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SACRIFICE RECONSIDERED: INTERPRETING STRESS
FROM ARCHAEOLOGICAL HAIR AT HUACA DE LOS SACRIFICIOS

by

BENJAMIN J. SCHAEFER

Under the Direction of Bethany L. Turner, Ph.D.

ABSTRACT

The Inka Empire (A.D. 1450-1532) practiced flexible forms of statecraft that affected their periphery populations across the Andean cordillera. Lived experiences of Inka subjects differed in varied ways, which therefore requires nuanced bioarchaeological approaches. This study aims to interpret psychosocial stress through assays of cortisol in archaeological hair from sacrificed individuals recovered in the Huaca de los Sacrificios at the Chotuna-Chornancap Archaeological complex. This site is located in the Lambayeque Valley, and was used as a ritual and ceremonial complex by both the Inka and earlier Chimú states, and originally by the local Muchik. The remains analyzed here are associated with the Inka period. Utilizing enzyme-linked immunosorbent assay (ELISA) to obtain overall cortisol levels, this study examines spikes in

cortisol and analyzes these data along with clinical data. These archaeological cortisol levels are also compared to cortisol data from living participants, in order to better reconstruct and infer overall stress levels in these sacrificed individuals. Cortisol levels vary between the adults (n=2) and children (n=8) in this sample. The adult cortisol levels range well within clinical data. The cortisol data from the children appear to be representative of pubertal development rather than physiological stress.

INDEX WORDS: Muchik, Inka, Sacrifice, Stress, Health, Cortisol, Stable Isotopes, ELISA, Lambayeque, Peru, Endocrinology

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FROM ARCHAEOLOGICAL HAIR AT HUACA DE LOS SACRIFICIOS

by

BENJAMIN J. SCHAEFER

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2017

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FROM ARCHAEOLOGICAL HAIR AT HUACA DE LOS SACRIFICIOS

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May 2017

DEDICATION

I dedicate this thesis to those that were sacrificed at Huaca De Los Sacrificios. Without you, this project would not have been possible.

Dedico esta tesis a los que fueron sacrificados en la Huaca De Los Sacrificios. Sin ustedes, este proyecto no hubiera sido posible.

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Any errors in this thesis are the fault of one of these anthropologists, most likely Bethany Turner because she supervised this thesis and should have trained me better (jokingly of course). Any and all errors in this thesis are my own.

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1 Introduction

1.1 Research Objectives

This study investigates sacrifice utilizing biochemical methods to extract the cortisol hormone imbued in hair from archaeological contexts. A key question in the archaeology of Andean sacrifice is if victims were captives under duress or willing, cognizant participants. An initial biochemical perspective on this question can be gained from a group of 33 well-preserved sacrifice victims documented at the Chotuna-Chornancap Archaeological Complex (Klaus et al. 2016; Turner et al. 2013).

1.2 Research Questions

This thesis examines how stress is internalized around the sacrifice event that occurred during the political transition at Huaca de los Sacrificios in a multiethnic community. The following research questions address sacrifice writ large while also incorporating this exploratory research as a framework for nuanced future studies.

- 1) Do estimates of psychosocial stress via cortisol levels in these individuals provide any insights into the context of their ritualized deaths, given that

traditional coastal sacrificial rites differed significantly from rites like the Inka *capacocha*?

- 2) Given that the sacrificed individuals include subadults and adults, and that cortisol plays key roles in growth and maturation, is there a potential age-related confounder to estimating psychosocial stress in these individuals using cortisol levels?
- 3) Will prior-published isotopic data estimating paleodiet and these cortisol data estimating stress show any significant associations that might give insights into social marginalization or other aspects of lived experience?
- 4) Because the hair samples are small, will hair with a mass less than 10 mg provide viable data?

1.3 Overview of Chapters

Chapter 2 highlights the social complexity of Andean South America in the Late Intermediate Period (A.D. 1100-1450) and the Late Horizon (A.D. 1450-1532).

The chapter begins with an overview of the local Sicán culture. The Sicán culture

persisted when the region underwent occupation by the Chimú and later the Inka but ultimately was transformed. This chapter examines the early beginnings of the Sicán and then provides an overview of the coalescence and expansion of the Chimú state before turning to Inka conquest of the region (Table 1).

Chapter 3 introduces the Lambayeque Valley on the north coast, which is the geographic setting of this study. This chapter includes overviews of north coast ecology and landscape and a more in depth discussion about the Chotuna-Chornancap Archaeological Complex, in particular Huaca de los Sacrificios.

Chapter 4 of this thesis provides a comprehensive review of theoretical perspectives on ritual violence around the world in archaeological contexts, focusing in particular on the Andes. Arguably, most research on human sacrifice is influenced by the work of Hubert and Mauss (1964) from their seminal work, *Sacrifice: Its Nature and Functions*. This chapter first examines theoretical concepts and critiques of sacrifice studies. A discussion of ritual violence contexts in the Old World follows before the chapter focuses on the Americas, which are broken down into North America, Mesoamerica, and finally the Andes.

Chapter 5 presents methods and theories in bioarchaeological research for investigating stress. The chapter begins with definitions and critiques of stress and how it is applied to archaeological samples. The subsequent sections detail nutritional stress, non-specific systemic stress, infectious disease, occupational stress, and how biochemical models are used to interpret health and stress from archaeological samples. The chapter explores debates about how stress can be embodied during life and ultimately how stress is manifested onto the skeleton

Chapter 6 outlines the research design of this thesis. It provides the background of the study samples from Huaca de los Sacrificios. This includes how the hair samples were prepared before assaying for cortisol levels and methods used to complete this research. The following section revisits my research questions from this chapter and expands on the hypotheses that have shaped this thesis.

Chapter 7 displays the result of the ELISA assay for cortisol and interpretations with isotopic data. This chapter incorporates multiple data sets to provide a better insight into who these individuals were before they were sacrificed.

Chapter 8 discusses the interpretation of the stable isotopes and cortisol analysis from Huaca de los Sacrificios. Together, these data demonstrate the variation of stress and diet from each context and how they correlate to social stratification, perceived stress, and stress that can be affected by other potential confounders resulting in spiked cortisol levels.

Chapter 9 concludes this thesis. This chapter focuses on the research questions and hypotheses outlined in previous chapters. This concluding chapter also details its contributions to Andean bioarchaeology and stress studies in archaeological samples. The next section of this chapter provides ideas about how this research can be used for bioarchaeological praxis and used for the greater good of anthropology. The final section of this thesis illuminates the potential future research directions of ritual violence on the north coast and in Ancient Peru.



Figure 1: Map of Peru showing the mosaic Andean Landscape (University of Texas Libraries)

2 Social Complexity During the Transition from the Late Intermediate Period (A.D. 1100-1470) to the Late Horizon (A.D. 1470-1532)

The Late Intermediate Period (LIP) (A.D. 1100-1470) was a dynamic time period in Peruvian history chronologically situated between the previous Middle Horizon

(A.D. 600-1100) and subsequent Late Horizon (A.D. 1470-1532). This period is characterized by the regional development of small polities that controlled their own local territories across much of the Andean cordillera (Williams 1980). Scholars focusing on the Late Intermediate Period suggest that this period is associated with the post-collapse balkanization of dominant empires during a tumultuous period (Covey 2008a). Since Rowe's (1962) ethnographic work, more excavations have been carried out of Late Intermediate Period sites. Contemporary literature suggests that the Late Intermediate Period is a cycling between periods of greater and lesser social complexity with widespread social, cultural, and ecological change (Bauer and Kellett 2010).

The frequency and increased degree of conflict and warfare throughout the cordillera during the LIP is debated, though on the north coast the level of conflict is decreased and nearly the complete opposite of the southern valleys and highlands (Arkush and Tung 2013). The north and south coast during the Late Intermediate Period underwent different developments in social complexity and growth.

Homogenizing these areas under one-time period is inappropriate and erases the

sheer overall diversity of the myriad of culture's respective political reach. To better understand the polities and economies of the Late Intermediate Period, the antecedent Middle Horizon (A.D. 600-1000) needs to be examined in order to understand this transitional phase. The following chapter is broken into sections as case studies examining regional developments on the north coast, Cusco, and southern coastal valleys of Peru.

Table 1: Peruvian chronology of the north coast and the south highlands. This table shows the complexity of influence and cultural persistence through the various periods and horizons. Table by author.

Time Scale	North Coast	Southern Highlands	Horizon/Periods
1532	↑	↑	Late Horizon
1470	Inka	↑	Late Intermediate Period
1100	Chimú	Killke Inka	Middle Horizon
750	Muchik/Sicán/ Lambayeque	↑	
600	↑	Wari	Early Intermediate Period
A.D. 0	↑		
B.C. 200	Moche		

2.1 The North Coast

Archaeological investigations have defined three polities that dominated their respective northern valleys during the early LIP, shown in Figure 2: Sicán (or Lambayeque) (A.D. 850-1532), Chimú (A.D. 1000/1100-1470) and Casma (A.D. 800/900-1300) (Shimada 2000; Moseley 2001; Vogel 2012).



Figure 2: Map of North Coastal Peruvian political territories during the Late Intermediate Period.
Adapted from Public Domain Map.

These groups may have developed into small and centralized complex polities that began coalescing during the Middle Horizon, with little impact by Wari imperialism, and continued into the early LIP (Conlee 2004; Schreiber 2001; Vogel 2005). Around the beginning of the Middle Horizon (A.D. 600-1000), changes in sociopolitical organization and political decline began to occur in many valleys (Shimada 1990; Wilson 1995). Additionally, scholars debate when the LIP began on the North Coast because it does not exactly fit in with the chronological model developed for the highlands. For this reason, a more fluid framework that allows for long-term regional trajectories is utilized (Covey 2008a:289; Kaulicke 1998; Marcus 1993; 1998). Data on the transitional period from the end of the Middle Horizon to the Early LIP suggest that populations began to grow in the Jequetepeque and Lambayeque valleys (e.g., Chotuna, Túcume, and Pacatnamu) and at Chan Chan (Kolata 1982; Sandweiss 1996; Shimada and Montenegro 1995).

2.1.1 The Sicán

The collapse of the Moche occurred over a period of time beginning around A.D. 550 with large-scale sacrificial events performed by non-elite individuals at Huaca de la Luna (Bouget 2016) up until A.D. 750, when Pampa Grande was sacked by what Shimada (1994) suggests was an internal revolt and ousted the ruling elite. The Sicán culture, also known as the Lambayeque culture, flourished out of the political vacuum left by the Moche. During the Middle Sicán period (A.D. 900-1100) a regional style was crystallized and the "Sicán Lord" (or deity) ancestor cult motif adorned ceramic vessels (Jennings 2008; Shimada 2000). The Sicán expansion in the Lambayeque Valley was due in part to a centralized theocracy, but also to their exceptional trade networks, large-scale production of copper arsenic alloys, silver, and gold, and diverse subsistence economy (Shimada 2000; Shimada et al. 2004; Klaus 2013:394). Though the Sicán emerged from the Moche, they did not expand through militarization (Klaus 2013).

The mortuary record indicates that the Middle Sicán culture was a multiethnic society that was headed by an elite Sicán ethnic group (Klaus 2013). These peoples

were ethnically Muchik and were bioculturally descendants from the earlier Moche (Klaus 2013). Sicán lords were more invested in wealth through trade networks than in annexing new territories outside of their capital and local regional centers (Arkush and Tung 2013). Warfare and violence is almost absent in the Sicán ruled valleys and almost all settlements lack defensive fortifications (Shimada 1990).

In other parts of the Lambayeque Valley, the Muchik continued to offer blood as a ritual offering (Klaus et al. 2010). In contrast to Moche ritual killings of captive warriors that appear to be exclusively men, Sicán ritual killings included young females and children (Farnum 2006; Klaus 2010; Toyne 2008), suggesting a shift towards dedicatory practices of local people from surrounding areas or controlled valleys (Toyne 2008). Sacrifice seems to be relatively confined to specific ritual contexts associated with either elite spaces offering un mutilated bodies or rural ethnically Muchik communities giving a blood offering (Klaus 2013, 2014).

Around A.D. 1100, the Middle Sicán period abruptly ended which left the ruling elite class ousted from power and the local Muchik community unscathed (Klaus 2013). The Late Sicán period is relatively understudied. However, the Late

Sicán capital was moved to the monumental site of Túcume, or "El Purgatorio", after the old capital was burnt and abandoned (Klaus 2013; Jennings 2008). Most Late Sicán settlements continued to be non-defensive in nature despite the shift in Sicán cultural periods (Arkush and Tung 2013).

Sacrifices continued at Cerro Cerrillos, located in the Reque Valley, suggesting that ritual killing involved mutilating the throat and neck, a practice that appears to be consistent with earlier Moche and Middle Sicán dedicatory offerings (Klaus et al. 2010). Toyne (2011) reports that one mutilated skeleton was interred along with dedicatory burials at Huaca de las Balsas at Túcume.

In the wake of social reorganization on the North Coast, the multiethnic Muchik culture became subject to the Chimú from the southern valleys. The Chimor Empire annexed the Lambayeque region around A.D. 1375 through military conquest after the conquest of the Jequetepeque Valley (Mackey 2009; 2010; Shimada 1990). Despite being conquered, Muchik ethnic identity endured, although transformed, throughout Chimú and subsequent Inka control of the region.

2.1.2 The Chimú

The Chimú capital of Chan Chan began to grow to urban proportions during the early LIP and demonstrated more centralized planning, status differentiation, and monumental, religious, and administrative architecture (Donnan and Cock 1997; Klymyshyn 1982; Shimada 1990,1995). Throughout this time period, Chan Chan began to expand and solidify its secondary administrative sites from existing local centers or newly constructed settlements (Keating and Conrad 1982; Mackey and Klymyshyn 1990). The Chimú center of Chan Chan was linked to these secondary sites by a roadway system. The elite had a special interest in local labor management focused towards economic and political administrative growth rather than defensive structures at their capital (Moseley 1975; Topic 1982). However, fortified sites and defensive structures have been found on the Chimú frontier in locations near rival boundaries with rivals such as the Casma polity, as is the case at Cerro la Cruz in the Chao Valley or Acaray in the Huaura valley (Brown Vega 2009; Covey 2008a; Vogel 2012). These structures may have been oriented toward maintenance of natural resources rather than strategic defense (Moseley and Mackey

1973). However, Brown Vega (2009:256) suggests that it is more likely that Cerro la Cruz and Acaray were fortresses intended to halt the Chimú expansion at the Casma frontier.

Territorial expansion of the Chimú state is characterized by three phases; (1) the consolidation and reduction of administrative control in the Moche Valley to a nucleated center, which allowed (2) for expansion to the north and south of the Moche Valley. This, in turn, (3) directly affected the successful incorporation of the Late Sicán and Casma polities and begun to influence political reach to the north and south valleys (Keatinge 1982; Parsons and Heating 1988; Mackey and Klymyshyn 1990; Covey 2008a:308). During its slow imperial expansion, the Chimú state did not attempt to colonize the eastern highland-lowland ecological areas. It seems as though elites focused their investment on wealth production and display rather than large scale annexation once the north coast was conquered (Covey 2008a). Once the Chimú had instituted political control over their newly acquired lands, fortified structures in the Moche and Virú Valleys became rare during the relative peace of the LIP on the North Coast. (Arkush and Tung 2013).

2.2 Inka Heartland

Many local groups resided in the Cusco basin, located in the southern highlands of Peru. During the Middle Horizon, these peoples were influenced by Wari colonists who established settlements between A.D. 600-900 throughout the Vilcanota Valley, Lucre Basin, and Hauro area (Covey 2008a). However, toward the end of the Middle Horizon (circa A.D. 900), major Wari sites in this region were abandoned, which ushered in a new era of factionalism and conflict (McEwan 2005). The northern region increased in size through land annexation and political influence of the Killke and sites distributed along the valley (Covey 2003). Larger settlements are situated on hilltops that allowed for defense while smaller hamlets were located at lower elevations in the valley. The southern region had small population coalescence that appear to be organized through economic interest rather than defensive strategy (Bauer 1992, 1999). Overall, the settlement distributions to the

north and south suggest moderate political complexity characterized by community level management (Covey 2008a).

Mortuary data in the Cusco region are incomplete and negatively impacted by centuries of grave looting and destruction of interments, as in many regions of Peru. Above-ground structures increased exponentially during the LIP, though the preservation is inconsistent from site to site (Isbell 1997; Hiltunen and McEwan 2004). Other funerary contexts located in this region have suggested group burials in caves (see Dean 2005), while domestic structures often featured subfloor burials of infants and children (Covey 2006a). The variation in funerary and mortuary contexts suggests diversity in social structure and is consistent with conveying status in group identity and potentially age and gender, while downplaying differences of regional and/or ethnic affiliation (Isbell and Korpisaari 2014).

The Inka coalescence was made possible by Wari decline (circa A.D. 900-1000) and their influence in the area post-collapse, although a consensus has not been reached regarding the degree to which the Wari Empire influenced the Inka (Covey 2006). Additionally, the Inka were not direct lineal descendants of Wari but instead

were influenced by Wari legacies, elements of the Tiwanaku culture, and the local political groups in the Cusco region (Covey 2003, 2006a). Covey (2003) reported radiocarbon dates from a second-tier Inka administrative site at Pukara Pantillijilla that suggest a terminus ante quem for Inka state formation of about A.D. 1300. This correlates with Morris's (1988) interpretations of Early Inka (Killke series – A.D. 1200-1438) and Late Inka (Cusco series A.D. 1428-1532) periods. The regional population grew exponentially as new lands were incorporated for cultivation and construction of canals and terracing along the valleys. Additionally, settlements in marginalized uninhabited lands for agricultural production began to increase, which easily enabled land acquisition (Bauer and Covey 2002).

Covey (2006a,b) suggests that these endeavors helped feed the ever-expanding state in Cusco, increased the competitiveness of the Inka polity, and potentially stabilized resources during El Nino Southern Oscillation (ENSO) climatic events, specifically the extended period of drought that occurred during coalescence (Chepstow-Lusty et al. 1996). During the expansion period, the Inka incorporated lands through marriage alliances between existing *ayllu* kin networks, established

administrative and religious architecture in local villages under their control, and through warfare (Covey 2008a). Competing states and polities remained autonomous until the Inka consolidated to a nucleated capital and began to expand around A.D. 1400 to the coast and into the central highlands of modern day Bolivia and northwest Argentina.

