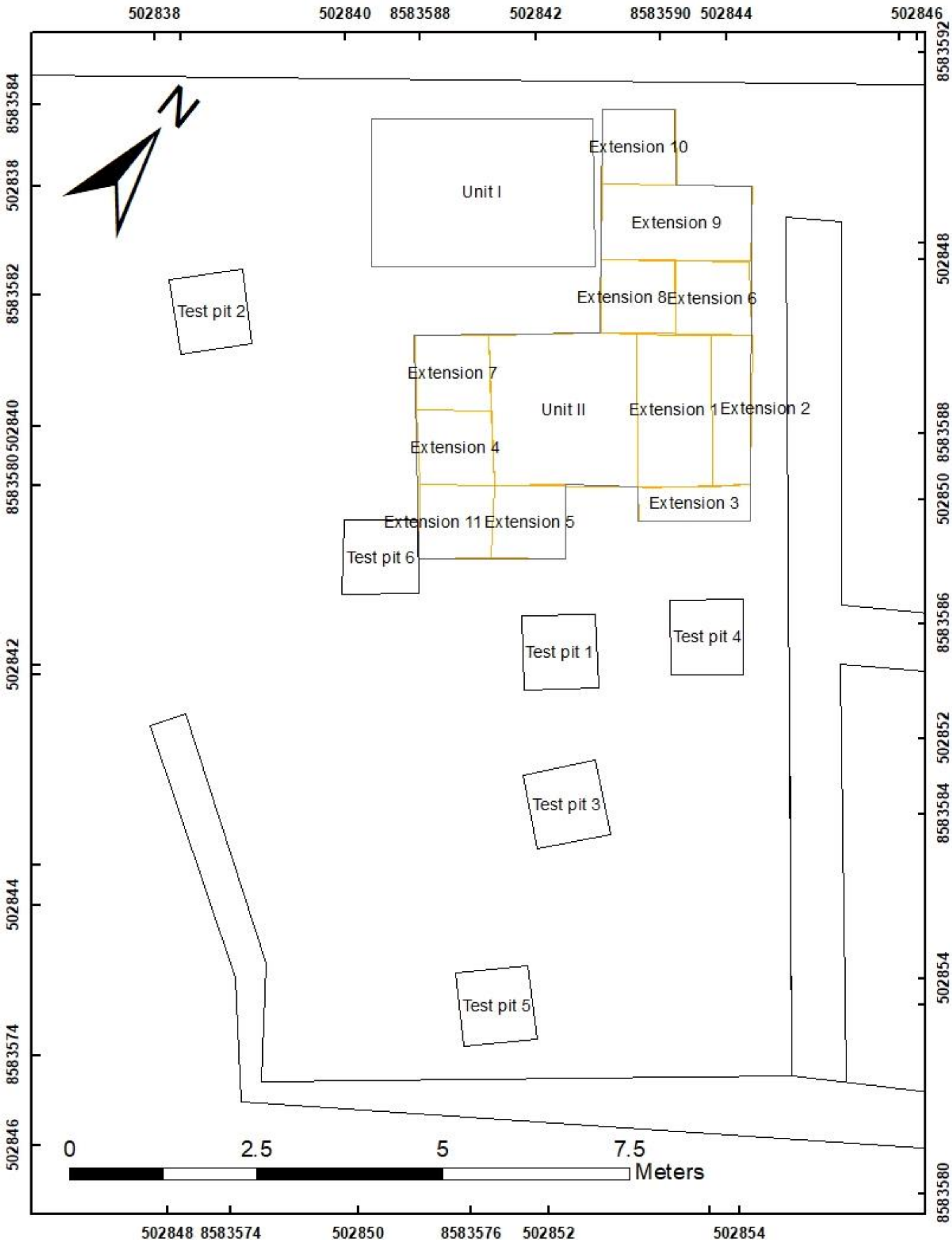

Figure A-1 - Map of excavation units in Santa Barbara churchyard

Archaeological Excavations in Unit I

Introduction

In the 2014 PIHA-SB research season, two secondary burial contexts were discovered southeast of the church at the Santa Bárbara site. These deposits (Secondary Context 1 and Secondary Context 2) were left *in situ* in 2014 and were the subject of the Unit I excavations in the 2018 excavations.

Description of Excavations

Unit I was excavated under the direct supervision of Terren Proctor, assisted by Dr. Douglas Smit. First, we excavated the southeastern portion of the unit that was fill from the 2014 season excavations. Next, a datum was established from which to measure elevations.

Layer A

Surface layer. The soil is compact, dark brown, Munsell 7.5YR 3/2 (Dark Brown), with inclusions of large rocks in an approximate proportion of 30% of the layer. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 5cm to the northwest and 16cm to the southeast.

Layer B

This layer covered the entire unit and was directly below layer A. It was distinguished from layer A by presenting a lower degree of compaction and a decrease in the size of the inclusions. The soil is semi-compact, dark brown, Munsell 7.5YR 3/3 (Dark Brown), with inclusions of medium-sized rocks in an approximate proportion of 40% of the layer. The composition of the earth is partially clayey. Two human hand bones and one human tooth were found. In addition, we found fragments of larger fauna. It appears that artifacts from this level migrated from further down in the stratigraphy. The average thickness of the level was 11 cm to the northwest and 7 cm to the southeast.

Layer C

This layer covered the entire unit and was directly below layer B. It was distinguished from layer B by a different color and a decrease in the size of the inclusions. The soil is semi-compact and partially clayey, dark reddish brown, Munsell 5YR 3/4 (Dark Reddish Brown), with inclusions of small stones in a proportion of approximately 10% of the layer. Fragments of non-diagnostic pottery and fragments of colonial *botijas* were found. There were also fragments of human bone and fragments of larger fauna. The average thickness of the level was 12cm to the northwest and 11cm to the southeast.

Layer D

This layer covered the entire unit and was directly below layer C. It was distinguished from layer C by much more clay and the presence of inclusions of pure clay and large stones in 40% of the layer. The soil is semi-compact, dark reddish brown, Munsell 2.5YR 3/4 (Dark Reddish Brown). The plastic tarp left by Dr. Douglas K. Smit's excavation team was found on the surface of this layer in the southeastern part of the unit. Under the tarp, two deposits of disarticulated human bones were found (secondary contexts 1 and 2). We also excavated the upper course of a wall composed of uncut stones. This is located along the northwest profile. The human bone contexts are adjacent to the wall. Layer D also contained both diagnostic and non-diagnostic ceramics, as well as fragments of larger fauna. It appears that these materials were waste materials that were used to fill the pit. The average thickness of the level was 52cm to the northwest and 53cm to the southeast.