2.3 Inka Consolidation

Despite regional and geographic differences between these the Peruvian coast and the southern highlands, Parsons and Hastings (1988) suggest that the the local resource base and the sociopolitical development during the Late Intermediate Period increased competition between polities in close proximity to one another. The complexity of the society varies proportionately to the level of massed agricultural and herding resources available in a given region. The movement of resources between populations living in ecologically distinct regions in close proximity probably took place in the absence of a unified political system (Parsons and

Hastings 1988). During the later part of the LIP, the early Inka began to develop and eventually would dominate the western coast of the southern hemisphere.

2.4 The Late Horizon

The Late Horizon (A.D. 1470-1532) is characterized by Inka imperial domination and incorporation of many small polities reaching limits from coastal Ecuador, coastal and highland Peru, northern Chile, northwestern Argentina, and western Bolivia (Covey 2008). The Inka polity is known for its economic and complex administrative system keeping precise counts of resources and products (D'Altroy 1999). Perhaps the most notable marker of expansion, one still visible today, is the sheer amount of terracing and hydraulic systems from mountain tops throughout the Andes that also acted as a cultural statement. The Inka co-opted a tax system, called *mit'a*, that built on existing notions of labor reciprocity. Work performed through *mit'a* was critical to maintaining and developing the Inka statecraft, elite power, and invested interests needed for the expanding Empire (D'Altroy 1999; 2015). The Inka economic system was not merely to dominate and extract new

territories, but to co-opt local histories and transform cultural practices of human and nonhuman actors under Inka control (D'Altroy 2015:115). Overall, the Inka employed an economic system and policies that allowed the state to be sustained – including aristocratic elites and religious institutions – through the guise of shared social responsibility.

As noted in Spanish colonial documents, the Inka expanded rapidly due to a form of split inheritance. Split Inheritance involves the process which the Inka leader did not inherit all of the kingdoms land, instead they had to go and conquer their own land which would then be incorporated into the Empire (Bauer and Covey 2002). In return, these imperial campaigns demanded that the empire grow rapidly in a short period of time. Each *Sapa Inka* would then be known by their incorporated domain into Tawantinsuyu. The incorporation of the North Coast was led by Sapa Inka Tupac Inka Yapanqui between A.D. 1450 and 1470 (Betanzos 1551; Sarmiento de Gamboa 1999 [1572]). The Inka overtook the Chimor Kingdom and seized control over the fertile lands and raw resources as well as skilled laborers that were already organized to pay tribute to imperial rulers.

A paucity of imperial Inka artifacts that have been found in the coastal valleys of Chillón (Silva Sifuentes 1992) and in the southern valley of the Osmore Drainage (Owen 1993). Some researchers have noted that the scarcity of Inka artifacts and architecture on the north coast (Rowe 1948:46; Tschnauer 2001) is a result of the late conquest of the area, or on the reliance on local lords and the existing ethnic traditions (Hyslop 1993). However, Inka expansion is well documented and appears differently due to their strategies of indirect rule in most places and modifying and adding additional structures (Bray 2015; Hayashida 2008; 2015). On the south coast, Covey's (2000) work in the Locumba Valley in Southern Peru suggests that the Empire's strategy avoided direct control of incorporated areas. Wilson's (1988) research in the Santa Valley suggests that this imperial strategy of indirect rule was employed in the northern coastal valleys as well, echoing D'Altroy's (1992) proposed flexibility in imperial domination among a territorial (direct) – hegemonic (indirect) continuum. However, comparable evidence in the Chincha valley suggests that there was substantial Inka reorganization by modifying the local political system potentially through treaty rather than militaristic campaign (Marcus 1987; Morris

1998; Sandweiss 1992). This differs from earlier ethnohistorical work, which suggests minimal Inka impact on these societies (Rostworowski de Diez Canseco 1990). This is due to the fact that Inka control varied depending on complexity of the incorporated polity and their political system. The competing evidence from around the Empire's domain suggests two plausible imperial strategies. If there was not an established political system or if the Inka were met with resistance and conflict, they would essentially construct and build new centers and administrative posts. In areas where the local lords were compliant with the Inka, they would be folded into the Inka power structure and kept in power as administrators for the Cusco heartland (Covey 2003; Kosiba 2010).

Once the Chimú were conquered by the Inka ca. A.D. 1450-1470, the latter imposed indirect rule and relied on local lords to continue governance to further the Inka state and Imperial ends. The Inka appropriated Chimor textile production because cloth was a valuable prestige item to the Inka. In a similar fashion to burying individuals, the textiles legitimized the politico-economic control and

communicated a form of social identity that allowed for the state to assert its dominance (Costin 2011).

Archaeological evidence also suggests that the intensity of textile production increased dramatically post-Inka conquest. *Unkus* woven with *t'oqupos* (a sleeveless tunic with tessellated patterns worn by males that symbolized identity within Inka society) displayed a higher degree of stylistic and technical standardization indicating a "high degree of supervision of garments" (Costin 2011:109).

Comparatively, women and lower-ranking individuals, whose clothing was less uniform had little degree of sophistication suggesting the opposite (Baker 2001).

Textiles were produced at the capital Chan Chan before Inka conquest. There is evidence for textile production in three LIP contexts: 1) lower-class neighborhoods that had both habitations and workshops; 2) luxury textiles in residential workshops associated with elite architecture (administrative architecture was interspersed among both types of workshops); and, 3) large quantities of weaving equipment were found with females buried in a royal or noble burial platform adjacent to palaces at Chan Chan (Costin 2011).

During the Late Horizon, production began to grow exponentially by means of intensive cotton processing as seen through the amount of cotton seeds recovered from primary midden contexts at Túcume and painted patterned wooden boards with Inka designs that match recovered textiles suggesting that the Inka had involvement in production. Regardless, it seems as though the Inka established *acllawasi* at admin centers, whose *aqllakuna* played a pivotal role in producing only a certain kind of *cumbi* (cloth) used for political gift giving and facilitated integration of new areas for the Inka (Costin 2011).

2.5 Summary

Detailing these transitional periods in ancient Peru is difficult due to the variation in complexity in regional development. The collapse of the Wari and Tiwanaku states that had previously assumed control over large portions of the Andes during the Middle Horizon set the stage for regional factionalization. This resulted in a process of decentralization and factionalism into smaller polities with intra- and inter- conflict and warfare during the early and later, Late Intermediate

Period. The presence of ridgetop hillforts along the Andean landscape reinforces this interpretation regardless of whether the culture is known for its belligerence. Also during this period, the Early Inka (Killke) began to coalesce in the Cusco region as a result of Wari influence. It should be noted that McEwan et al. (2002) considers the Killke to be culturally distinct from the Inka whereas Bauer and Covey (2002) suggest that they are culturally the same. As a result of Wari collapse, the Inka began to alter the landscape for intensive maize production and to incorporate other small polities enacting political and economic dominance in areas where settlements were previously absent (Covey 2008b). The complexity of statecraft and conquest of the Andean landscape, while instituting indirect rule in many parts allowed for Inka rule to quickly dominate.

Inka statecraft varied in each of the four parts of Tawantinsuyu. Understanding the cultural contexts of both the north coast and southern highlands and the differences between them and with the Inka heartland is important for interpreting how social processes are then written onto the body. The lived experiences and psychosocial environment of peoples in the Inka peripheries varied

depending on the kind of Inka statecraft that was put in place. The Inka would forcefully move groups of people and extended families to recently conquered areas in order to bring Inka culture and extend their political hold (D'Altroy 2003). This occurred when the region had a high number of rebellions and uprisings, although this is not always the case, for example in the Lambayeque valley. In doing so, peoples were forced to comply and conform to Inka culture and tradition through direct rule. Other places that the Inka indirectly controlled would appear to have less Inka influence because they still performed their local ethnic customs (Klaus et al. 2016), but this was just a different type of influence.

The collapse of the Wari and Tiwanaku states during the Middle Horizon (circa A.D. 950/1000) brought upon major political and social change throughout the Andes. While these states declined into the early part of the Late Intermediate Period (circa A.D. 1100-1200), the Muchik (Sicán), the Chimú, and the Inka began the early stages of social development. Early characterizations of this period suggested that there was full out warfare, however new data suggests that polities on the north coast during this time period were the complete opposite and lacked defensive

structures (Arkush and Tung 2013). The absence of fortified structures left the Muchik vulnerable to attack from the encroaching Chimú state from the south.

Ultimately, the Chimú overtook the Sicán polity and established political rule over the newly acquired areas that focused on wealth production that state expansion (Covey 2006). The Chimú ruled for a short period of time over the Muchik, which resulted in the transformation of the Muchik ethnic identity.

The transition from the Late Intermediate Period to the Late Horizon (A.D. 1470-1532) was a dynamic period in Peruvian history where the Inka Empire began to expand and annex territories outside of Cusco in adjacent highlands and the coastal fronts. This expansion has been attributed to the 'split inheritance' of the Sapa Inka dynastic rulers that enabled the empire to grow exponentially in a short period of time (Bauer and Voey 2002; Covey 2008). The Inka campaign to the north coast was done to gain access to the natural resources that could help fund the Inka (D'Altroy 2015), and grow the empire. Once the Inka overtook the Chimú (circa 1470), the Inka instituted indirect rule over the local Muchik due to established policies of the antecedent Chimú. The Muchik may have been less affected by the

political reorganization from the Chimú to the Inka, but the Muchik ethnic identity was transformed once again. During the Inka occupation of the north coast, they exploited the local natural and raw resources while using the skilled laborers to help sustain the Inka Empire.

Inka statecraft varied in each of the four parts of Tawantinsuyu. Understanding the cultural contexts of both the north coast and southern highlands and the differences between them and with the Inka heartland is important for interpreting how social processes are then written onto the body. The lived experiences and psychosocial environment of peoples in the Inka peripheries varied depending on the kind of Inka statecraft that was put in place. The Inka would forcefully move groups of people and extended families to recently conquered areas in order to bring Inka culture and extend their political hold (D'Altroy 2003). This occurred when the region had a high number of rebellions and uprisings, although this is not always the case, for example in the Lambayeque valley. In doing so, peoples were forced to comply and conform to Inka culture and tradition through direct rule. Other places that the Inka indirectly controlled would appear to have less

Inka influence because they still performed their local ethnic customs (Klaus et al. 2016), but this was just a different type of influence. Importantly, Besom (2013) points to human sacrificial practices and religious ideology as a potent strategy through which the Inka were able to incorporate and dominate hinterland polities through non-militaristic means (see Chapter 4 for a more detailed discussion of human sacrifice and ritual violence).

Imperialism could be exercised through ritual violence and push the political expansion over local polities that dominated the coast and upper-valley areas. Since the north coast of Peru already has a rich history of imperialism and ritual violence from the Sicán and the Chimú, it means that studying sacrifice in the Late Horizon on the north coast could provide more insights into the on-the-ground lived experience of these bigger tectonic shifts in the geopolitical landscape.

3 The North Coast of Peru

The north coast of Peru is comprised of 14 river valleys that span over 400 linear kilometers of coastline. These river valleys are divided into the northern and southern sectors (Klaus 2008). From north to south, they are the Olmos, Motupe, La Leche, Lambayeque, Reque, Zaña, Jequetepeque, Chicama, Moche, Virú, Chao, Santa, Nepeña, and Casma Valleys (Klaus 2008:74; Figure 2).

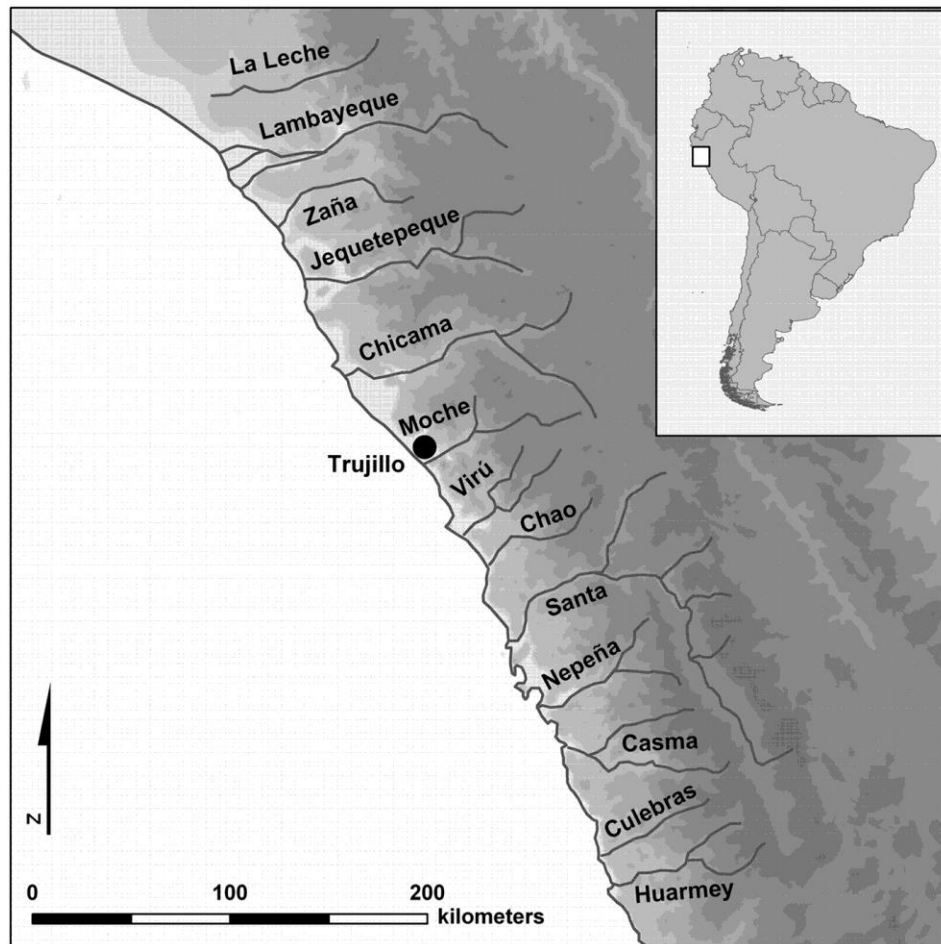


Figure 3: Map of the North Coast Peruvian River Valleys (Millaire, Copyright 2010) National Academy of Sciences.

Klaus (2008:81) notes that the north coast of Peru is a paradoxical setting given that it hosts an environment hostile to human life, but is abundant with a variety of natural resources that, when coupled with anthropogenic transformation, can foster demographic and economic potential. There is evidence in the upper Zaña Valley of tropical rainforest habitat that was established during the greater pluvial periods of the late Pleistocene (Craig 1985; Dillehay et al. 2004; Klaus 2008). During the de-glaciation period of South America, the environment drastically changed and this led to desiccation and desertification of the South American coastlines (Klaus 2008). With environmental pressures and scarce water resources, it was necessary to transform the landscape for irrigation and cultivation. However, the north coast is greatly affected by natural phenomena that can be potentially catastrophic. This environmental instability is not unique to the north coast but affects the entire Andean landscape. Earthquakes, volcanic eruptions, and ENSO events have devastated parts of Andean Peru resulting in deaths ranging in the tens of thousands in modern day (Erikson et al. 1970; Klaus 2008). Catastrophes could damage or completely wipeout irrigation systems or constructed gardens, resulting

in the destruction of crops. More specifically, during the warm-water cycle, new marine dietary choices would actually fill the vacancy of the previous marine foodstuffs (Caviedes 2001; Klaus 2008; Shimada 1994).

3.1 The Lambayeque Valley Complex

The Lambayeque Valley Complex is comprised of five river valley systems, from north to south, Motupe, La Leche, Lambayeque, Reque, and Zaña, and flows into a single intervalley irrigation network that was constructed during the Moche era (Klaus 2008:88). The Lambayeque Complex is occupied by the Cordillera Occidental and is delineated by two branches; the northeast-southwest branch that presses upon the La Leche Drainage (Klaus 2008:88), and the southern branch from the highlands to Cerro de Reque (Klaus 2008; Shimada 1976). As Klaus (2008:88) notes, the Lambayeque Valley Complex is a unique setting on the Peruvian coast and is ideal for extensive irrigation agriculture and today features around 136,000 hectares

of arable land. During the Late Intermediate Period, Kosok (1959; 1965) estimated that the Lambayeque Valley Complex contained a third of the human population and arable land of the entire Peruvian coast (Klaus 2008:88).

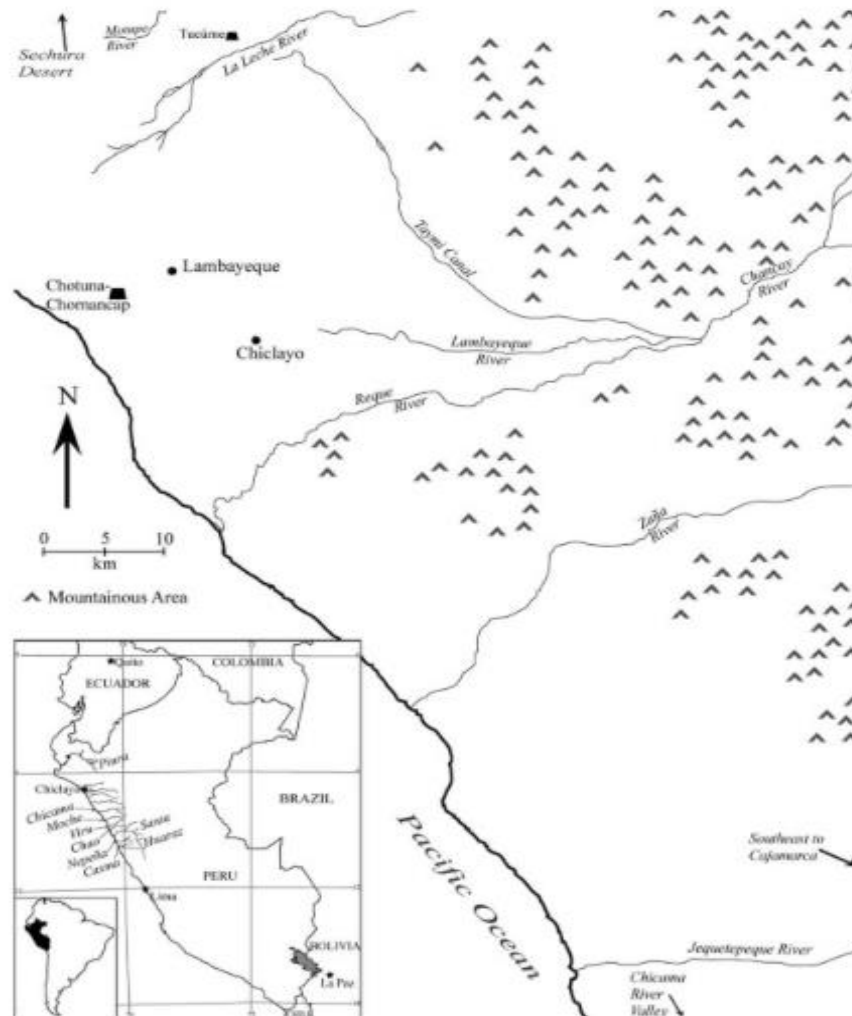


Figure 3: Map of the Lambayeque Valley (Borrowed from Turner et al. 2013).