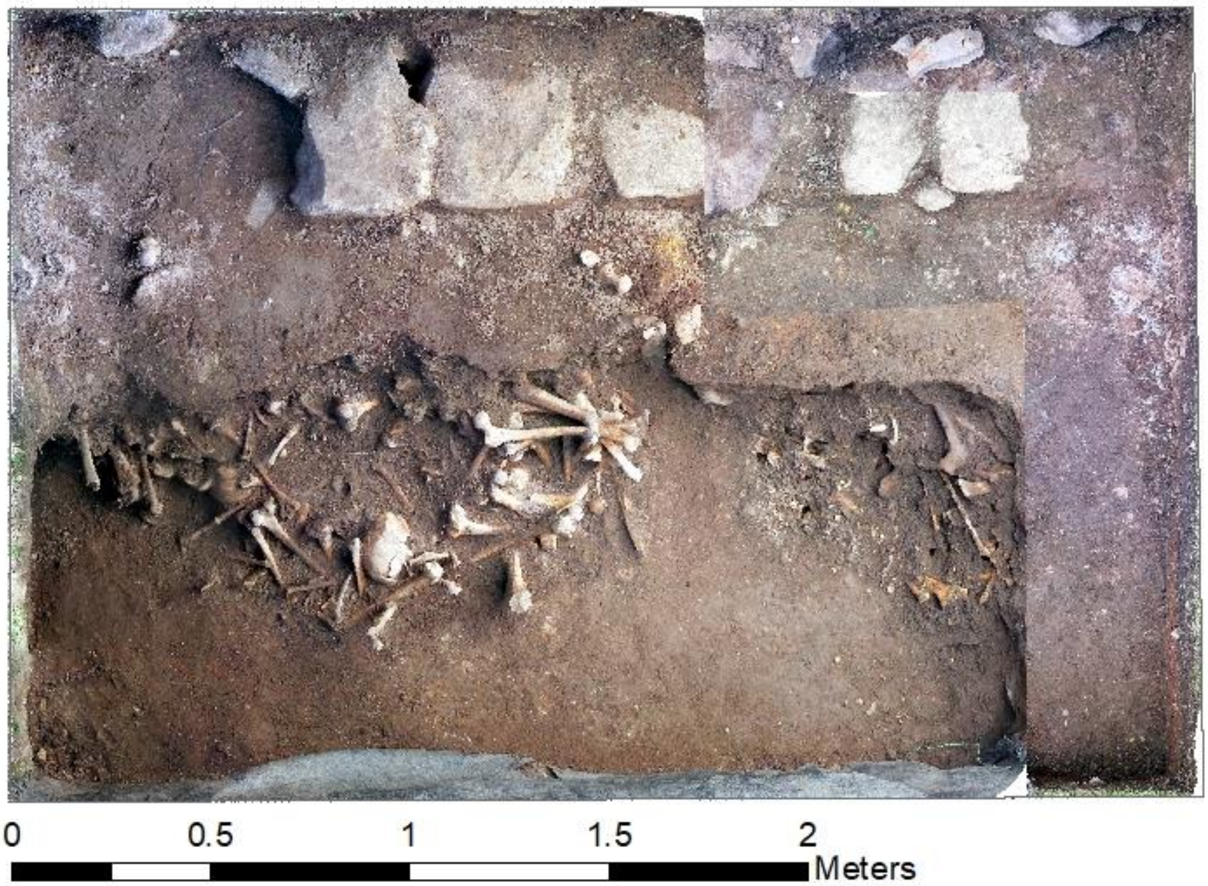

Figure A-2 - Orthomosaic of Layer D of Unit I, with upper layer of Secondary Contexts 1 and 2 visible after tarp from 2014 excavations was removed

Layer E

This layer covered the entire unit and was directly below layer D. It was distinguished from layer D by a change in color and compaction, and inclusions of pure clay rather than stone. The earth is compact, black, Munsell 10YR 2/1 (Black). The end of the wall was found, and of secondary contexts 1 and 2. There were also large animal bone fragments, fragments of diagnostic and non-diagnostic ceramics as well as numerous *botija* fragments. In addition, an almost complete *botija* was found. The average thickness of the level was 50cm to the northwest and 40cm to the southeast. At the end of the excavation of layer E, we reached the sterile layer in the unit.

Figure A-3 - Pedestaled Secondary Contexts 1 and 2 in Layer E of Unit I

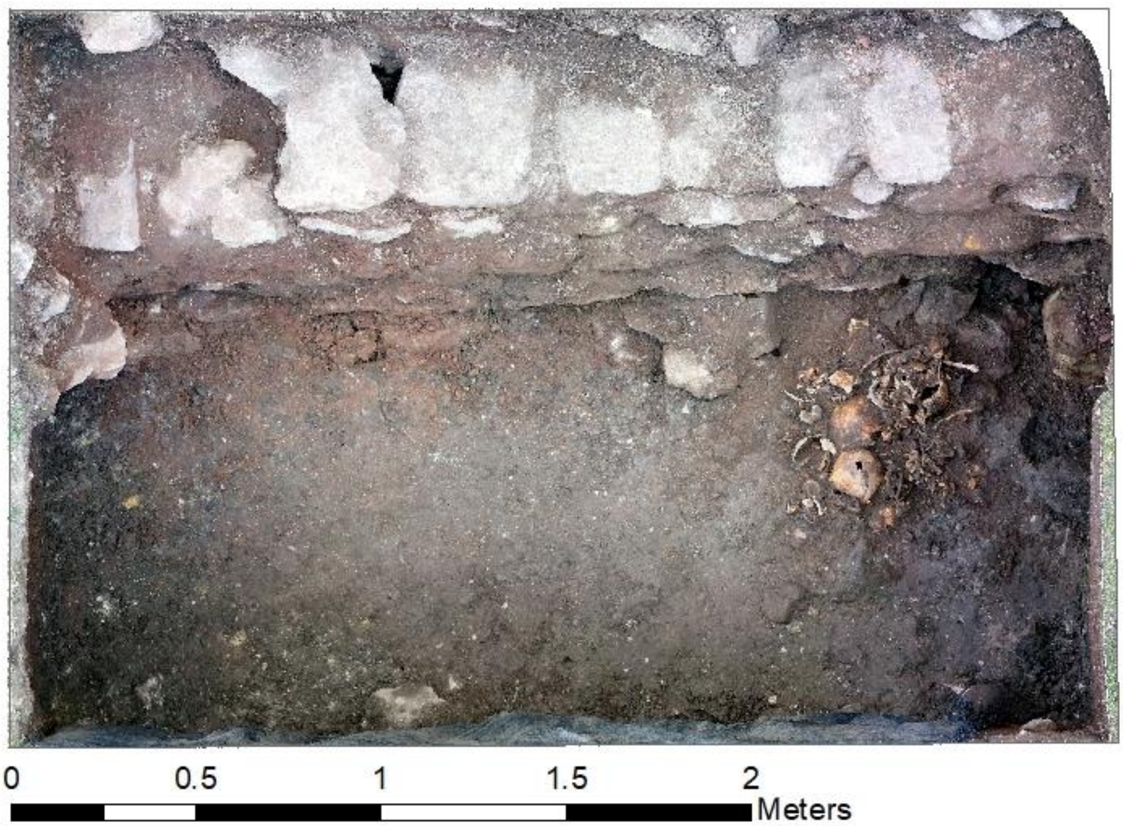

Figure A-4 - Final deposits of Secondary Context 2 exposed, Secondary Context 1 fully excavated in lower part of Layer E in Unit I