3.2 Chotuna-Chornancap Archaeological Complex

The Chotuna-Chornancap Archaeological Complex is located in the lower coastal Lambayeque valley. This area is believed to be 'Chot' (possibly short for Chotuna) from the mythical legend of Naymlap, the lord that arrived on a raft from the pacific and attained control of the area and expanded with his sons (Donnan 2011). This archaeological complex is comprised of *Huacas Susy*, *Huaca Gloria*, *Huaca Mayor*, *Huaca Chica*, and *Huaca Norte* (now renamed *Huaca de los Sacrificios* Wester et al. 2010) within a square kilometer of each other. Initial excavations were conducted by Christopher Donnan during 1980, 1981, and 1982 field seasons. From Donnan's (2011) work, he developed the chronology of the site based on ceramic and adobe brick seriation and radiocarbon dates. Since the excavations of this site, two sacrifice events have been documented at the complex.

Table 2: Brick Seriation at The Chotuna-Chornancap Archaeological Complex (Modified from Donnan 2011)

Years A.D.	Phase	Adobe Type	Ceramic Types
1375 – 1600	Late	Tall Loaf	Inka-Chimú Late Phase

1100 – 1375	Middle	Loaf	Chimú-Inka Late Phase Chimú Late Phase
700 – 1100	Early	Flat Rectangular	Early/Middle Sicán Phase

3.2.1 The Early Phase

The early phase of occupation dates to approximately A.D. 700 to 1100. The local Muchik and Early/Middle Sicán peoples occupied the site and began developing the location after the collapse of the Moche confederation around A.D. 750. The adobe bricks that were produced during this cultural phase appear to be flat rectangular bricks (Donnan 2011). Donnan (2011) also suggests that early phase ceramics at this site were influenced by the Wari on account of paint decoration similar to Wari and use of red, black, and white colors. Early phase ceramics were in a simple decorated appearance that does not appear in the subsequent Middle and Late Phases. The most distinctive characteristic that does not appear on ceramics are the paddle markings that became popular later (Donnan 2011). The absence of these

early phase traditions that were not continued into the the Middle and Late Phase appears to reflect a shift in artistic interest during this cultural phase tradition.

3.2.2 The Middle Phase

The Middle Phase dates from approximately A.D. 1100 to 1370 when most of the monumental architecture at the Chotuna-Chornancap Complex was built. Donnan note that the adobe bricks used during this phase have a “loaf shape” appearance and are bigger than the previous bricks (2011:9). There is a reduced presence and almost disappearance of painted red, black, and white paint in ceramic assemblages. (Donnan 2011). Early crafting traditions appear to be abandoned during this phase. Instead a new ceramic tradition characterized by long double spouted and bridged bottles with pedestal bases was adopted.

3.2.3 The Late Phase

The Late Phase dates from approximately A.D. 1370 to 1600, during which the site underwent three successive foreign influences by first the Chimú state at approximately A.D. 1370, followed by Inka control that began circa A.D. 1470, and ultimately with Spanish colonization after A.D. 1532. The adobe bricks used in later construction at Chotuna-Chornancap structures had a "tall loaf shape" and are distinct from those of the Middle Phase (Donnan 2011:10). However, new architectural construction during this time is very limited. Instead, existing structures were remodeled using the newly shaped adobe brick.

The ceramic assemblages of the Late Phase are continuous from the Middle Phase assemblages; though foreign influences are discernable. The Chimú Late phase at this site introduced the stirrup spout bottle with a monkey modeled on the spout (Donnan 2011). Donnan (2011:11) notes that the Inka ceramics during the Chimú-Inka era are discernable in the cases of arybaloid bottles, keros, human and bird heads, and bowls with looped handles. Spanish influence can be identified by ceramic sherds with green glaze and one vessel that Donnan notes as indicating Spanish influence over production (Donnan 2011).

3.3 Huaca de los Sacrificios

The sacrifice events that occurred at Huaca de los Sacrificios (formally known as Huaca Norte, Wester et al. 2010) have been radio-carbon dated to the Inka time period (A.D. 1470-1532). Inside Huaca de los Sacrificios, there are three burial chambers that include a total of thirty-three individuals. Chamber I (burials 1-3) contains the remains of two adolescent women and a child. The child burial contained a *conopa* copper figurine with Inka motifs that was placed next to the bodies, along with seven subadult camelids (Klaus et al. 2016). Chamber II (burials 4-8) contained the bodies of 5 individuals; two subadults, two young males, and one middle aged female. What is interesting about Chamber II is that the mixed stratigraphy suggests that burials were reopened and the heads were taken off (burials 4; 5; and 8) and the right hand and both feet (burial 8). Burial 6 had their legs taken and haphazardly replaced *in situ* (Klaus 2016). Chamber III was a multilevel, mass deposit. The first level contained ten individuals (burials 9-18) who were all sub-adults ages 4-15. Directly beneath them was the second level of eight more individuals (Burials 19-26). Klaus et al. (2016) suggest this was a single event

due to the lack of disturbance and stratigraphic association. About 50 cm. below this level was an earlier Inka phase of disposition that contained two adult women and a child (burials 27-29) by the east wall and the remains of one adult woman and three children were placed into a small enclosure and all faced west (Klaus et al. 2016).



**Figure 4: Computer populated image of the burials from Huaca de los Sacrificios.
Photo credit to Wester et al. (2010)**

Cut marks on the skeletons were interpreted as sacrificial on account of the repeated and ritualized attention to mutilating the neck and chest. Huaca de los

Sacrificios tends to have more cut marks around the chest, specifically on the left clavicle and sternal rib endings. Less frequent are cut marks on the neck and anterior vertebral bodies. At Huaca Chornanacap, the cut marks are more frequent on the anterior vertebral bodies and medial and lateral sides of the body. Less frequent are cut marks situated on the manubrium, left clavicle, and sternal rib ends. This suggests that the sacrifice aesthetic varied slightly from the Chimú and Inka Empires. The Chimú focused more on throat slitting and a few examples of decapitation while the Inka focused somewhat more on chest mutilation (Klaus et al. 2016). The sacrificial mutilation pattern is a variation on the same sacrificial theme that can potentially characterize which culture carried out this ritual act. This is not to say that the Chimú only practiced sacrifice with neck mutilation or the Inka focused solely on chest mutilation. These are not mutually exclusive given each culture carried out sacrifice out on both the neck and chest.

There are no artistic depictions on the walls or murals at Huaca de los Sacrificios. However, there are canals that run between chambers. These canals were dug into the architecture extending downward to the feet of the sacrificed

individuals. These canals are similar, if not analogous, to those found at Huaca Loro, Las Ventanas, and El Corte in the Pamac forest. Klaus and Shimada (2016) suggest that these canals leading up to the feet were involved in rituals where liquids, or more specifically water, would flow from the Huaca. Similar water rituals are seen at Túcume and associated with Chimú sacrifice along with other higher quality and status goods such as spondylus shells. Ethnohistoric data from Rubiños y Andrade (1936 [1702]) describe lore in Mórrope where a life-giving water source in the desert would receive child sacrifices. Calancha (1972 [1638]) describes Chimú sacrifice as offerings to the moon deity Si, because they connected water, blood, and the ocean in tripartite (Rowe 1948).

3.4 Summary

The north coast of Peru is a dynamic geographical area that hosts a hostile environment to human life, but is abundant with a variety of natural resources. (Klaus 2008). The Lambayeque Valley complex connects five of the fourteen river valleys located on the north coast. The extensive irrigation in this valley allowed for

water transport throughout the valley and permitted the local Muchik to expand their territory from the coast inward towards the Cordillera Occidental. Furthermore, the north coast is susceptible to environmental phenomena that drastically could damage or completely wipe out irrigation systems or constructed gardens; during the warm-water cycle, new marine dietary choices would actually fill the vacancy of the cold-water marine niche (Klaus 2008).

The Chotuna-Chornancap Archaeological Complex is located in the lower coastal Lambayeque valley and has been thought to be the mythical place 'Chot' from the Naymlap (Donnan 2011). This site was continuously occupied and construction during the terminal Middle Horizon by the Sicán up until the Colonial era (Table 2). *Huaca de los Sacrificios* was used as a ceremonial place for sacrifice throughout the multiple occupations as argued through the deliberate cutmarks on the anterior cervical spine, sternal aspect of ribs, left clavicle, and the manubrium and corpus sterni (Klaus et al. 2016; Turner et al. 2013). The specific construction of the canals at *Huaca de los Sacrificios* that lead up to the feet were involved in rituals where liquids, or more specifically water, would flow to the body. The water would

collect the blood and become mixed with the water and flowed to the ocean (Klaus et al. 2016; Klaus and Shimada 2016; Rowe 1948). The local Muchick used these spaces for sacrifice and watery areas to invoke the Andean spirits to stabilize and maintain the balance for life and death.

4 Ritual Violence

4.1 Introduction

This chapter provides a comprehensive review of theoretical frameworks for and debates about sacrifice in antiquity. Defining sacrifice can be challenging because many scholars frame their interpretations solely in terms of religious practice. Because of this, sacrifice outside the realm of religion appears to be atypical. However, a survey of ritual violence in global contexts demonstrates that it can be as much politically driven as religiously. Highlighting various sacrifice events from various temporal and geographical contexts show that sacrifice is not only restricted to hyper-ritualized and religious contexts. In essence, this chapter serves to reshape the paradigm of ritual violence as restricted to religious practice and explore how local politics, economics, and social organization are embodied.

4.2 Theoretical Concepts

Ritual violence is a distinct act that makes what would be considered an act of murder a justified killing (Klaus and Toyne 2016). Ritual violence can be associated with and performed for various reasons, all of which embody local politics, economic systems, and social organization of the society (Klaus and Toyne 2016). Sacrifice is not mutually exclusive to the justified killings of humans. Many scholars have interpreted sacrificial contexts for non-human actors such as artifacts (Gaither et al. 2016), animals (Goepfert 2012; Van Straten 1995; Yaun 2005) and even architecture (Chase 1998; Harrison-Buck et al. 2007 Zucherman 2007). Human sacrifice has been studied extensively throughout the world and documented both in ethnographic accounts and in the archaeological record (Ramirez 2005). Various ethnohistorical documents in Andean South America noted sacrifice rituals and suggested different motives for ritualized killings (De Ayala (1980 [1615])). These should be approached with caution since etic perspectives may aggrandize and events in ways that may be inaccurate.

Differing models have shaped our understandings of human sacrifice and its function in societies in which it is practiced. Though Tylor (1874) does not offer an exact definition of sacrifice, he details various accounts of sacrifice events from animistic societies and mythology. Tylor (1874) suggests that sacrifice events occur in various contexts across human civilizations, and distinguishes between human sacrifice for the greater good of the community and animal sacrifices. Tylor (1874:303) notes that these different kinds of sacrifice are kept separate from each other and draws upon the division between the animate body and inanimate parts of the body that would be used in various ceremonies and are imbued with significance such as gender and mystic powers. Hubert and Mauss (1964 [1894]:19) suggest that sacrifice is a religious act that can only be carried out in a religious atmosphere and by means of essentially religious agents. However, before the ceremony neither sacrificer nor sacrificier, or other aspects of the ritual such as place, instruments, or victim, need to possess this religious characteristic. The first phase of the sacrifice is intended to impart the body and spirit. Individuals are for the most part always profane; because of this, their condition must be changed and

transformed so that the ritual can come to an end (van Gannep 1964). To do this, rites are necessary to introduce them into the sacred world and involve them in it.

Together these theoretical frameworks for sacrifice favor the western intellectual definitions of sacrifice and are used to influence other scholarly writings surrounding sacrifice.

Tatlock (2006:1) offers a more comprehensible definition of sacrifice stating that, "it is not only the destruction of an individual in an act directed towards a divinity or immaterial entity, but it is more specifically a slaying done with the direct intent of affecting the suprahuman realm." Additionally, Tatlock (2006) suggests sacrifice can follow two pathways: the conjunctive in which the sacrificer connects to the immaterial deities or disjunctive that disconnects the line of communication between the immaterial world from the material world. This definition demonstrates that the overall function of sacrifice should not only serve as a framework for connecting with the immaterial world. Human sacrifice is culturally specific and should be understood within its social milieu before drawing parallels to other sacrifice events. For example, sacrifice on the north coast of Peru will appear

different than on the south coast. However, once the sacrifice event is interpreted within its own cultural environment it is then plausible to draw from other sacrifice events to gain a deeper understanding and construct an argument for the variation in sacrifice theme (Tatlock 2006).

Schwartz (2012) divides sacrifice into a tripartite explanatory model. The first kind of sacrifice is offering sacrifices to the supernatural by terminating the life of an individual or the functional destruction of an object or animal. The second kind are foundation sacrifices that align with dedication, deification, or consecration of the offering within the built monumental architecture and environment of ritual places. The third are retainer sacrifices that are associated with high-status funerary offerings. Retainer sacrifices may have willingly performed autosacrifice in order to accompany the deceased to the afterlife, or may have died before being placed within the tomb (Klaus and Toyne 2016). Although this classificatory model offers a way of categorizing sacrifice, it should be recognized that these categories are not necessarily mutually exclusive.

Early definitions from E.B. Taylor, and Hubert and Mauss use religion as a model to understand sacrifice events and are often cited in the ethnohistorical literature as well. The overarching theme though is the theoretical conceptions of ritual violence established a means of communication to the immaterial world (Girard 1977 [1972]). Gaither et al. (2016) state that calculated sacrifice, an accumulation of bodies or objects that are then calculated as a higher quantity sacrifice, has been suggested in contexts of natural disasters, earthquakes, and poor harvests and may result in goodwill from the gods, drawing from cosmological explanations (Bourdillons 1980). Bourdillons (1980) suggests that a number of sacrificed individuals can be calculated as one major offering or gift that will create lines of communication and reciprocity between the living and the supernatural and ancestors in a cross-cultural religious experiences. Creating a line of communication between the living and the supernatural fosters a continuous reciprocal relationship that benefits each party (Aldhouse-Green 2001). The individuals that are sacrificed then act as the glue for social cohesion between the profane and the sacred that fuels both religion and sociopolitical organization (Benson and Cook 2001; Durkheim

1976 [1915], Klaus and Toyne 2016; Tung 2016). The most sacred sacrifice is autosacrifice where one inflicts pain on oneself in order to communicate with the deities thus establishing a direct connection between individual and deities and perhaps even self-deification (Tatlock 2006).

Kertzer's (1988) theoretical insightful discussion of ritual examines how ritual are inextricably tied to politics and power. Kerzter (1988:9) defines ritual as a highly structured and standardized sequence of behavior that is often enacted at certain places and times. Those places and times are themselves endowed with special symbolic meaning. Ritual action is repetitive and, therefore, often redundant. These very factors serve as important means of channeling emotion, guiding cognition, and organizing social groups as well. Though Kerzter is not directly exploring about sacrifice, because sacrifice is a ritual action, Kertzer's examination is relevant to thinking about the way in which these real social circumstances play out in various contexts. If there is discontinuity in the ritual, it threatens the integrity of the political organization's performance and the potential for ritual instability.

Many powerful symbols of legitimacy are of religious origin. In the wake of political change, new political governance would co-opt the preexisting religious rituals and symbols that will enrich their own ritual action as was the case in various parts of the Islamic world with emerging political forces enforcing religious rites to help build their claim to religious legitimacy (Kertzer 1988:45); a similar strategy was employed by the Inka Empire. Political legitimization through the use of religious ritual is not limited to the divergence of political and religious as these can be presented as identical (Kertzer 1988). It is more profitable overall to expropriate the old ritual to the new organizational ends, as Kertzer (1988:45) notes, when the new political regime is the sworn enemy of the previously dominant religion, it makes more sense to co-opt the ritual than to destroy it as the European church learnt from losing battles with "pagan" ritual. If paying tribute to the governing authority, as was the case with the local Muchik to the Chimú, is already set in motion and can be co-opted without full revolt and resistance, then it would be more practical to allow it to continue once the Inka controlled the area.

Rituals that legitimate authority can often take different forms depending on the official ideology associated with the political system. For example, the rites of divine kings differ from elected leaders (Kertner 1988) or the role of ancestors in Inka practice differ from in Wari traditions. Once the ritual becomes established and institutionalized, it takes on a life of its own and continuously is transformed and transcends those that participate in it (Kertzner 1998). While the state or institution is legitimizing itself through ritual, it concurrently legitimizes the subordination of non-elites and violence. Thus, it continues to separate the elites and non-elites of a society by reinforcing and reproducing inequality. Kertzner (1988) suggests that the body is no longer one's own, but owned by the state as if it is a material object that can be used and then disposed from society. In some cases, the elites perform ritual on themselves and completely leaves out the narrative of the subordinate population. Regardless, power is expressed through symbolic guises that continue the cycle of inequality through ritual practice.

Seeing ritual violence through the perspective of political forces reinforces the different means and ways ritual violence is performed. Foucault (1995[1977])

provides an excellent vignette of corporeal punishment, sacrifice, and the state taking control of the body of a criminal in 18th century France,

“There are no longer any of those executions in which the condemned man was dragged along on a hurdle (to prevent his head smashing against the cobblestones), in which his belly was opened up, his entrails quickly ripped out, so that he had time to see them, with his own eyes, being thrown on the fire; in which he was finally decapitated and his body quartered. The reduction of these 'thousand deaths' to strict capital punishment defines a whole new morality concerning the act of punishing (Foucault 1995[1977]:12).”

Here, executions can be synonymous for sacrifice as the structure of the event is housed in two different paradigms. Execution by the French state was a public event that people would gather in the square to watch and idly consume Foucault (1995[1977]). Seeing these horrific events play out does two major things; 1) it reinforces the power in politics and 2) how politics become embodied and reproduced which further legitimizes the state and inequality. The work of Foucault (1995[1977]) and Kertzer (1988) suggests that pulling back the layers of constructed rituals can reveal that politics are highly involved in ritual violence.

The modern west has come to view sacrifice as inexplicably tied to religious practice (Asad 1993). In doing so, it loses sight of indigenous ideology and theoretical perspectives and loses sight of deeper anthropological interpretations away from religious perspectives. . The etymology of the word sacrifice (to make holy or sacred) further privileges the western viewpoint and concept that it cannot exist outside the realm of religion (Campbell 2012; Tung 2016). This perpetuates the continued divide between the sacred and the profane and ties it back to the motivation of Hubert and Mauss' (1964 [1898]) theoretical frameworks behind the explanatory models sacrifice practices (Tung 2016).

In present day, people around the world are enculturated with the assumption that the life of a human being holds the utmost value in society, of which this perception makes human sacrifice unacceptable (Green 1998). This perception of value then questions this assumption that a human life would be as equated in antiquity as it is in contemporary society. Many scholars place sacrifice in a religious framework, but should sacrifice be placed within the realm of religion (Schwartz 2012)? Tung (2016:362) outlines three issues with sacrifice: 1) sacrifice should not be

conceived solely as a religious practice, 2) theoretical frameworks attempt to illuminate a common division of the sacred and the profane between sacrificial acts and other activities, and 3) how does sacrifice affect the social and political realms particularly as it relates to social and gender role hierarchies more generally.

It would be inappropriate to assume that sacrifice is inextricably religious around the world including in Andean South America. Campbell (2012) argues that sacrifice should not be influenced by religion or 'in the sacred' ideology since many ancient texts confine sacrifice to politics. Despite these frameworks attempting to show other avenues to explain sacrifice, these frameworks create more questions about the practice. How does religion and ritual connect to the community and to individual lives? Could religion exist outside the social spheres that separate sacrifice as experience and perceived as ritual acts (Tung 2016)? Specifically, on the north coast of Peru, there is a relative absence of widespread evidence associated with interpersonal or sociopolitical sanctioned violence during the Late Intermediate Period (Klaus 2014; Klaus and Toyne 2016). Then how can violence be so repetitious and so highly ritualized at the same time?

4.3 Ritual Violence in Global Perspectives

4.3.1 Africa

Archaeological and ethnohistorical evidence indicates that sacrifice events are well documented in West Africa. Connah (1975; 2015) reported that there was a mass sacrifice event dated to the 13th century that occurred in modern day Benin City, Nigeria. An excavated cistern contained about forty-one individuals all likely being females around the age of twenty. Due to the stratigraphy of the continued use of the burial context, grave goods were placed on each stratigraphic layer, which included an isolated cranium just above the burial and ended with significant ivory deposit on the ante-quem final deposit. The intentional grave offerings suggest that this burial was not forgotten and perhaps was continuously revisited as evident by stratigraphic disturbance (Connah 2015). At the 10th century site of Igbo-Ukwu, an excavated tomb housed six individuals that were associated with various luxury items. Shaw (1970) suggested that these individuals were sacrificed slaves, whereas

Isichei (1973; 1978) interpreted this burial context as the cultural specific practice of sacrifice of non-elites from the community.

An ethnohistorical account from the Asante Kingdom details the practice of attendant sacrifice once a monarch died (Connah 1975). One aspect of the ritual was the spilling the blood of these attendants around the grave of the monarch would allow the sacrificed individuals to accompany the monarch into the next life (Bowdich 1819). In order to complete this ritual, greater sacrifices (calculated sacrifice) of at least thirteen women would be eviscerated to 'wet the grave' (Bowdich 1819; Bourdillions 1980). These individuals served as retainer sacrifices who had previously been charged with crimes like adultery or violating traditional practice. The Asante utilized sacrifice as corporal punishment as a means to ritually execute those that did not adhere to Asante traditional law (Williams 1988).

The intersection of ritual violence and corporal punishment provides an interesting model for understanding sacrifice. European sources that detail sacrifice in Africa describe the executions of criminals as a sacrificial rite, incorporating their own concepts of a penal system onto the Asante (Tatlock 2006). In this

understanding, the public display of killing individuals for spectacle or on momentous occasions serves to deter future criminal behavior and realign social continuity (Collins 1962). However, assuming that sacrificed individuals are criminals loses sight of the fact that captives from war were sacrificed too.

4.3.2 Asia

4.3.2.1 China

In Asia, sacrifice has been documented in China, Indonesia, Japan, and India. The earliest account of sacrifice in Ancient China dates to 677 BCE when sixty-six individuals were forced to leave the realm of the living and enter into the afterlife at the burial of a leader named Wu (de Groot 1894:721; Shelach 1996). It is documented that this is the first sacrifice event to be performed in his dynasty in China. These retainer, or attendant, sacrifices served the purpose of completing the ceremonial ritual once a dynastic king died. In this specific case, de Groot (1894) notes that Wu's nephew was one of the attendants that was buried. This appears to

be unique to this performance. More recent archaeological evidence pushes back the first accounts of Chinese sacrifice to the tomb of Fu Hao of the Shang Dynasty (ca. 1600-1100 BCE) (Qian 1981a). The tomb contained sixteen sacrificed children, women, and men, two of whom appeared to have been killed before interment and deposited inside the tomb (Qian 1981b).

4.3.2.2 Indonesia

In Indonesia during the 20th century, Manggarai rumors of kidnapping children and incorporating them to be sacrificed into the newly constructed architecture ensued panic (Drake 1989; Erb 1991; Tsing 1993).. The incorporation of the children would help augment and solidify the structural integrity of the structure (Drake 1989; Erb 1991; Tsing 1993). Ethnographic data from Borneo suggest that when a mausoleum or structure was constructed, the builders would request bounded slaves in the past, or rumored children during the 20th century to be placed in the hole for the final installment to be placed. Once the victim was in

position and the post was put in place, the weight would crush the victim and consecrate the place (Metcalf 1991). Human remains were recovered from an exposed post dating to the mid- to late- 1900s and corroborated the ethnographic data (Erb 1991). Similar archaeological evidence has been found in other parts of Indonesia (Wessing and Jordaan 1997; Jordaan and Wessing 1996; Wessing 1991). Another example of construction sacrifice can be found in northern Thailand of a person buried in a flexed position by the constructed water system (Moore 1992). This most likely originates to the similar belief found in Borneo (Wessing and Jordaan 1997).

4.3.2.3 India

In India, there is a highly ritualized and highly controversial ritual practice known as *sati*. *Sati* is the practice of burning a widow on the funeral pyre of her husband (Tatlock 2006). This auto sacrificial practice performed by the widow glorifies her social position in her caste system and becomes deified as a result of

her veneration of her husband. By the 1980s Sati worship had become a contentious issue for the Indian government and legislation was submitted to denounce sati worship and the destruction of sati temples (Gopalakrishnan 1987). The Indian government's argument was that an increase in sati worship may lead to more sati sacrifice. However, restricting religious belief could actually lead to other religious sanctions in India (Kishwar 2000). The widow who was going to autosacrifice herself was not acting entirely voluntarily; the agency of the woman is controlled by either cultural idea around sati worship among her social network or by the State.

4.3.3 Europe

European ritual violence has been documented since the Roman Empire (27 B.C – A.D. 476 [Western]/ A.D. 1453 [Eastern]) dominated much of the mosaic European landscape. Perhaps the most fascinating is the phenomenon of bog bodies, which do predate the Roman occupation in Northern Europe and can be associated with local ethnic groups as well. that preserve incredibly well due to their interment in peat moss swamps. Though the preservation is remarkable, it is difficult

to establish a cause of death and many scholars rely on ethnohistoric and ethnographic narratives that can provide any ounce of insight (Tatlock 2006). The bog body recovered from Britain - called Lindow Man - was assumed to be part of criminal activity which ended in body deposition (Turner 1986). However, radiocarbon dates suggest that the individual lived during the Roman era (Gowlett et al. 1986).

Initial interpretations associated the individual with Celtic and early European sacrifice rituals due to garroting, cutting, and drowning evidence (Ross 1986). Additionally, the stomach contents contained burnt bread and mistletoe which strengthens Ross' argument for a Celtic sacrifice ritual. The burnt bread was a ritual that would be given to the selected victim to be sacrificed while the mistletoe is a sacred flora that would potentially aggrandize and consecrate the ritual (Ross 1986). Other interpretations of Lindow Man have suggested that it may be a case of capital punishment because the Celts executed (sacrificed) criminals (Magilton 1995). Green (2001) cautions that there may not be one true explanation for these individuals that are transformed into bog bodies, given that there are various potential reasons why

they were killed and thrown into the peat moss swamps. However, it should be noted that some bog bodies are thought to be accidental rather than ritual killings. Tacitus mentions that these individuals could have been traitors, disgraced warriors, or even suicides (*Germania* 12). In some form, it appears that the bog bodies were associated with sacrifice and potentially auto sacrifice. One caveat, however, is that attempting to corroborate the ethnohistorical data with the archaeological record can be inappropriate at times, especially foreign accounts.

In Imperial Rome, sacrifice was carried out for various festivals, as dedicatory offerings to monumental architecture, and in ritual deification processions. Green (1998) suggests that during Roman rule, sacrifice was practiced all over the Republic although it was viewed as a reminiscent artifact from the mythic past and only under extraordinary circumstances would the Romans perform sacrifice. Outside the imperial core, sacrificial rites varied between which deities were called upon which the thematic ritual can differ between sacrifice. The sacrificial processions appear in a variety of contexts in Roman art, for example on altars and sanctuary walls at *Ara Pacis*, the arches of Titus, and columns (Elnor 1991). This vignette of Augustan

Roman sacrifice appears to be idealized through the artwork yet is disconnected from other archaeological and ethnohistorical data. Through the use of material culture and ethnohistorical documentation, it is possible to see that ritual violence was practiced throughout prehistoric Europe.

4.4 Ritual Violence in the Americas

4.4.1 The Oneota

Investigating ritual violence in Native American populations is a difficult task due to the historical and contemporary political tensions faced by these peoples. However, the archaeological and bioarchaeological studies that have begun to examine warfare and ritual violence, although sparse, provide an interesting glimpse into the pre-contact past. The case studies available that discuss warfare and religious violence should not be taken as a monolithic view of these cultures. Chacon and Mendoza (2007) note that armed conflict and religious violence were

continent-wide phenomena. In their work, religious violence is used as a blanket term for ritual killing.

Milner et al. (1991) examined the skeletal remains of the Oneota. The site was previously excavated at Norris Farm #36 which was located in the central Illinois Rover Valley in the west-central Illinois and dates to around A.D. 1300 (Santure et al. 1990). There were 264 Oneota burials that were interred at this site and about 43 were complete or partially complete that died violently (Milner et al. 1991). The trauma analysis of these individuals illuminated that fourteen were scalped and eleven were decapitated. by The specific cut marks on the frontal bone, occipital bone, and cervical vertebra are consistent with other North American assemblages (Milner et al. 1991; Owsley and Berryman 1975). Milner et al. (1991) note that this violent scene was part of a larger conflict, but the absence of osteological data of nearby sites in conjunction with a fortification structure makes this difficult. However, osteological analysis from Orendorf, a Mississippian site, which demonstrates higher trauma rates among a small Mississippian group that was intruded upon by the Oneota, suggests that war broke out (Steadman 2008).

4.4.2 *The Maya*

The Spanish utilized scribes, chroniclers, and Catholic priests to describe the Aztec (also called the Mexica) in the Valley of Mexico and other local Maya groups in the high- and low lands. From these accounts, ritual violence became fantastical vignettes depicting the 'savage' practices of human sacrifice. Etic perspectives of ritual violence do not always understand the purpose of sacrifice in specific contexts and lose sight of the fact that it fed an ecological and social niche for the peoples of Mesoamerica.

Ritual violence can be depicted in varying ways depending on the function and purpose of the sacrifice event. Auto sacrifice among the royal Maya has been depicted in epigraphy from Yaxchilan (now in modern day Chiapas) and other iconographic murals (Munson et al. 2014). Royal Maya women would tether a rope with obsidian flakes or stingray spines through their tongues to blood let into a basket, set fire, and then would conjure a vision serpent. Royal Maya men would sacrifice blood from their penis and follow suit (Joralemon 1974; Munson et al. 2014; Stuart 1984; Tate 2013).

The environment of Mexico and Central America is not ideal for natural mummification to occur, so it is impossible to find direct evidence of this practice. However, given the abundance of repeated iconography and epigraphy would suggest that auto sacrifice occurred elsewhere in the Maya realm. This ritual opened a direct line of communication between the royal Maya and the deities and indirectly self-deification.

The transition from the Classic Period (A.D. 200-900) to the Post-Classic Period (A.D. 950-1539) is regarded as a time of increased violence in the Maya high- and low- lands. A common theme in Maya art is the role of captives in ritual ceremonies as portrayed in the Leyden Plaque and representations at Tonina (monument 83) and the Usumacinta zones (Yaxchilan, Bonampak, Piedras Negras, La Mar, Morales and others) (Baudez and Mathews 1978). Captives are depicted as small individuals compared to their vanquisher and are seated in a submissive position with their arms tied. At Palenque, it appears that the northern half of the palace was sectioned off as a political monument to display power and perform ritual as display for their acolytes (Baudez and Mathews 1978).

Human sacrifice is typically associated with birth and death (Mock 1998).

During the transition from foraging in small groups to larger domestic villages, sacrificed transitioned from autosacrifice to sacrificing others (Joyce 2010). However, the means of being sacrificed appear to be related to cardinal directions as well (Vail and Hernandez 2007). For example, decapitation and heart extraction are associated with north and south respectively (Duncan 2011; Vail and Hernandez 2007:149).

Other forms can manifest as spearing, axing, drowning, disemboweling, being stoned, and of course being mauled by a jaguar (Duncan 2011). The number of practices that has been recorded as sacrifice ritual suggest that ritual violence was very diverse, although it may be the case that the absence of osteological data supporting these acts are due to poor preservation in Mesoamerica.

Decapitation is the most common form of sacrifice depicted in codices and carved into reliefs in the northern lowlands (Vail and Hernandez 2007). Other scholars have noted the connection between decapitation and the ball game suggesting that individuals would pay the ultimate price if they lost (Miller 1999; Wilkerson 1984). Isolated crania have been recovered at Chichén Itzá (n=14) and the

Las Monjas complex (n=40) in association with other isolated long bones (Bolles 1977). Castro-Leal Espino (1972) and Chacon and Mendoza (2007) suggested that heads may have served the purpose of passing either to or from the underworld like portals.

Mass graves have also been found in cenotes and cave spaces. Cenotes and caves were regarded as sacred spaces as evident by dedicatory human offerings and ritual altars spaces (Brady and Colas 2005; Serafin and Peraza Lope 2007; Woodfill et al. 2012). Throughout the northern highlands, cenotes were used for mass interment (more than 10) of individuals that exhibit dismemberment and defleshing suggested by the high volume of cut marks on bones at Mayapán and Champoton (Hurtado Cen et al. 2007; Serafin and Peraza Lope 2007). Cave interment contexts typically featured small sized interments (fewer than 10) near altars, shrines, and domestic houses (Serafin and Peraza Lope 2007). The close proximity and grave goods would suggest that these burials are of family members. The social environment played a pivotal role in regards to sacrifice and dedicatory offerings.

4.4.3 *The Aztec*

Human sacrifice in Aztec society has been a contentious topic. Scholars initially attempted to explain sacrifice as a direct result of ecological crisis in the Valley of Mexico. Harner (1977) suggested that a growing population and reduced availability of wild game and domesticated animals resulted in nutritional deficiency. The suggestion is that in order to compensate for the depleting nutrition, individuals were sacrificed in order for the people to feast on their flesh. However, this theory is riddled with inconsistencies given that it would take an infinite number of people to continuously feed the Aztec Empire and nutritional deficiency would still result (Garn and Block 1970). Isotopic data would provide additional lines of evidence against the cannibal hypothesis given that human flesh has a high nitrogen range compared with lower level trophic animals.

Conrad and Demarest (1984) reject the cannibalism hypothesis but suggest that militarism was the driving force for sacrifice. Aztec religion was transformed into an imperial cult that was fueled by obtaining prisoners, fighting, and ultimately sacrificing to rejuvenate the sun (Conrad and Demarest 1984). Ritual warfare, titled

flowery war (Nahuatl: *xochiyaoyotl*/ Spanish: *guerra florida*) was organized at certain times and places among the Aztec, Texcoco, and Tlacopan (Tuerenhout 2005).

According to ethnohistorical documents, Cortez' captain Andres de Tapia asked Montezuma II why he practiced ritual warfare and did not take over the neighboring Texcoco peoples (Hicks 1979). Montezuma II responded by saying that the [Aztec] could if they wanted to but [the flowery wars] serve the purpose to train their soldiers and to obtain sacrifices (Hicks 1979). Human sacrifice was the main objective for the Aztec in order to preserve social cohesion of the Empire and to kept the deities fed.