Archaeological Excavations in Unit II

Introduction

An additional secondary funerary context was discovered in the 2014 PIHA-SB research season and was named Secondary Context 3. This deposit was left *in situ* in 2014 and was the subject of Unit II excavations. As previously indicated in this report, we created eleven extensions in Unit II. For the purposes of this report, they are all considered as a single unit since the stratigraphy is the same in all extensions. I refer to each extension solely to distinguish physical location.

Description of Excavations

Unit II and its extensions were excavated under the direct supervision of Samantha Seyler with the assistance of Terren Proctor. First, we excavated the 2014 season fill in the southwest corner of the unit. Afterwards, a datum was established from which to measure elevations.

Layer A

Surface layer. The soil is compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The surface was found covered with organic material. Modern trash was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 15cm to the northwest and 23cm to the southeast.

Layer B

This layer covered the entire unit and was directly below layer A. It was distinguished from layer A by a lower degree of compaction and a reduction in the size of the inclusions. The soil is semi-compact, yellowish brown, Munsell 10YR 5/8 (Yellowish Brown), partially sandy, with inclusions of large stones in an approximate proportion of 20% of the layer; extension 10 - closest to Unit I - has characteristics most similar to the first unit. Extension 10 has compact earth, dark brown, Munsell, 7.5YR 3/2 with medium stone inclusions, and a partially clayey texture. Diagnostic and non-diagnostic ceramics were found, without *botija* fragments. There were also fragments of larger fauna and fragments of human bone. The average thickness of the level was 5cm to the northwest and 7cm to the southeast.

Layer C

This layer covered most of the unit except main Unit II and extension 10. The difference in the main part of Unit II is due to the fact that the majority of this section was composed of backfill from the excavations of the 2014 season. In the other parts of the Unit, layer C was distinguished from layer B by exhibiting a different color, a change in compaction, a change in composition, and a larger proportion of inclusions. The soil is semi-compact, dark brown, Munsell 7.5YR 3/2 (Dark Brown) with inclusions of large stones in an approximate proportion of 80% of the layer, partially clayey in composition; the extension has compact soil, brown, Munsell 7.5YR 4/4 (Brown) with inclusions of large stones in an approximate proportion of 50% of the layer, partially sandy in composition. Some fragments of human bone, fragments of colonial glass, fragments of larger fauna, and some fragments of non-diagnostic ceramics were found. The average thickness of the level was 7cm to the northwest and 15cm to the southeast.

Layer D

This layer completely covered the unit. It was distinguished from layer C by a different color, a change in compaction, and a decrease in the size and quantity of inclusions. The soil is compact, very dark gray, Munsell 5YR 3/1 (Very Dark Gray) with inclusions of small stones in a proportion of approximately 20%, and partially clayey in composition. The upper part of Secondary Context 5 (a commingled burial deposit) was found in Extension 9. In addition, fragments of diagnostic and non-diagnostic ceramics, fragments of larger fauna, fragments of colonial glass, and some metal artifacts (mainly nails) were found in the unit. In Extension 10, large stones were found that continued below. The average thickness of the level was 20cm to the northwest and 26cm to the southeast.

Layer E

This layer completely covered the unit. It was distinguished from layer D by a different color and a change in the type of inclusions. The soil is compact, dark reddish brown, Munsell 2.5YR 3/4 (Dark Reddish Brown) with small inclusions of stone and pure clay. The upper part of Secondary Context 3 was found in the central part of Unit II, the beginning of Secondary Context 4 in Extensions 6, 8, and 9, and the top layer of Secondary Context 5 in Extensions 9 and 10. All these contexts contain disarticulated human bones. In addition, some metal objects, fragments of larger fauna, and fragments of diagnostic and non-diagnostic ceramics and *botijas* were found. The stones seen in layer D continued here, forming a wall. The average thickness of the level was 26cm to the northwest and 25cm to the southeast.