Figure 5: Moche Sacrifice Ceremony (Borrowed from Donnan 1979)

4.5 Ritual Violence in the Andes

Arguments have been made for sacrifice in the Andes in various contexts from the Initial period (1800 B.C. - 900) to the Late Horizon (A.D. 1470-1532).

Iconographic depictions typically referenced mythological or metaphorical rhetoric, and in terms of sacrifice these depictions can reinforce that sacrifice had potentially occurred when skeletal evidence is sparse or absent (Proulx 2001). However, using iconography alone must be approached carefully because without the osteological data to reinforce these interpretations, it can only suggest that they may have happened.

4.5.1 Ritual Decapitation

Decapitation as a form of sacrifice has been noted in various cultural contexts and through iconographic depictions on ceramics and textiles there is evidence that the Cupisnique practiced decapitation (1500-1 B.C.) on the north coast as seen through bioarchaeological and ceramic assemblages that later influenced Moche society (Cordy-Collins 2001). Perhaps the most famous depiction of Moche sacrifice

is an image found at Sipán in the Lambayeque Valley dating to the Early or Early Middle Moche period (A.D. 50-300) (Cordy-Collins 1992; Bourget 2001). Scholars proposed that the sacrifice ceremony (Figure 6) and depiction of the feline and spider decapitator motifs suggested that these early ceremonies were violent (Alva 2001; Alva and Donnan 1993; Donnan and Castillo 1992). However, recent archaeological excavations at both Huaca del Sol and Huaca de la Luna located at Cerro Blanco in the Moche Valley have discovered atypical sacrificial remains in funerary contexts (Sutter and Cortez, 2005; Verano 2001). Verano's (2008) osteological analysis suggests that the individuals that were left at Huaca de la Luna were brutally sacrificed. Verano notes sharp force trauma on the anterior aspect of the cervical vertebrae and blunt force trauma to the posterior neurocranium.

In the Nasca region of southern Peru, researchers have identified 'partial burials' in which body parts, typically the head, would be missing from an individual and would be replaced with a ceramic jar (DeLeonardis 2000). Browne et al.'s (1993) research has suggested that these heads would be cached together with holes through the frontal bone left in situ. Conlee (2009) interprets these caches as

evidence of headhunting that became popular towards terminal Nasca. The interpretations of these heads have noted possible conflict between individuals who were then sacrificed and then used as trophy heads (Forgey 2005; Knudson et al. 2009). However, it should be noted that there is a debate of whether isolated crania are trophy heads of fallen warriors or were they revered ancestors from the community (Forgey 2005). Conlee (2009) has also suggested that individuals would be sacrificially decapitated for agricultural prosperity and in the coming seasons and reinforce the dichotomy of life and death.

In some cases, the heads from decapitated individuals would be ritually transformed into trophy heads for display. This cultural practice is typical in the Nasca controlled areas and perhaps permeated into the Wari Empire, as is suggested by some Wari iconography (Cook 1994; Proulx 2001). Tung and Knudson (2010) argue that the children recovered from ritual spaces at Conchopata in the Wari heartland were taken from distant lands and then sacrificed. Two of the nine children were local to the area based on strontium isotopes and sacrificed as well, suggesting that both local and non-local children were ritually killed and

transformed into trophy heads. Knudson et al. (2009) found that Nasca individuals that were transformed into trophy heads did not differ in isotopic signatures from those interred in typical burials. This contrast between Wari and Nasca trophy heads is relevant to debates about whether the recovered crania were transformed into trophy heads (Forgey 2005).

In some ritual spaces on the north coast of Peru, decapitation was accompanied by body mutilation in. Klaus (2010; 2014) and Klaus et al. (2016) demonstrate that the local Muchik ethnic group elaborated on the earlier Moche style of sacrifice involving neck and chest mutilation. Their interpretation is due to the high volume of cut marks on the cervical vertebrae (C1-C2 for children and C2-C6 in older individuals), sternum, ribs, clavicle. *Templo de la Piedra Sagrada* (Temple of the Sacred Stone) At Túcume shows the majority of human skeletal remains (~94%) displayed perimortem sharp force trauma to the upper thorax and neck (Toyne 2016). This is consistent with throats being slit, heads removed, and chest cavities cut open. These are not mutually exclusive as individuals could exhibit a combination of these practices as well (Toyne 2011). This sacrifice complex is

comprised of a ritual ceremony platform that favored taking blood, the heart, and decapitating the head that may have commonalities with the sacrifice event at Huaca de los Sacrificios. Due to the high volume of sacrificed individuals (n=110), it seems that this ritual was performed on a frequent and regular basis and may have been timed to certain calendrical events (Toyne 2008; 2015; 2016). Overall, given the biological stress due to the higher levels of cribra orbitalia and porotic hyperostosis coupled with the dental diseases in the local population, it seems that the individuals that were chosen to be sacrificed tend to be of lower status (Klaus et al., 2016; Toyne 2016).

4.5.2 Inka Capacocha

The Inka Empire was widely documented by many Spanish chroniclers and these accounts include descriptions of sacrifice (Betanzos 1551; Sarmiento de Gamboa 1999 [1572], Poma De Ayala (1987 [1615])). Given the ethnohistorical documentation and Guaman Poma de Ayala's depictions of the Inka capacocha (also spelt *Qhapaq Kucha* and is translated to 'solemn sacrifice') ritual, child sacrifice

is typically associated with the Inka bioarchaeological studies have corroborated these practices by recovering sacrificed beautiful and unblemished children on high Andean mountaintops as offerings to the mountain deity (called *apus*) (Besom 2011; Ceruti 2004; Reinhard 2005). Sacrifice events typically occurred to mark important and significant imperial events, for example the death of a royal Inka, an Inka ascending to rule or successful military campaign and incorporation to the Empire (Betanzos 1551; Sarmiento de Gamboa 1999 [1572]). Capacocha rituals were also performed in response to environmental catastrophes such as earthquakes, droughts, or volcanic eruptions (Cobo 1979 [1653]). Rowe (1982) argued that the boys and girls that were selected from around the Inka Empire were important to processes of unifying incorporated lands.

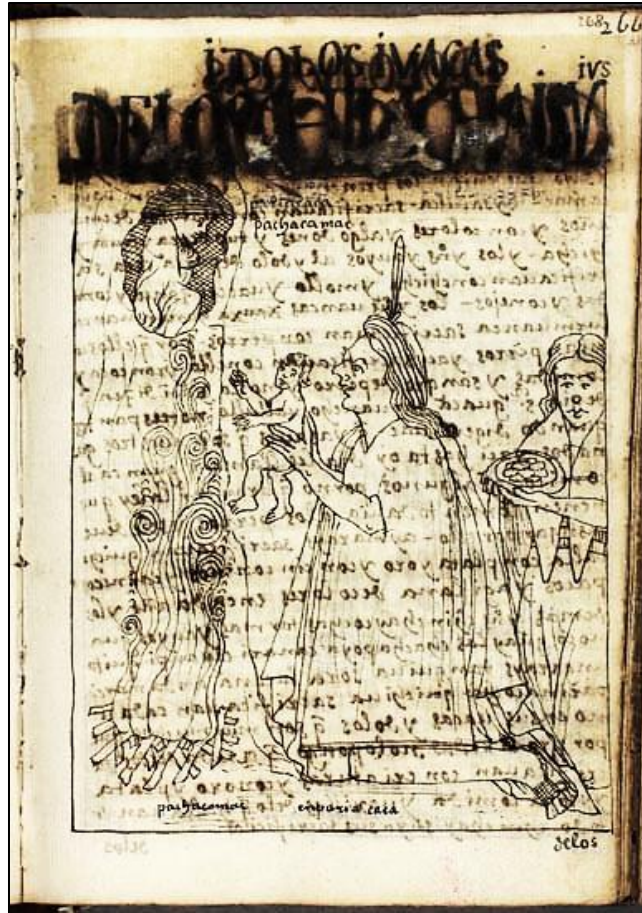


Figure 6: Depiction of the Inka Capacocha Ceremony at Pachacamac (Poma de Ayala 1987 [1615]).

Reinhard (1996; 2005) uncovered a frozen Inka child mummy, popularly called "Juanita", at the summit of Cerro Ampato in the Colca Canyon. This Inka mummy was wrapped in an Inka style dress and shawl held together by a *tupu* (shawl pin), Inka ceramics, and coca (Reinhard 1996). Blunt force trauma to the back of the cranium suggests that a blow to the right side of her head contributed to her death. Additionally, Reinhard (1999; 2005) uncovered three child mummies on Cerro

Llullaillaco in northwestern Argentina deposited with similar artifacts to "Juanita" but also doll figurines dressed as the sacrificed individuals were. These children did not display any blunt force trauma on their crania and were left without harm making possible cause of death impossible (Previgliano et al. 2003). Recent data also suggest that this Inka capacocha model is neither mutually exclusive to mountaintops nor restricted to individuals deemed 'adult.' As Andrushko (2011) suggests, capacocha can possibly be detected in other contexts with interments with an association to luxury grave goods similar to capacocha offerings found on mountaintops (Andrushko et al. 2008; Andrushko 2011; Bray 2009; Gibaja et al. 2005). Since these findings, Inka capacocha has been expanded allowing for the discovery of additional capacochas outside highland and high-altitude contexts as such on La Plata, the island off of Ecuador (Bray 2009).

4.5.3 Non-Human Sacrifice

Llama sacrifice has been well documented in funerary contexts across the Andes during prehispanic and colonial eras and in dedicatory offerings for structures

(Andrushko 2011; Bauer 1996; Ceruti 2004; Gose 1986; Reinhard and Ceruti 2005; Wheeler 1995; Wilson 2007). Animal deaths cross-culturally are typically highly ritualized whether it is peoples hunting for foodstuff as shown in zooarchaeological assemblages in domestic structures and in the burial environment surrounding the grave (Szpak et al. 2016). Burials with human and animal remains can be interpreted as the animal being an offering that is needed inside the grave for life after death. The absence of butchering on the bones recovered in ritual spaces can provide additional lines of evidence for how animals were used in ritual during death, the construction of domestic structures, and other potential uses that may never be adequately understood (Goepfert 2012; Losey et al. 2013; Lucas and McGovern 2007; Wheeler 1995; Yuan and Flad 2005).



Figure 7: Llama sacrifice ceremony at pachacamac (Poma de Ayala 1987 [1615], Left)
 Figure 8: Colonial era llama sacrifice according to the ancient laws of idolatry (Poma de Ayala 1987 [1615], Right)

Szpak et al. (2016) suggest that at Huanacaco, the Inka may have raised llamas that were intended for sacrifice differently than those for transportation of goods and husbandry. However, the isotopic data do not suggest any significant variation between sacrificed and buried llamas, and only indicate small differences between the Delta ^{13}C and Delta ^{15}N signatures. However, the authors suggest that the llamas were raised on the coast and not in the highlands (Szpak et al. 2016).

Typically, investigations of sacrifice and ritual violence focus on animate beings. This loses sight of the fact that inanimate objects can also be sacrificed, or terminated, and intentionally buried. Millaire (2016) investigated two smashed ceramic assemblages that were destroyed in situ and then buried at Huaca Santa Clara in the Virú Valley. The first pot sherd assemblage resembled Moche-like ceramics in decoration but is atypical in the Virú ceramic tradition and possibly represents local attempts to recreate Moche ceramics (Millaire 2016). The second set of pot sherds were stylistically Virú but the raw materials used in their construction suggest that they were imported from over 100 kilometers outside the valley.

4.6 Summary

This chapter reviews current theories and methods around ritual violence and understanding sacrifice. The diversity of sacrificial contexts speaks volumes to the overall function of the ritual killing of people, animals, and inanimate objects both in ethnographic and ethnohistorical data, and bioarchaeological assemblages. These accounts introduced the concept of corporeal punishment and the influence of

politics in which the ruling class legitimize and reproduce their authority while subjugating it through religious practice. The accounts from Mesoamerica and the Andes allows us to draw parallels between sacrifice events as well. A comprehensive review of ritual violence at a global scale contributes to the theoretical paradigms of interpreting sacrifice in antiquity and the potential to yield new interpretations and questions.

5 Methods and Theories in the Bioarchaeology of Stress

The WHO's definition of health envisions a "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" and has not been altered since 1948 (World Health Organization, 2006). Reitsema and McIlvaine (2014:182) state that physiological stress markers to measure health in past populations are that self-perceptions of health and quality of life may not track well with a person's physiological state. Their rationale is that the WHO model of

stress and health is potentially inappropriate for assessing perceived stress due to the fact that the self-perceptions are not always consistent.

Temple and Goodman (2014:190) suggest that while considering 'health' and 'stress' in bioarchaeology, attention needs to be focused on the imperfect relationship between skeletal indicators of stress and population health. It is imperative to understand the context of stress because it can mean different things in various circumstances and contexts. However, integrating methods and theories from human biology and primatology into bioarchaeological research will begin to alleviate the gap between health and stress studies (Temple and Goodman 2014). In essence, the absence of skeletal lesions does not denote the 'health' of the individual or population.

In archaeological samples where macroscopic markers of stress are the only measurements available, they can be problematic with assessing the health of the community. Various types of stressors that affect the body result in lytic lesions and atypical bone, however, many are otherwise invisible and do not manifest on bone.

The following segments of this paper provide a concise definition of stress and

outline pathological lesions and nuanced methods to investigate different types of stress and their relationship to social inequity and structural violence.

5.1 Operational Definitions of Stress

Defining stress is no easy task to do because stress can manifest in different ways. To do this, examining the historical definitions of stress in bioarchaeology will lay the foundation for this study while also incorporating recent studies. Huss-Ashmore et al. (1982:396) defined stress as the physiological disruption of an organism resulting from environmental perturbation. The degree of physiological disruption is a function of both the severity of environmental stressors and the adequacy of host response. Goodman et al. (1984:16) defined stress as the result of environmental constraints, cultural systems, and host resistance factors. When the environmental constraints and host resistance factors stay relatively constant, cultural factors will attribute to the raise of stress; in return this can also reshape or reconfigure cultural patterns as a way to dissuade continued stressors and disease prevalence.

Larsen (2003:7; also see Larsen 2015) defined stress as the physiological disruption of homeostasis resulting from impoverished environmental conditions. Sapolsky (2004:393) defines a stressor as any physical or psychological factor that perturbs or threatens to perturb homeostasis, and stress is the state of homeostatic imbalance. In order to reestablish a homeostatic balance, the body constitutes a stress-response of hormones. Together, these definitions comprised together created the definition for stress in Webb et al. (2010) research for archaeological population using hair to interpret stress.

Webb et al. (2010:807) define stress as a physiological disruption caused by real or subjective threats, which perturb an individual's physical or psychological state and may be single or combined physical, physiological, and psychological conditions. definition allows for various disciplines Inferring that people's stress levels are heightened and cortisol levels are spiked closure to death, by comparing the proximal mean segment to the distal mean segment can act as a comparison following Van Uum et al. (2008) model for chronically stressed and healthy individuals (Webb et al. 2010).

Each definition states that the body returns to homeostatic balance suggesting that there is an optimal range of "normal" physiological states. Hans Selye (1957; 1974; 1976) introduced the term 'allostasis' which encompasses the constant flux of optimal points and idiosyncrasies of typical stress levels which respond to three interlinked levels of the hypothalamic-pituitary-adrenal (HPA) axis. From Selye's research, revolutionized the concept of stress and introduced a different model to examine the physiological adaptive processes. Maintaining physiological balance from stress is essential to health where deviation from typical cortisol levels result in spiked levels to compensate (Schilkin 2003).

Combining the definitions of stress from Larsen (2015) and Sapolsky (2004) in Webb et al.'s (2010) definition produces a concise and comprehensible definition of understanding stress meaning that any perceived threat will cause homeostatic imbalance and enact a stress response; this definition allows for various disciplines to utilize in research as well. Essentially, at any given time, an individual is under some sort of stress that affects how they function and carry themselves throughout the day depending on the given stressor. It may manifest within an individual,

resulting in being written on to the body from various etiologies. However, this working definition is entirely too broad to be useful to explicitly diagnose causal factors.

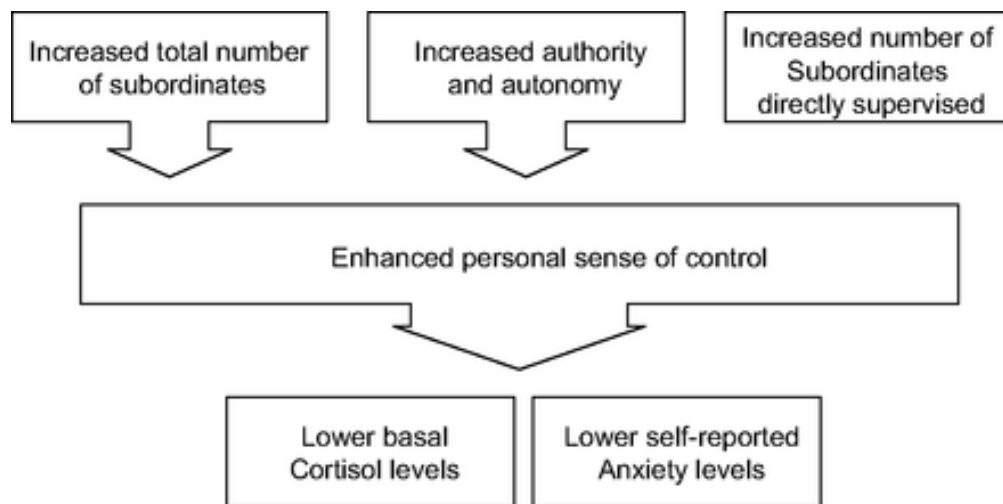
Stress can manifest in different ways and varies from person to person as noted by the definitions mentioned above. This thesis explores the common ways to interpret stress in the archaeological record from human remains. Over a period of time, stress can become internalized and imprinted onto the body. This manifests many biomarkers of arrested growth on or point-stop periods of stressful periods in an individual's life that can be measured within the time frame of the developmental period (Robert and Hockey 1997). In some cases, the morphological syndrome may have different causal factors that manifest the same condition (i.e., porotic hyperostosis). Sapolsky (2012) also suggests that the level of control an individual has in their life can attribute to decreased levels of cortisol and anxiety profiles (Figure 4). Additionally, by examining the social setting, which is affected by social, political, and environmental factors can be internalized and provide differential diagnosis for the osteological data (Fuller et al. 1980; Marmot et al. 1991).

5.2 Nutritional Stress

Nutritional stress impacts the body in different ways during an individual's life.

The type of food an individual eats play an important role in the development of the body and person as a whole. In living populations, it is easier to remedy these

Figure 10: Increased personal sense of control can lead to lower levels of cortisol and lower anxiety profile (Sapolsky 2012).



situations with readily available supplements, vitamins, or introducing variation to

the diet (Schemehorn et al. 2007). However, this is not the case for archaeological

samples where access to food can be scarce, and there is ongoing internal or

external warfare and conflict, or if certain types of foods are the only available

resources. This short list of confounders for nutritional stress potentially characterizes

everyday life in the Prehispanic Andes during the Late Intermediate Period (A.D.

1100-1470) and Late Horizon (A.D. 1470-1532), depending on regional context. This translates to developmental dental disruptions from the time in utero till remodeling phases of skeletal elements later in life (Barnes and Manchester 2003). It is important to interpret nutritional status in the pre-Hispanic Andes in the context of established regional and long-distance trade networks.

5.2.1 Stature

Stature is considered a complex trait that has a heritability between 0.2 and 0.6 (Mielke et al. 2011:269), is polygenic in expression, and is highly malleable to environmental influences. An individual's genetic makeup mediates their potential stature maximum (Steckel and Rose 1995), but diet and the lived environment play important roles in attained height. Steckel and Rose (1995) note that comparing populations that are genetically similar and dissimilar in various environments indicates that height differences are attributed to the lived environment. There is a strong association between the lived environment, nutritional status of an individual, and the susceptibility to disease can be enhanced by poor nutrition, depressed

immune systems or being immunocompromised, and poor absorption of nutrients (Roberts and Manchester 2003:39).

Reduced stature occurs when the body is under nutritional stress or overall poor health during development and growth during childhood, which can lead to growth stunting (Nickens 1976). Once these conditions have begun to be remedied, periods of 'catch-up' growth can occur where the increase in growth rate following the suppression period in older subadults (Bogin 1988). The energy needed to recover and 'catch-up' from these periods of stunted growth are significant and are considerably larger than the necessary expenditure (Stinson 2000). In valleys that have poor nutrition, as evident by dental diseases, these individuals are unable to achieve the necessary level of energy to recover and remained stunted (Eveleth and Tanner 1990).

Subadult growth is a more sensitive measure of changes in health and nutritional status than adult arrested growth (Roberts and Manchester 2003). The variation in subadults tend to be more immediate causes, like nutrition, whereas in adults it more attributed to chronic conditions over a period of time (Goodman and

Martin 2002). Lewis (2002) found that with the increase of urbanization and industrialization led to the increase of the morbidity and mortality of subadults in Post-Medieval England.

5.2.2 Vitamin Deficiencies

Vitamin deficiencies also inexorably tied to diet and the nutritional status of individuals. Commonly-diagnosed micronutrient deficiencies in the skeletal record include chronic insufficiency of Vitamins B₁₂ and B₆, C, D, iron, and calcium, though there are numerous others (Ortner 2003). Vitamin C is found in fresh fruit and uncooked vegetables that were staples of ancient populations (Roberts and Manchester 2003). Shifts to agriculture reduced the availability of vitamin C from fresh foods due to prolonged storage and loss during cooking, both common in settled communities and growing populations (Roberts and Manchester 2003).

Vitamins are necessary to combat infections and aid in the absorption of iron, an essential vitamin for normal development of body tissues. Vitamin A deficiency can be exacerbated due to iron deficiencies and alcohol consumption and induce

diarrheal disease and other susceptible diseases (Holick 2007; Leo and Lieber 1982; Scrimshaw et al. 1968). Porotic hyperostosis is multifactorial and will be discussed in the following section, but one set of factors appears micronutrient-related. Originally thought to be an iron (Fe) deficiency (Armelagos et al. 1984), now it is regarded as megaloblastic anemia from B₁₂-vitamin deficiency (Walker et al. 2009). The deficiency of vitamin C also predisposes the individual to internal bleeding in soft tissues and in the periosteum (membrane that surrounds the bone) (Klaus, 2014; Ortner and Ericksen 1997). The clinical manifestation of Vitamin C deficiency is called scurvy, and is still prevalent in infants that consume boiled milk and the elderly who seldom consume fresh fruits and vegetables (Elia 2002).

Osteopenia is related to calcium (Ca) deficiency by either a diet that lacks sufficient calcium or the metabolic bone mining process of excessive fecundity in women (White and Armelagos 1997). Rickets are due to vitamin D deficiency due to infant diet that is absent in the breast milk or insufficient endogenous vitamins D due to sun exposure. Inhabited vitamin D through diet or exposure can result in depleted calcium and phosphate levels, of which facilitate bone mineralization, and

result in other diseases such as severe osteomalacia or celiac disease (Elidrissy 2016).

These are not mutually exclusive as both are possible pathways for the disease.

5.2.3 Dental Caries

Teeth and bone are similar in respect that they both are composed of calcium, phosphorus, and other minerals, but what sets them apart is that teeth lack collagen (White et al. 2011). Developmental stages of teeth can be comprised of two gross stages, the formation of the crown and roots and the eruption of the tooth (Al Qahtani et al. 2010; Scott and Turner 2000). Teeth begin to develop in the alveolar bone of the mandible and maxilla and erupt primarily during early childhood and a final dentition set in adulthood. Teeth are the most susceptible to physiological perturbations (for example stressors) during amelogenesis causing developmental point stops on enamel (Goodman et al. 1990). While tooth morphology and eruption schedules are generally under a very strong degree of genetic control, disruptions to the social and nutritional environment of the individual and the intrauterine environment can disrupt ameloblast far easier.

Teeth are the only part of the skeleton that is exposed to the environment as they are used as tools to bite, shred, and crush food. Over time, lesions can develop on the occlusal surfaces continue to the pulp cavity and potentially become infected if left untreated and can result in death (Lukacs 2008). The etiology of cariogenic lesions stems from the fermentation of dietary sugars by acidogenic bacteria that exist within the oral biofilm that covers tooth surfaces and progressively demineralize the calcified matrix in a focal manner (Cucina et al. 2011; Larsen 1983; Walker and Erlandson 1986). The dental destruction itself is not a sign of stress, however it can provide insight to stress and how the body responds at the molecular level.

5.2.4 Dental Calculus

Examining the dental calculus can provide further insights into nutritional status and related health outcomes. Dental calculus is the accumulation of microorganisms that sit on the teeth and the proteins from saliva that foster a desirable environment for plaque to form (Lieverse 1999). The calcified plaque left on teeth can accumulate

faster when the alkaline environment inside the mouth favors a high protein or carbohydrate diet (Roberts and Manchester 2003). Ubelaker and Stothert (2006) found that coca chewing from an Ecuadorian sample, a common practice in the Andes (see Allen 1981), which elevates the alkaline environment within the mouth does not appear to correlate with the prevalence of calculus. However, Aufderheide (2003) and Indriati and Buikstra (2001) from Peruvian samples found that other diseases such as periodontitis, cervical root caries, and antemortem tooth loss are correlated with coca usage. These conflicting findings may be due to the geographical variation of each sample, access to food and subsistence patterns, and overall environmental conditions. Macroscopically, calculus is characteristically seen as calcified masses or distinctly discolored lines around the cemento-enamel junction (CEJ) and comprised of two types; supragingival and subgingival calculus. However, the differentiation of the two have been less explored and commonly scored as the same in archaeological settings. More nuanced methods through isotopic analysis can provide a better understanding of paleodiet from dental calculus and will be discussed later (Scott and Poulson 2012).

5.3 Non-Specific Systemic Stress

5.3.1 *Linear Enamel Hypoplasias*

Linear enamel hypoplasia (LEH) are deficiencies in the mineralization of enamel matrix that can manifest during the development of a tooth crown (King et al., 2005). These growth arrest lines that appear on the teeth reflect when the individual was under relatively acute subadult metabolic stress. However, the aetiology of LEHs defects can be multifactorial in origin. For example, genetics, trauma, and systemic metabolic stress as in the case of nutritional deficiency or childhood illness (in essence, leishmaniasis or Chagas Disease) can cause these defects (Hilson 1986; Marsteller et al. 2011; Roberts and Manchester 2003). For these reasons, the context of the culture or time period along with other lines of evidence to provide adequate differential diagnoses must be taken into account.

Research shows that these developmental periods coincide with stress denoting that an individual had inadequate nutrition at specific ages (i.e., during the second year of life (Goodman et al. 1990a, Goodman and Song 1999; Mays et al.

1993). Goodman et al. (1990b) investigated LEH in a Nahuatl community by supplementing one group with vitamins and had another group as a control. Their result show that the anterior maxillary teeth were notably less in the supplemented group compared to the control group (Goodman et al. 1990b). In clinical settings, children that consume a higher nutritional quality from their diet are more likely to demonstrate a lower prevalence of LEH and the inverse for populations that do not have access to these types of food (Goodman and Rose 1991). These lines suggest that these arrest lines were periods where individuals were not obtaining sufficient nutrition resulting in defect during development.

5.3.2 Harris Lines

Harris Lines are dense, opaque transverse lines manifest radiographically on long bones (e.g., tibiae, femora, and radii specifically) likely representing some kind of expression of arrested growth due to nutritional deficiency or childhood disease during development (Roberts and Manchester 2003; Waldron 2008). While some studies suggest that there is no association with Harris lines and illness

(Papageorgopoulou et al., 2011), other studies have demonstrated that the lines are associated with rapid growth with the absence of nutritional stress and adequate diet (Alfonso-Durruty 2011). For these lines to appear on long bones, the individual would have to recover from the stress period, and like gross dental enamel defects, that these lines are markers of recovery from disrupted physiology as opposed to deterioration in health. The contour line thickness ranges from one millimeter to one centimeter, while thicker lines suggest a rapid growth period (Dreizen et al., 1964; Garn et al., 1968; Larsen 2015). Unlike LEHs, these lines are seen only in radiographs that visualize the associated variations in bone density that otherwise are invisible. While exploring Harris lines presents a possible means to interpret stress in archaeological samples, it has only recently become feasible to measure these in field settings using handheld X-ray machines.

5.3.3 Porotic Hyperostosis

Porotic hyperostosis and cribra orbitalia are related metabolic disorders and are defined as the porous appearance localized to the cranial vault and eye orbits

respectively. This condition and has been of interest to many researchers due to the pathogenesis of subadult metabolic stress (Walker et al. 2009). Radiographically, they create a hair-on-end appearance for clinical diagnosis of iron deficiency (Ortner, 2003). This disease appears in the archaeological record and has been interpreted as signs of malnutrition caused by diets lacking in sufficient bioavailable iron. Despite early research explicitly pointing to this causal factor, recent research has refined this approach and argues that many causal factors can, which includes dietary deficiencies to cultural modifications, can manifests porous lesions on the cranium and orbits (Gadison 2015; Stuart-Macadam 1992; Walker et al. 2009).

Porotic hyperostosis lesions have been associated with nutritional deficiency (Stini 1969) and/or dietary restrictions (Chu et al. 2006; Stuart-Macadam 1998). Blom et al. (2005) suggest that the presence of local and regional pathogens from Moquegua, Peru such as tuberculosis are directly affected by population crowding and other non-dietary factors contribute to the overall pathogen load. Klaus and Tam's (2009:365) findings echo similar local and regional roles of parasites on the north coast. They suggest that post-contact Mórrope displayed in increase in stress

via Spanish economic endeavors, population nucleation, and resettlement into a marginal microenvironment. The dynamic microenvironments on the north and south coasts reinforce that many factors can influence stress responses in populations at both the local and population level. Other attempts to advance a differential diagnosis through destructive histological analysis has also been recommended (Klaus 2015; Schultz 2001; Wapler et al. 2004).

5.4 Infectious Disease

In the late nineteenth century, improvements in hygiene and sanitation as well as the development of antibiotics and vaccinations in the western world led to a decline in mortality from infectious diseases (Colgrove 2002). However, factors such as population migrations, anti-vaccination movements, and overuse of antibiotics allowed for old infectious diseases to re-emerge and new kinds of infections to develop (Blaser 2014). The rise and fall of emerging infectious diseases are affected by social inequalities today (Farmer 1996) and may be linked to some patterns of disease in the past (Klaus 2012). Factors that affect the pathogenesis of infectious

diseases include, but are not limited to, poverty which leads to poor diets and immune suppression, travel and migration into and out of new areas where the pathogen had yet to be exposed, and climate change that allows for pathogens to thrive in warmer climates.

5.4.1 Osteomyelitis

Osteomyelitis is a sign of widespread bacterial infection characterized by reactive bone formation, bone destruction, and formation of cloaca for pus drainage. The bone destruction manifests pitting and irregularity on the bone surface while subsequently forming a pustulosis cavity within the bone interior (Roberts and Manchester 2003). The pathogenic microorganisms are spread throughout the long bone and in turn produces satellite abscesses that can communicate to one another and remain localized. These manifest within the bone interior and will remain undetected unless radiography or bone sectioning is used. The bone remodeling process is the new foundation and development of plaque on the bone surface.

Bone forming cells called osteoblasts are produced in the innermost layer of the periosteum and creates new woven (immature) bone. The complementary action of absorptive cells, osteoclasts, and osteoblasts develop together to make the woven bone become compact (mature) bone. For these pathological conditions to arise, the bacteria must be transported by the bloodstream from an infected area, most likely originating from the respiratory and plural systems (Roberts and Manchester 2003).

Ortner (2003) reports that the bacterium *Staphylococcus aureus* (commonly called 'staph' or methicillin-resistant strain, MRSA) is responsible for about 90% of clinical osteomyelitis. These bacterial infections will spread to distant organs and other bones; you adults tend to only have one bone affected during secondary infection while adults would have multiple (Ortner 2003). Children between the ages of 3 and 12 when bone growth is most active for pathogenesis (Aufderheide and Rodriguez-Martin 1998; Jaffe 1972), though individuals of all ages can succumb to the disease. The interaction between nutrition, immunity, and infection have a synergistic, antagonistic, and cyclical interactions between malnutrition and infection

(Katona and Katona-Apte 2008); meaning that these linked relationships have a negative effect on the bodily systems.

5.4.2 Perisotosis

Perisotosis is the inflammation of the periosteum, or the membrane that covers the outer layer of the bone, and not part of osteomyelitis reactions (Klaus, 2014 AJPA; Waldron 2008). The inflammatory process manifests as pitting, longitudinal striation, and plaque-like formation on the original cortical surface (Roberts and Manchester 2003). The most common affected area is the anterior surface of the tibiae probably due to the closeness to skin surface, however Resnick and Niwayama (2002) note that infection or trauma are causal factors. Schultz et al. (2001) suggest that histological analysis can specifically detail whether infection or trauma is the main pathway for pathogenesis. Other reasoning for this reaction is that the anterior tibial surface is physiologically inactive which allows for bacteria to colonization (Steinbock 1976). Goodman et al. (1988) suggest that periosteal reactions are indicators of visible stress in the skeletal record.

5.4.3 *Treponemal Disease*

Treponematoses are characterized by four disease syndromes: venereal syphilis (*Treponema pallidum* ssp. *pallidum*), bejel syphilis (endemic nonvenereal) (*T. pallidum* edemicum), yaws (*T. pallidum pertunue*), and pinta (*T. carateum*), which all except pinta do not result in a bone response (Mandell et al. 1990; Ortner and Putschar 1986). These spirochete bacterial pathogens express similar symptoms which make it difficult to distinguish them from one another. The origins of syphilis have been a highly debated topic among bioarchaeologists (Harper et al. 2008a, b, Hudson 1963; Ortner et al. 1992); regardless of their evolutionary origins, treponemal infections have had significant impacts on human societies for millennia, visible in both non-specific and highly diagnostic skeletal lesions. Treponemal infections are contracted by two vectors of transmission: skin contact from an infected person or mucous membranes during sexual contact. Bejel and Yaws are transmitted by nongenital lesions on the arms, legs, and abdomen through nonsexual physical contact (Larsen 2015). Venereal syphilis is transmitted through genital lesions during sexual contact. In all three cases, they are passed through the circulatory system

which allows for multiple soft and hard tissue involvement. Venereal syphilis can be passed from mother to child through the placenta during pregnancy which manifests as congenital syphilis and results in distinctive skeletal changes such as osteochondrosis (poor bone formation of endochondral ossification areas), perisotosis, osteomyelitis, as well as malformations of the incisors (Larsen 2015; Waldron 2008). In clinical populations, there are three stages that characterize the progression of disease (Hackett 2013); however, in archaeological populations the tertiary state, or the most progressive stage is visible in lytic and gummatous manifestations on bones such as 'saber shins' and caries sicca, with varying skeletal element involvement (Larsen 2015) (Larsen 2002).

5.4.4 Parasitism

Mitchell (2013) notes that there are two types of pathogenic parasitism in disease processes: heirloom and souvenir parasites. Heirloom parasites are parasites that have coevolved and infected humans often to the point of symbiosis, while souvenir parasites are parasites that have been picked up as environmental

conditions or the parasite itself had been mutating and evolving over evolutionary time which allows for them to infect humans. Many parasites do not have any skeletal involvement, meaning that an infected individual's skeleton could appear otherwise healthy; this is the case with Chagas' disease (American trypanosomiasis – *Trypanosoma cruzi*) and others.

Aufderheide et al. (2004) report that the soft tissue samples from mummies from southern Peru contained *Trypanosoma cruzi* (or Chagas' disease), and sequenced the genome for the parasite to investigate the pathogenesis of this disease. The transmission of *T. cruzi* is dependent on the insect vector to infest the wild animals' nest or residence. This provides an opportunity for the insect to then infect animals and transmit the infectious agent (Aufderheide et al. 2004).