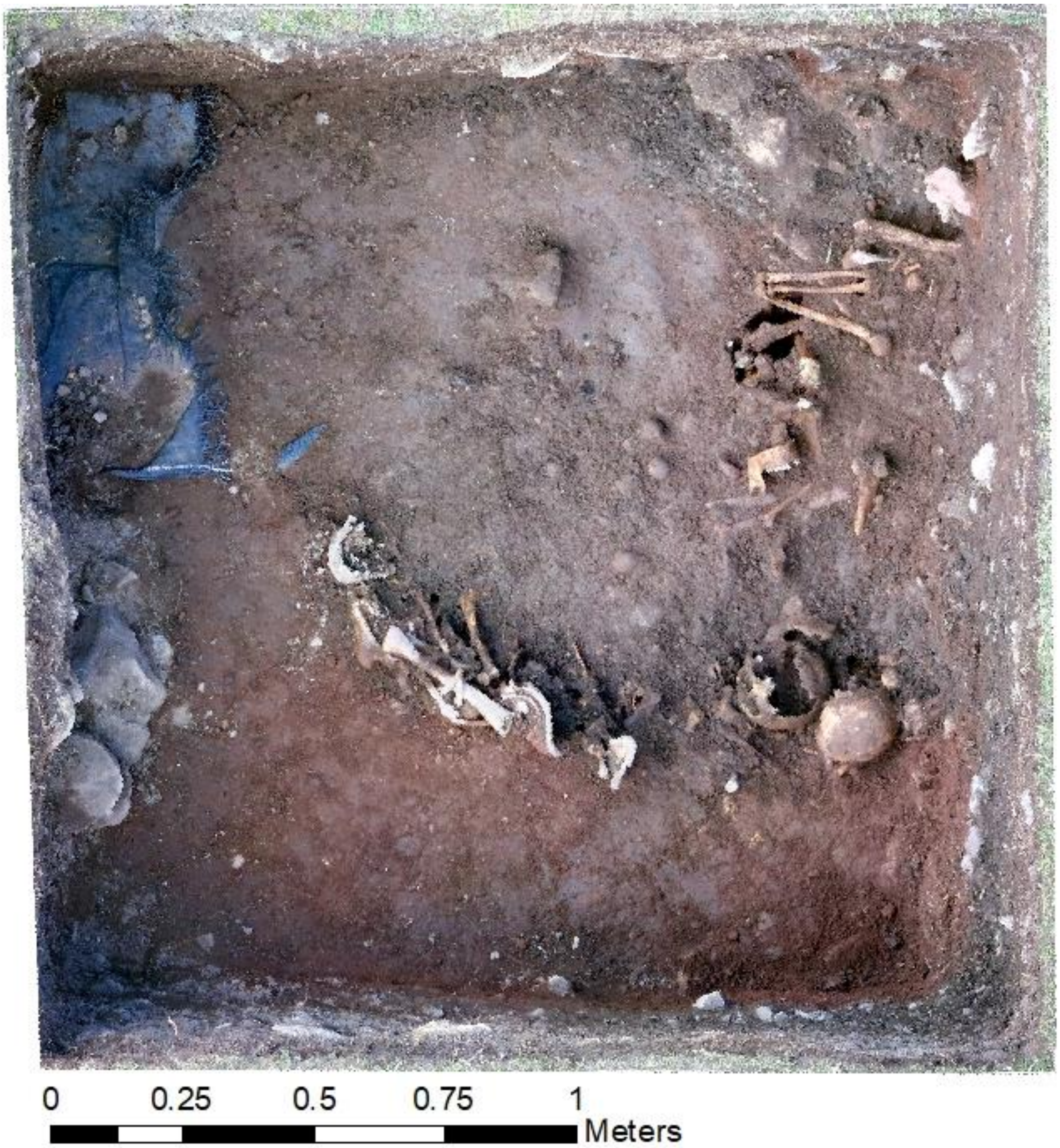

Figure A-5 - Upper part of Secondary Context 3 found in Layer E of Unit II

Figure A-6 - Upper courses of wall and top layer of Secondary Context 5 in Layer E of Unit II, Extension 10

Layer F

This layer covered the unit. It was distinguished from layer E by a different color and a change in soil composition. The soil is compact, black, Munsell 7.5YR 2.5 / 1 (Black) with inclusions of stones of various sizes. The continuation of Secondary Contexts 3 (in the original part of II and in Extension 1), and 5 (in Extension 10) were found. Furthermore, two primary funerary contexts were discovered; CF10 and CF11 were found in the main part of Unit II. In the southeast profile of Extensions 2 and 3 there was a lens of red and white earth that we declared a feature. Fragments of diagnostic and non-diagnostic ceramics and *boitjas*, fragments of larger fauna, and a carved stone (Figure X) were also found. The average thickness of the level was 24cm to the northwest and 19cm to the southeast.