Aufderheide et al. (2004) study shows that about 41% of the archaeological samples from Ilo, Peru to Antofagasta, Chile demonstrated a positive reaction (hybridization) for *T. cruzi*. Gonçalves et al. (2003) examined coprolites to find parasite eggs and investigate human dispersion in the past through parasite prevalence. This method for investigating pathogens should be taken with caution as it is difficult to

differentiate between true and false parasitism when using only stomach or fecal matter (Gonçalves et al. 2003).

Marsteller et al. (2011) examined macroscopic lesions of mucocutaneous leishmaniasis and radiogenic strontium isotopes of individuals from San Pedro de Atacama cemeteries. Costa Junquiera et al. (2009) sequenced the ancient DNA sequence from the pathological tissue and demonstrated the presence of *Leishmania dovani* species. This research combined both the archaeological, ethnohistoric, and ethnographic data to investigate contemporary stigma of leishmaniasis and how that may have influenced burials and lived experience at San Pedro de Atacama. However, the cautionary note from Gonçalves et al. (2003) predates the work of Marsteller et al. (2011), false parasitism is not accounted for the *L. dovani* disease transmission in antiquity.

5.5 Biomechanical Stress

5.5.1 Degenerative joint disease

Occupational stress occurs when an individual experiences excessive mechanical loading on articular joints of which the activity becomes physiologically imbalanced, and result in one or more of the many manifestations of degenerative joint disease. Osteoarthritis and osteoarthrosis have become interchangeable in usage, despite the former implying an inflammatory response (which is not the primary response) and researchers have suggested using other terms such as 'degenerative joint disease' (Hough 1993). However, there are criticisms for using the latter term (Dieppe 1987), and contemporary clinical research suggest that the inflammatory response is inherently diagnostic and crucial to the pathogenesis of osteoarthritis (Punzi et al. 2005). For the purpose of this thesis, the broader term degenerative joint disease (DJD) is used to characterize the destruction of the protective joint cartilage and underlying bone.

Chronic mechanical stress will begin to deteriorate the articular joint cartilage on the surface and margins of the bone and be aetiologically variant (Rogers and Waldron 1995). Clinical studies suggest that there is a greater prevalence of degenerative joint disease in the load-bearing joints of obese individuals, especially females (Spector et al. 1994), and highlighted on their weight-bearing joints that have experienced considerable mechanical stress (Salih and Sutton 2013; Weiss and Jurmain 2006; Weiss et al. 2007).

Older clinical studies suggest that women have a higher incidence and prevalence than men in individuals older in age in twentieth century United States and Great Britain (Jurmain 1977; Kellgren et al. 1963; Roberts and Burch 1966). These studies suggest that there is hormonal influence in the development of degenerative joint disease. Other factors that may be contributing to pathogenesis may be an individual's metabolism, nutritional status, bone density, infection and trauma, and heritable influence (Davidson and Clark 2015; Delco et al. 2016; Ortner and Putschar 1986; Rogers and Waldron 1995).

The connection between physical labor and degenerative joint disease are complicated because they are not often directly associated with pathogenesis (though see Klaus et al. 2009). Though the destruction of the joint surfaces through mechanical stress suggest that the individual had degenerative joint disease, the type of labor may not increase the severity of the disease. Waldron (1994:94) notes that manual laborers had no more nor less osteoarthritic lesions which contradicts epidemiological literature leading to say that there is no 'convincing evidence of a *consistent* relationship between a particular occupation and a particular form of degenerative joint disease'. Although these skeletal changes can infer behavioral characteristics that may be consistent with labor, identification of specific activities or potential occupation almost always impossible (Larsen 2015).

The pathophysiology of degenerative joint disease in regards to the hyaline cartilage around the joint surfaces and bone changes is still unclear. Radin (1982) argued that the changes, fibrillations, or tearing in the cartilage precede bony responses while others argue that minute changes in the subchondral bone precede cartilaginous change (Felson 2004). The precise order of events that transpire to

result in bony responses is immaterial for archaeological samples given that the responses arise from degenerative joint disease, including proliferative exophytic growth of new bone known as osteophytes or 'lipping' appearance on articular facets (Larsen 2015). Osteophytes can vary in appearance and form from fine, bristle-like protrusions to massive projections. Spinal degenerative joint disease tends to have the marginal osteophytes link creating a bridge, or ankylosing, between two or more vertebrae (Rogers et al. 1987). In other cases, where the cartilage on the joint disintegrated completely, the articular surface of the bone appears to be polished, produced from bone-on-bone friction. This condition is called eburnation where the polished appearance indicates that the joint was still actively used at time of death (Hough and Sokoloff 1989; Rogers et al. 1987; Molnar 2011).

5.6 Biogeochemistry and Stress Studies

5.6.1 Stable Isotopes

Beginning in the 1970s, biogeochemistry and isotopic analysis of human remains have increasingly been employed to understand diet and migration in

archaeological populations (Katzenberg 2000; Wilson et al. 2007; Tykot et al. 2009; Gil et al. 2011; Turner et al. 2013). Light isotopes involve the analysis of stable carbon (^{13}C), nitrogen (^{15}N), oxygen (^{18}O), and sulfur (^{34}S). Heavy isotopes are comprised of radiogenic (unstable) lead (^{210}Pb) and strontium (^{87}Sr) (Pollard and Heron 2008; Pollard 2009). Recently, Kellner and Schoeninger (2008) have demonstrated that $\delta^{13}\text{C}_{\text{apitite}}$ and $\delta^{13}\text{C}_{\text{collagen}}$ provide the most accurate reconstruction for paleodietary analysis. Isotopic ratios of carbon from carbonate from the hydroxyapatite draws from all aspects of the individual's diet, including terrestrial and marine-based foods (Turner et al. 2013), and has been seen to affect sulfur composition in the body. This augments variation in isotope signatures for different geographical areas and ecosystems (Richards et al. 2003; Craig et al. 2006). Nitrogen signatures reflect the types of proteins the individual is incorporating to the diet and consuming (animal or plants as opposed to marine-derived proteins) (Petzke et al. 2005). This allows for a trophic-level effect to occur allowing an ecosystem association in regards to protein type (Ambrose and Norr 1993; Ambrose et al. 1997; Turner et al. 2013).

Stable oxygen in bone carbonate reflects the composition of body water at about 37°C and is influenced by meteoric water with predictable fractionalization (Longinelli 1984; Lutz et al. 1984; Turner et al. 2013:8). The isotopic composition is linked to environmental conditions (i.e., aridity, seasonal temperature change, latitude, and longitude) and in the Andes is associated with El Niño Southern Oscillation events (ENSO) and topographical variation along the Cordillera. It must be taken into account that water kept in cisterns or boiled for consumption, for instance in the production of chicha, can increase and alter the composition of ^{18}O where the signatures are well above ^{18}O ratio in the altiplano (Turner et al. 2013).

5.6.2 Hair Studies and Stress

5.6.2.1 Physiological Mechanisms

The activation of the hypothalamic-pituitary-adrenal (HPA) axis of the neuroendocrine system in response to perceived stressors represents an evolutionarily old adaptation in animals (Nesse et al. 2007). When an individual encounters stressful stimuli, whether as part of an acute event or as a chronic

process, the sensory input is relayed to the central thalamus, amygdala, locus ceruleus, and the hippocampus (Lavallo 2015). Each of these areas play a pivotal role in the production of stress, fear, and anxiety. The autonomic nervous system (ANS) includes both the sympathetic (SNS – unconscious action) and parasympathetic (PSNS – conscious action) systems. These systems formulate the 'fight or flight' response of a perceived harmful event (Bracha 2004), mediated by hormones and neurotransmitters such as cortisol (called glucocorticoids in non-human animals), adrenaline, and dopamine, and a subsequent counter-response mediated by neurotransmitters such as norepinephrine.

The sympathetic nervous response increases heart rate, peripheral blood flow, muscle contractility, and downregulates non-essentials such as the immune and reproductive systems and bone metabolism (Chin 1982). HPA activation is therefore highly adaptive in a short-term context, but has the potential to cause significant damage to a number of bodily systems if it becomes chronic (Nesse et al. 2007). For example, longitudinal studies of Japanese male children over the course of about a century measured the height of ten year olds. When analyzing the distribution of

height, it concluded that the stress experienced during World War II had a significant and negative effect on achieved height (Meilke et al., 2011:252).

5.6.2.2 Psychosocial Stress

What is particularly interesting in behaviorally-complex animals, humans included among them, is the degree to which HPA activation and the resulting sympathetic nervous response occurs in response to abstract and often socially-mediated stimuli (Sapolsky 1995; 2000). Recent studies underscore the significance of an individual's *subjective* sense of control over their life's circumstances rather than *objective* variables such as income or level of education (Sapolsky 2012). Moreover, McEwan and Sapolsky (1995) and Sapolsky (1996) have argued that cortisol damages the hippocampus and other brain structures and thereby affect memory, learning, and both psychological and physiological resilience. These factors mean that psychosocial stress both individually variable in terms of what triggers it, and at least partially measurable using biomarkers such as cortisol.

Stress is therefore a difficult term to define due to the many definitions and spread across various academic disciplines (Larsen 2003; Sapolsky 2004; Webb et al. 2010) and idiosyncratic variability depending on the perceived stressor in an individual's life (Style 1950; Kalra et al. 2007; Miller et al. 2007; Russell et al. 2012).

Stress and perceived stress (meaning that there is the potential that the stressor is not real or aggrandized during heightened responses) have been separated in some disciplines, such as Psychology, to discern the responses between the stressors.

However, in the arena of biological anthropology and bioarchaeology, researchers rely on interpreting perceived stress as it is real to that individual due to affecting the skeleton and other tissues. Perceived stress is the interpretation of a real or false stressor that foments a biochemical reaction (Hohenn 2014). This response triggers the production and influx of three hormones: cortisol, adrenaline, and dopamine.

Each hormone that is produced by the body is utilized differently but produced together and amalgamates to heightened stress. The body has adapted to bursts of acute stress, meaning that there is a greater degree of phenotypic plasticity, but less so to chronic experiences of stress (Sapolsky 2005). Cortisol is the hormone that can

be used to infer stress levels and the direct response the individual is undergoing while exposed to stress.

The body responds to stress by increasing the production of cortisol. This steroid hormone is then released throughout the body through the hypothalamus and the adrenal glands (Hohenn 2014), which then allows for glycogenesis to occur. The hormone is then dispersed throughout the body in order to mediate the parasympathetic and sympathetic nervous system, otherwise known as the fight-or-flight response. Specifically, for hair, it creates a point stop biomarker band that denotes the stress period in life. Higher cortisol levels arrest the immune system and bone formation and growth thus allowing for pathogenesis to occur. McEwan and Sapolsky (1995) and Sapolsky (1996; 1999) have argued that stress affects the hippocampus and through the causal agent production of glucocorticoids which secrete at higher levels under times of stress. This suggests that periods of stress can be investigated from tracing back (proximal to distal end) the hair strand and examining for elevated or spiked cortisol levels.

Davenport et al. (2006) use salivary cortisol from rhesus macaques provide insight to the primate's reaction of a stress event and a means to understand stress in transition. There are different methodologies when preparing samples for assaying cortisol depending on what species the hair came from and context. Fourie et al. (2015) adapted methods from Davenport (2006) and used primate hair to validate that 10 mg is sufficient to obtain accurate levels of cortisol from hair samples and incubated for varying time periods to investigate whether prolonged saturation may affect levels. Sauvé et al. (2007) used comparative hair samples from other regions of the body to see how stress was distributed. They found that the response signal is quicker in the arms where peripheral cortisol becomes imbued quicker than in scalp hair where there could be a two-week delay period depending on growth cycle (Nakamura 1982). Other methods that have been conducted have used an "Ultra-Turaxx Tube Grinder" to mince hair that was shown to yield a higher rate of cortisol levels. However, the authors suggest that the sample mass should be doubled to obtain a higher cortisol yield (Xiang et al. 2016). For archaeological populations, this

is nearly impossible and depends on many different factors such as looting, excavation and recovery biases, and available sample.

The fact that cortisol is metabolized into the keratin structure of hair means that, assuming human remains are sufficiently preserved, it is possible to estimate cortisol levels in archaeological remains and use them to infer psychosocial stress. This would in turn open in a window into individual life experiences that may be otherwise invisible in the archaeological and ethnohistorical record.

5.6.2.3 Exploratory Models in Bioarchaeology

While biological stress has been measured in living populations using a variety of methods and in archaeological populations using skeletal remains, bioarchaeologists can also investigate manifestations of stress levels that are present in hair remains (Webb 2010). Davenport et al. (2006) study shows that salivary cortisol from rhesus macaques provide insight to the primate's reaction of a stress event. Stress events may be either actual or perceived and can be physical or psychological (Russell et al. 2012). Miller et al. (2007) caution that the type of stress

should be taken into consideration since individuals can overcome these perceived stress periods and potentially skew analysis. Archaeologically, nuanced methods to interpret stress through cortisol need to be conducted to build a robust data set in known contexts rather than a comparative data set from various contexts. Other studies have found similar results where individuals were exposed or undergoing a period of stress resulting in the high levels of cortisol from saliva, hair, and blood (Linder et al. 1990; Kerrigan et al. 1993; McEwan and Sapolsky 1995; Karlen et al. 2009; Luo et al. 2012); other factors contributing to overall stress have also been interpreted such as pregnancy that demonstrates a three-fold increase of cortisol from clinical normal samples (Kalra et al. 2007; Webb et al. 2010; Staudte et al. 2013; Uhart et al. 2013; Webb et al. 2014).

Hair grows at a rate of 0.35mm/day, meaning that a centimeter of hair represents approximately one month's growth (Williams et al. 2011), though research has shown that there is about a two-week delay for hair growth (Nakamura et al. 1982). By investigating the cortisol biomarkers that are contained within hair strands, it is possible to cut the strands of hair into smaller segments. Analyzing the smaller

segments by month over the course of their life that is coincident with the growth of the hair (up until the distal aspect of the hair strand) can trace back to periods of stress in the individual's life. Theoretically, elevated levels of cortisol closer to the proximal end of the hair (closest to the scalp) would suggest that the individual was under a measurably increased amount of stress in the perimortem interval. Inversely, low levels of stress can suggest that the individual was not susceptible to or under stress at or around time of death. However, findings from Webb et al. (2014; 2015) have found that children may have higher levels of cortisol compared to adults, with no difference in respect to sex given the small sample (n=5) and that compared to osteological data seems as though these individuals were not exposed to significant forms of stress. This paradox presents an issue with using hair from archaeological samples where it may suggest a correlation with the sample being studied but not characteristic of the population as a whole.

5.7 Embodiment of Stress

Examining skeletal markers of stress and altered developmental processes have been employed by bioarchaeologists to understand health and stress in archaeological populations. This allows for interpretations at the population level to understand palaeopathological lesions and stress factors (such as chronic nutritional deprivation or acute stresses associated with warfare) that they were experiencing. However, more nuanced methods are needed to begin discussing individual experiences of dietary change and potential perceived stress in life (Knudson and Stojanowski 2008). Shifting focus to the individual will allow for research to explore how larger social issues such as systemic oppression based on sex or gender (Gowland 2006; Sofaer 2006a; b), and social identity such as cultural modification to maintain social borders in multiethnic polities (Torres-Rouff 2002; Blom 2005) or loss during periods of cultural collapse and change (Logan et al. 2003).

Together, utilizing these methods to interpret stress at the population and individual level coupled with cultural context and social theories can infer the way in which economic and cultural processes are embodied and act as determinants of

health and disease (Krieger 2001). Examining the social environment can illuminate social inequality through the division of economic and political systems set in place for the elites to become richer while the poor become poorer (Krieger 2001).

Exploring these methods allow the bioarchaeologist to tell the story and interpret life, whether it is a general overview or specific periods leading up to death of these peoples of the past.

However, interpretations of stress and the health of a population in the archaeological past are not always straightforward and often can be obscured. Wood et al. (1992:349) proposed "the frequency of active lesions in a skeletal sample is greater than the fraction of affected individuals in the living population from which the sample was drawn." Essentially, individuals with lesions on their skeleton may represent resilience rather than frailty, adding another dimension to interpreting individuals' lived experiences in ancient complex societies. Goodman (1993) argues that bioarchaeologists need to approach their analysis by examining multiple skeletal markers of stress, and multiple layers of stress, if one is to reconstruct individual

lives and avoid a monolithic or “vulgar” (Goodman 1994) understanding of human bodies in cultural spaces.

Importantly, until the application of hormone assay techniques from human biology and primatology to bioarchaeology (Webb et al. 2014), it was not possible to directly compare proxies of nutritional and infectious disease stress, stress from violent trauma, and the less tangible and subjective state of psychosocial stress. This study therefore represents one of the earliest attempts to infer psychosocial stress from archaeological remains and link it to proxies of diet and local environment. It also represents the first study to reconstruct these dimensions of lived experience in the remains of people who were ritually sacrificed, and therefore—potentially—exposed to atypical and even prolonged (Wilson et al. 2007) stressful conditions.

6 Research Design

6.1 Introduction

While visible stress is measured in living populations, bioarchaeologists have also turned to investigating the stress levels that are imbued in recovered hair remains (Webb 2010). Elucidating stress levels from archaeological samples is an important emerging topic of research because cortisol levels can provide context of inequity, social determinants of disease, and dynamic approaches to other confounders of stress manifestation. This is because hair contains a different type of collagen than bone and is imprinted with biomarkers demarcating a stress period, as noted above. Analyzing hair samples can offer insight to psychosocial stress and otherwise illuminate how stress was perceived in the past and in what ways cultural practice (for example, human sacrifice) plays a role in forming stress.

6.2 Materials

The individuals studied for this thesis were excavated at Huaca de los Sacrificios at the Chotuna-Chornancap Archaeological Complex in the Lambayeque

Valley by the Museo Bruning project. Dr. Haagen Klaus participated in early excavations in 2008 and returned in 2009 to conduct data collection on the human remains, including the hair samples used in this study (per. comm. Klaus 2017). The Chotuna-Chornancap Archaeological Complex complex was constructed during the early Late Intermediate Period; otherwise known as the Middle Phase at this complex(A.D. 700-1100) (Donnan 2011) and occupied by the Middle Sicán state, the Chimor Kingdom, and the Inka Empire before Spanish conquest (Klaus et al. 2016; Turner et al. 2013). The specific sacrifice event has been dated to the Late Horizon (A.D. 1470-1532) during Inka conquest of the Chimor Kingdom relinquishing sociopolitical control of the local Muchik and continued campaign on the North Coast.