Figure A-7 - Composite orthomosaic of all burials found in Layer F of Unit II, including Primary Burials 1 and 2, Secondary Contexts 3, 4, and 5

Layer G

This layer completely covered the unit. It was distinguished from Layer F by a different color and inclusions of pure clay of medium size as well as large stones in an approximate proportion of 50% of the layer. The soil is compact, dark grayish brown, Munsell 10YR 3/2 (Dark Grayish Brown) with partially clayey composition. The end of Secondary Contexts 4 (in Extensions 6, 8 and 9), 5 in Extension 9, and another Secondary Context (7) in was found in Extensions 4 and 5. In the fill of Extension 5, we found a fragment of a green and blue colonial textile (Figure X). The wall in Extension 10 continued here, and we excavated the upper part of a wall in the southeastern part of the unit. Throughout the unit, we uncovered fragments of larger fauna, and diagnostic and non-diagnostic ceramic fragments. The average thickness of the level was 27cm to the northwest and 33cm to the southeast.

Layer H

This layer completely covered the unit. It was distinguished from Layer G by a different color, a change in texture, and a very clayey composition. The soil is compact, black, Munsell 2.5Y 2.5 / 1 (Black), with inclusions of medium stones in a proportion of approximately 30% of the unit. The end of Secondary Context 7 was found in Extensions 5 and 11, and another Secondary Context (8) was excavated in extensions 4 and 7, all with disarticulated human bones. Mixed and disarticulated human bones were also discovered adjacent to the wall. The layer contained fragments of diagnostic and non-diagnostic ceramic and *botijas*. Fragments of larger fauna were also excavated. The average thickness of the level was 32cm to the northwest and 28cm to the southeast.

Figure A-8 - Orthomosaic of the end of Secondary Context 5 in Layer F, Layer G in Extensions 6 and 8, and Layer H in the remainder of the unit.

Layer I

This layer covered the unit directly below layer H. It was distinguished by a different color and a change in the type and size of the inclusions. The soil is compact, very clayey, yellowish brown, Munsell 10YR 5/4 (Yellowish Brown), with inclusions of small stones. Layer I was sterile; we excavated approximately 30cm deep across the layer.

Archaeological Excavations in Test Pit 1

Test Pit 1 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 23cm to the northwest and 21cm to the southeast.

Layer B

This layer covered the entire test pit and was directly below layer A. It was distinguished from layer A by a lower degree of compaction. The soil is semi-compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. Fragments of diagnostic and non-diagnostic ceramics, and fragments of larger fauna were found. The average thickness of the level was 47cm to the northwest and 42cm to the southeast.

Layer C

This layer covered the entire survey and was directly below layer B. It was distinguished from layer B by a different color. The soil is compact, partially clayey, dark reddish brown, Munsell 5YR 3/4 (Dark Reddish Brown), with inclusions of large stones in an approximate proportion of 40% of the layer. Fragments of larger fauna were found. The average thickness of the level was 6cm to the northwest and 3cm to the southeast.

Layer D

This layer covered the entire survey and was directly below layer C. It was distinguished from layer C by a different color and a change in the soil composition and the size of the inclusions. The soil is compact, very clayey, black, Munsell 7.5YR 2.5 / 1 (Black), with inclusions of small stones in an approximate proportion of 20% of the layer. Two fragments of *botija* were found in the upper part of the layer and some fragments of larger fauna. The average thickness of the level was 19cm to the northwest and 29cm to the southeast. We finished excavations at sterile.

Archaeological Excavations in Test Pit 2

Test Pit 2 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, dark brown, Munsell 7.5YR 3/2 (Dark Brown), with inclusions of large cornerstones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 33cm to the northwest and 32cm to the southeast.

Layer B

This layer covered the entire survey and was directly below layer A. This layer was composed primarily of very large stones. The small proportion of soil is compact, partially clayey, black and dark reddish brown, Munsell 7.5YR 2.5 / 1 and 5YR 3/4. A fragment of a *botija* and some fragments of larger faunal bone were found. However, after removing approximately 60cm of large stones, we stopped excavating.

Archaeological Excavations in Test Pit 3

Test Pit 3 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, dark brown, Munsell 7.5YR 3/2 (Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 12cm to the northwest and 12cm to the southeast.

Layer B

This layer covered the entire test unit and was directly below layer A. It was distinguished from layer A by a lower degree of compaction, a change in composition and a change in color. The soil is semi-compact, yellowish brown, Munsell 10YR 5/8 (Yellowish Brown), partially sandy in composition, with inclusions of large stones in an approximate proportion of 30% of the layer. No artifacts were found. The average thickness of the level was 7cm to the northwest and 8cm to the southeast.

Layer C

This layer covered the entire test unit and was directly below layer B. It was distinguished from layer B by a different color, a greater degree of compaction, a change in composition and a change in the size of the inclusions. The soil is compact, very dark brown and reddish black, Munsell 10YR 2/2 (Very Dark Brown) and 2.5YR 2.5 / 1 (Reddish Black), partially clayey, with inclusions of small stones in a proportion of approximately 40% of the cap. Fragments of larger fauna, diagnostic and non-diagnostic ceramic fragments and *botijas* were found. The average thickness of the level was 67cm to the northwest and 66cm to the southeast.

Layer D

This layer covered the entire survey and was directly below layer C. The soil is compact, reddish brown, Munsell 5YR 3/4, very clayey, with medium stone inclusions. No artifacts were found. This level is sterile. We stopped excavating after approximately 15cm.

Archaeological Excavations in Test Pit 4

Test Pit 4 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 11cm to the northwest and 9cm to the southeast.

Layer B

Layer B is composed mainly of large stones that were part of a modern canal built in the 1960s. We stopped digging when we realized that we had crossed the canal.

Archaeological Excavations in Test Pit 5

Test Pit 4 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, dark brown, Munsell 7.5YR 3/2 (Very Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 13cm to the northwest and 16cm to the southeast.

Layer B

This layer covered the entire test unit and was directly below layer A. It was distinguished from layer A by a different color. The soil is compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), partially clayey in composition, with inclusions of large stones in a proportion of approximately 30% of the layer. No artifacts were found. The average thickness of the level was 16cm to the northwest and 18cm to the southeast.

Layer C

This layer covered the entire test unit and was directly below layer B. It was distinguished from layer B by a different color and a lower degree of compaction. The soil is semi-compact, dark brown, Munsell 7.5YR 3/2, partially clayey, with inclusions of large stones in an approximate proportion of 20% of the layer. Fragments of larger fauna were found, and fragments of diagnostic and non-diagnostic pottery, including fragments of *botijas*. The average thickness of the level was 24cm to the northwest and 27cm to the southeast.

Layer D

This layer covered the entire test unit and was directly below layer C. It was distinguished from layer C by a different color and a greater degree of compaction. The soil is compact, very clayey, very dark brown and reddish brown, Munsell 10YR 2.5 / 2 (Very Dark Brown) and 5YR 3/4 (Reddish Brown), with inclusions of small stones in an approximate proportion of 40% of the unit. Fragments of diagnostic and non-diagnostic ceramic were found, and fragments of larger fauna. The average thickness of the level was 45cm to the northwest and 53cm to the southeast.

Layer E

This layer covered the entire test unit and was directly below layer D. It was distinguished by a different color. The soil is compact, very clayey, reddish brown, Munsell 2.5YR 4/4 (Reddish Brown), with inclusions of small stones in a proportion of approximately 20% of the unit. Fragments of larger fauna and a glass fragment were found. The average thickness of the level was 25cm to the northwest and 27cm to the southeast. We stopped excavating at sterile.

Archaeological Excavations in Test Pit 6

Test Pit 4 was excavated under the direct supervision of Terren Proctor. First, a datum was established from which to measure elevations. We then took photos and initial heights, prior to starting excavations.

Layer A

Surface layer. The soil is compact, dark brown, Munsell 7.5YR 3/2 (Dark Brown), with inclusions of large stones in an approximate proportion of 30% of the layer. The earth is of a partially clayey composition. The surface was found covered with organic material. Modern garbage was found without archaeological artifacts, as well as rootlets that intrude into the layer. The average thickness of the level was 22cm to the northwest and 13cm to the southeast.

Layer B

This layer covered the entire survey and was directly below layer A. It was distinguished from layer A by presenting a different color. The soil is compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), partially clayey in composition, with inclusions of large stones in a proportion of approximately 30% of the layer. No artifacts were found. The average thickness of the level was 10cm to the northwest and 6cm to the southeast.

Layer C

This layer covered the entire test unit and was directly below layer B. It was distinguished from layer B by presenting a lower degree of compaction. The soil is semi-compact, very dark brown, Munsell 10YR 2/2 (Very Dark Brown), partially clayey, with inclusions of large stones in an approximate proportion of 20% of the layer. Fragments of larger fauna were found, and fragments of diagnostic and non-diagnostic pottery, including fragments of *botiajs*. The average thickness of the level was 43cm to the northwest and 67cm to the southeast.

Layer D

This layer covered the entire test unit and was directly below layer C. It was distinguished from layer C by a different color, a lower degree of compaction, and smaller inclusions. The soil is semi-compact, red and black, Munsell 2.5YR 3/1 and 2.5YR 5/8 (Black and Red), partially clayey, with inclusions of medium stones in an approximate proportion of 20% of the layer. Fragments of larger fauna were found, and fragments of diagnostic and non-diagnostic pottery, including fragments of *botijas*. A human hand phalanx was also found. The average thickness of the level was 6cm to the northwest and 2cm to the southeast.

Layer E

This layer covered the entire test unit and was directly below layer D. It was distinguished from layer D by a different color, a greater degree of compaction, and a change in the size of the inclusions. The soil is compact, brown, Munsell 7.5YR 4/3, partially clayey, with inclusions of small stones in an approximate proportion of 10% of the layer. No artifacts were found. Large stones were found in a straight line at the end of the level that are the continuation of the wall found in the southeast part of Unit II. The average thickness of the level was 32cm to the northeast and 30cm to the southeast.

Layer F

This layer covered the entire test unit and was directly below layer E. It was distinguished from layer E by a different color, a change in composition, and a change in the size of the inclusions. The soil is compact, black, Munsell 7.5YR 2.5 / 1, very clayey, with inclusions of medium stones in an approximate proportion of 30% of the layer. No artifacts were found. Additional courses of the wall were excavated. The average thickness of the level was 27cm to the northeast and 28cm to the southeast.

Layer G

This layer covered the entire test unit and was directly below layer F. It was distinguished from layer F by a different color, a lower degree of compaction, a change in composition, and a change in the proportion of inclusions. The soil is semi-compact, brown, Munsell 7.5YR 4/4, partially clayey, with inclusions of medium stones in an approximate proportion of 10% of the layer. No artifact was found. We excavated the final course of the wall. The average thickness of the level was 4cm to the northeast and 6cm to the southeast.

Excavation Results Summary

Churchyard Use

Through excavations, we determined that the churchyard at Santa Bárbara was primarily used for waste disposal. Of the two units and six test pits we excavated, seven excavation areas contained highly fragmented ceramic sherds (mainly in the form of botijas) and large animal bones. In no context do we find complete vessels or complete fauna bones. The final layers of the various units were composed mainly of a thick layer of clay that contained animal bones, but nothing else. These also corresponded to the bottoms of large walls in the north corner of Unit I, the northwest side of Search 6, and the southeast side of Unit II. Based on their orientation to the church and their association with the deeper levels and barren soil, it appears that these are retaining walls that were built with the intention of building the original plaza. These walls can also be seen outside the plaza, in the surrounding area of the slope on which the site is located.

Ceramic Results

Chronology was determined using associated ceramic fragments, which represent styles characteristic of the colonial period in Huancavelica, including tin-glazed, lead-glazed, and majolica styles. Upper levels also contained some British transferware and possible whiteware, indicating a terminus post quem of the 19^{th} century for reburial. Ceramics are stored at the Ministry of Culture office in Huancavelica; no detailed analysis has been done to date.

Faunal Results

All faunal bone came from large animals, and included teeth from camelids and bovids. No further analysis of faunal material was conducted; materials are stored at the Ministry of Culture office in Huancavelica.

Other Materials

Some metal nails and fragments of glass were found. These are stored in the Ministry of Culture office in Huancavelica. No analysis of these materials was conducted.

Mortuary Context

Although Dr. Douglas Smit's excavations in this churchyard discovered 8 individuals in primary burial contexts (Smit 2018), we only found two, both located in unit II. These burials did not appear to be carefully oriented, but rather were in a more or less north-south orientation. These appear to have been separate burial events from the burials found in 2014, as they are buried deeper than the eight individuals mentioned above, and there appears to be no intrusion of soil over the burials to indicate the presence of the upper layers at the time of burial.

Instead of additional primary burials, we discovered a total of seven secondary mass graves, which yielded the remains of at least 217 individuals based on the number of femurs. This provided us with a sufficient sample size to perform bioarchaeological analyzes, although the questions need to be changed since the bones are disarticulated. We argue that these secondary pits represent discrete burial events related to the lack of space in the church's formal cemetery in the 17th and 18th centuries. These probably represent a common practice of moving decomposed bodies to make room for new individuals in the cemetery, given the lack of articulation of skeletal elements. There were also no grave goods associated with any of the remains. No remains were found in the southern half of the plaza beyond Unit II, indicating that despite the fact that the exhumation appears to have been routine, proximity to the church was still important to those who they were buried.