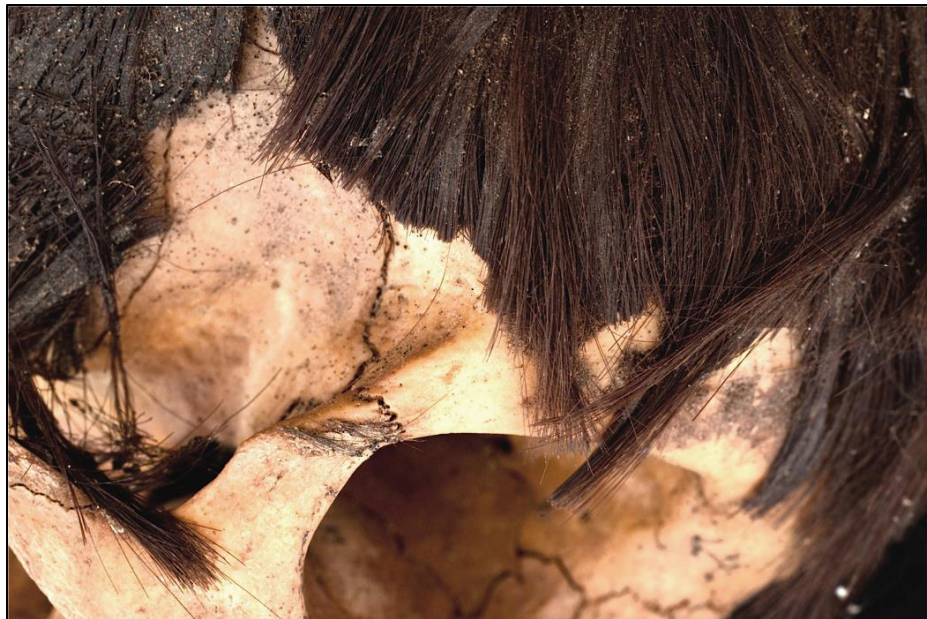


Figure 9 Burial 24 – This woman’s hair was cut perimortem and potentially another sacrificial medium (Klaus et al. 2016). Photo courtesy of Sam Scholes.

Hair samples were collected by Dr. Bethany Turner for isotopic analysis to investigate this sacrifice event (Turner et al. 2013), providing valuable biochemical data to augment the cortisol data generated here. Remaining hair samples (n=10) were curated in the Bioarchaeology Laboratory at Georgia State University and are used in this study. These new cortisol data and published isotopic and osteological data from Huaca de Los Sacrificios are analyzed together. The cortisol data are also compared to published archaeological data from different sites along the Cordillera (Webb et al. 2010; 2014; 2015).

Hair grows at a rate of 0.35mm/day, such that that a centimeter of hair represents approximately one month's growth (Williams et al. 2011). For this study, cortisol was extracted from bulk hair samples rather than 1cm segments, due to the low mass of the hair samples remaining after isotopic analysis (Turner et al. 2013), and uncertainty of the validity of the sample once extraction was complete.

6.3 Study Questions and Hypotheses

H₁: Hair cortisol levels representing the months prior to death will not be significantly higher than clinically-normal ranges. Archaeological and ethnohistorical research of north coastal Peruvian polities suggests distinct modes of human sacrifice from those practiced in highland regions, such as the Inka *capacocha* (Verano 2008). The Inka selected children and adolescents as much as one year in advance, took them from their homes, and paraded them throughout the empire prior to sacrificing them as part of the *capacocha* ritual (Betanzos 1551; Sarmiento de Gamboa 1999 [1572]). Coastal sacrificial rites, however, tended to

involve captured prisoners (Verano 2000), funerary accompaniments (Verano 2008), and delayed burial with partial decomposition (Verano 1997). In these scenarios, there would not have been the same lengthy time prior to the sacrificial event, where the intended victim would have been at least partially cognizant of their situation, separated from home and kin.

Indeed, Turner et al. (2013) and Klaus et al. (2016) interpret the Huaca de los Sacrificios assemblage as uncharacteristic of Inka *capacocha* ritual. Carbon and nitrogen isotopic values in sequential bone and hair samples do not indicate consumption of high-status foods such as maize and meat, and oxygen isotope values suggest that individuals were—and stayed—local to the Lambayeque region. The remains also had little indication of trauma or disease. Therefore, I expect that individuals' hair cortisol levels will not indicate prolonged psychosocial stress in the months leading up to sacrifice.

H₂: Individual hair cortisol levels will significantly vary according to hair carbon and nitrogen isotopic values. Since cortisol is a steroid hormone involved in myriad physiological processes over the individual's lifespan, it is possible that

increases in cortisol might have to do with other things like nutritional status, pregnancy, or maturation.

H₃: Individual hair cortisol levels will be distinctly different between adults

and subadults. Similar to H₂, a possible confounder affecting cortisol levels is an individual's stage of growth and development. However, if there is variation within the subadults of similar age at death, then it may be a more likely indicator of pubertal development than psychosocial stress.

6.4 Methods

Webb et al. (2010) provide a detailed protocol for preparation for human hair that was adapted from Van Uum et al. (2008). Hair segments were placed in glass vials and saturated with 1 ml of methanol (>98%) to extract the steroid. Sterile surgical scissors were used to cut the hair into small powdered samples. The vials were then incubated for sixteen hours while shaking at 100 rpm and heated to 50°C (122°F). Once incubation time expired, methanol was removed from the vial, transferred to test tubes and evaporated by using liquid nitrogen to freeze-dry the

samples. The residue was reconstituted in 250 μ l of phosphate buffered saline (PBS) at pH 8.0. The PBS mixture was then analyzed using a commercially available salivary enzyme immunoassay kit (ELISA) (Van Uum 2008; Webb et al. 2010:845; 2014; 2015).

The samples used in this study were cleaned with 3.0 ml of isopropanol to rid the sample of contaminants that could obfuscate results such as sebum or sweat.

With the assistance of Mary Karom, the lab supervisor of the Neuroscience Institute at Georgia State University, ELISA assays were conducted at the Petit Science Center.

The following procedure was used to extract cortisol data for the present study (Meyer et al. 2014:4).

6.4.1 Assay Procedure

The procedure was conducted using a Salimetrics enzyme-linked immunosorbent assay (ELISA) and all reagents used were included in the assay kit. 24 mL of Assay Diluent was pipetted into the microtube for 1.5 hours at room temperature. The microtitre plate was brought to room temperature. The enzyme

conjugate 1:1600 was diluted by adding 15 μL to the 24 mL Assay diluent. The plate was then placed on a rotator for 5 minutes at 500 rpm and incubated at room temperature for 1 hour and then subsequently washed 4 times with 1x (100 mL of wash buffer concentrate to 900 mL deionized H_2O) wash buffer. 200 μL of TMB substrate solution was added to each well and the mix was placed on a plate rotator for 5 minutes at 500 rpm and incubated in a dark room for an additional 25 minutes. 50 μL of Stop Solution was added to the sample and placed on plate rotator for 3 minutes at 500 rpm and read at 450 nm. Samples were then reconstituted at 200 μl and stored at -20 C for future assays and currently housed at the Neuroscience Institute at Georgia State University.

6.4.2 Data Calculation

Interpolation data reduction software was used to calculate and obtain raw data. Using the formula provided by Salimetrics, cortisol levels were then calculated using the following equation: $(A/B) * (C/D) * E * 10,000 = F$. A is the $\mu\text{g}/\text{dl}$ from the assay output; B is the weight (in mg) of hair subjected to extraction; C is the volume

(in mL) of methnol added to the powdered hair; D is the volume (in mL) of methnol recovered from the extract and subsequently dried down; F is the final value of hair CORT concentration in pg/mg (Meyer et al. 2014). These data were then converted to ng/g to obtain whole number values and analyzed.

7 Results

A total of 10 hair samples were assayed for cortisol in this study (Table 3). Burials 3 and 19 exhibit notably elevated levels of cortisol in comparison to clinical white adult males and females (Thomson et al. 2009) and archaeological adult hair data (Webb et al. 2010). Burial 3; the female, had a higher cortisol level than Burial 19; the male, and suggests that she may have experienced greater stressors before death. However, this interpretation is based on one male and one female in this study sample and additional data are needed from archaeological samples to strengthen this interpretation.

Burial	Age	Sex	Cortisol Level
1	7 to 11	Indeterminant	69
3	15 to 18	Female	248
9	10 to 12	Indeterminant	33
18	6 to 8	Indeterminant	30
18.1	6 to 8	Indeterminant	57
19	18 to 25	Male	151
22	13 to 17	Indeterminant	51
24	8 to 10	Indeterminant	18
25	14 to 16	Indeterminant	28
28	6 to 9	Indeterminant	28

Table 3: Age, sex, and cortisol data of the sample from Huaca de los Sacrificios

Burial	Cortisol Level	d18Ocarbo	d13Ccarbonate	d13Ccollagen	d13Ckeratin	d15Ncollagen	d15Nkeratin
1	68.71702638	28.6	-5.1	10.9	-11.45	11.5	11.35
3	247.9479479				-11.52		12.38
9	32.58933802				-11.025		10.975
18	30.05366726	27.2	-7.1		-14.1		9.08
18.1	57.27440147				0		
19	150.5836576	28.3	-6.2		-12.7333333		10.85
22	51.27635328	28.1	-9.3		-15.5		11.8
24	18.01943199	28.8	-6.8	-11.8	-12.975	11.5	11.45
25	65.40682415	28	-7		-15.4		9.5
28	28.20659062				-15.5		10.1

Table 4: Final table of combined cortisol with isotopic data comparison from Turner et al. 2013

The remaining burials (n=8) are all subadults between the ages of 6 and 17; which renders sex estimation impossible. The cortisol data from adults compared to the subadults are distinctly different. Among this subsample, each individual had considerably low cortisol levels compared to adults in this study and across sites (Webb et al. 2010). However, the cortisol levels between each of the subadults are similar suggesting that they may have been under similar distress before death. Due to the low number of individuals, more data are needed to render strong interpretations.

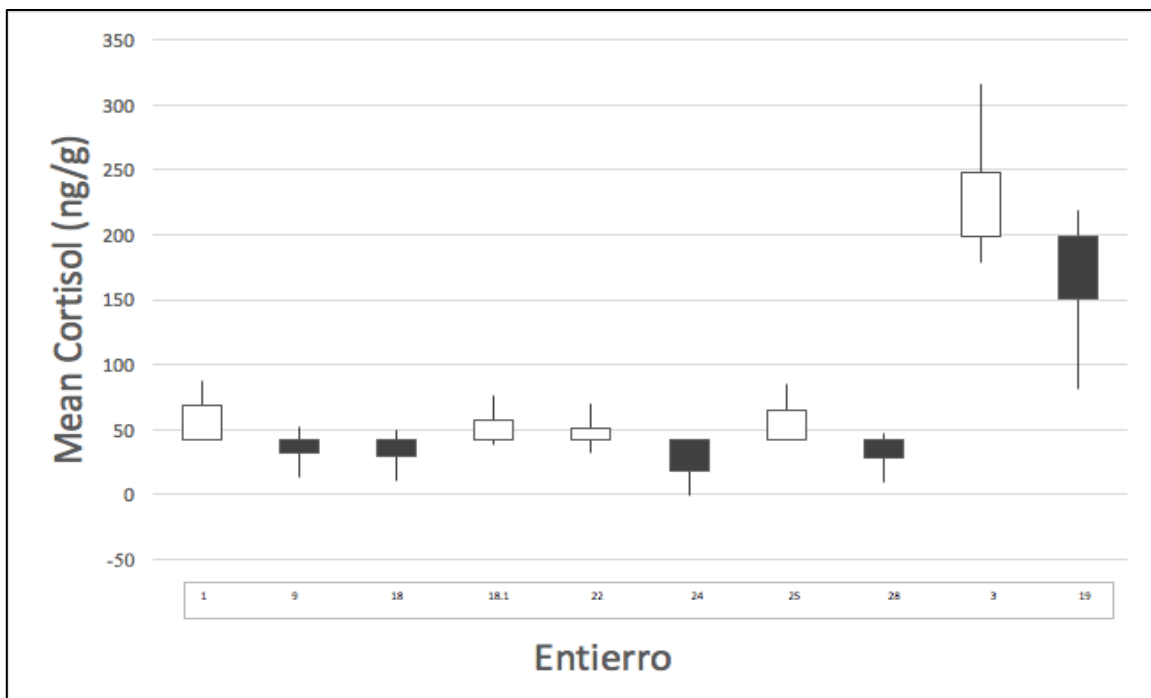


Figure 10: Graph showing the mean cortisol data at Huaca de los Sacrificios

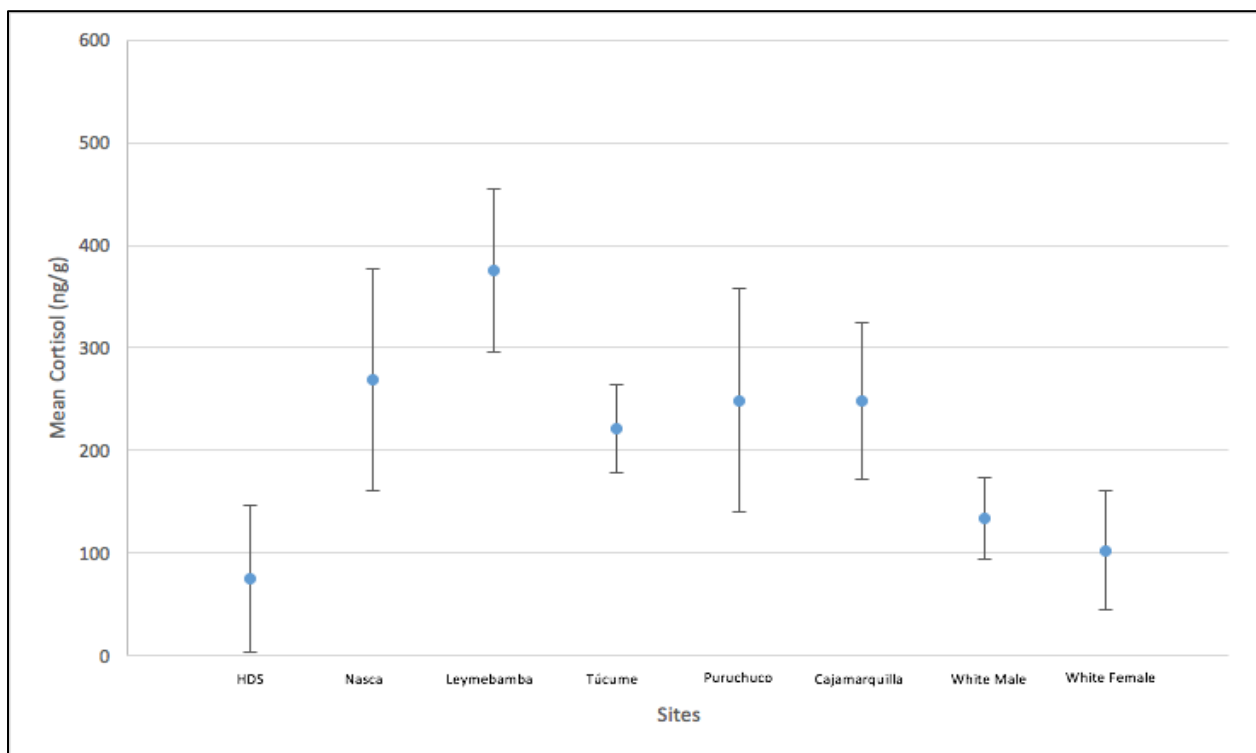


Figure 11: Graph showing comparative cortisol data from this thesis (HDS), the subsequent five Peruvian sites (Webb et al. 2010), and reference data from clinically normal participants (Thomson et al. 2009).

There are several potential analytical confounders to consider in reporting these data. First, is the issue of diagenesis. Diagenesis is processes in which a burial's chemical environment alters the isotopic composition in the preserved tissue and a potential factor in archaeological assemblages that must be addressed. The results of this thesis are dependent on the validity of preserved biogenic cortisol encased in the hair samples. Potential alterations that could affect the hair and cortisol levels are contamination within the burial and exchange or leaching of chemical elements or constituents that would result in altered levels (Hedges 2002; Webb et al. 2010). Webb et al. (2010:810) note that while there is no current means of directly assessing the preservation of biogenic cortisol, ancient hair is almost certainly diagenetically altered to a certain degree, even in the most well preserved hair samples.

Another potential issue concerns the preparation of the hair samples. The initial masses of 9 of the 10 samples were below the 10 mg threshold suggested by Meyer et al. (2014). The individual that had a hair mass greater than 10 mg was a

subadult and yielded similar cortisol levels among the same age groups, while the male and female hair masses were below 10 mg, but yielded expected cortisol levels (134±40 ng/g for the male, 102±58 for the female) from Thomson et al. (2009).

Given that the preparation techniques for cortisol assay are sensitive, the initial preparation or the procedure may have some affect on the extraction of the cortisol hormone. However, the coefficient of variance (CV) for the samples all ranged within acceptable CV percentages suggesting that the procedure was successful despite low levels of cortisol.

8 Discussion

8.1 Interpretation of Results

Interpreting stress in antiquity is a challenge. Rather than attempting to find one cause for low cortisol levels, differential diagnoses in regards to comorbidity and potential pathogen load are needed. Many clinical studies have used salivary and hair cortisol with various known health conditions to interpret how disease can affect stress. Using these data and comparing them to archaeological samples can open up further discussion about potential factors that were affecting these individuals in life.

8.1.1 What are "Normal" Cortisol Levels?

Studies have suggested that cortisol levels increased in association with stress load brought upon by various conditions such as pregnancy (Karlen et al. 2007), real

or perceived threats (Horowitz 1997; Sapolsky 1996; 2000), and disease (Kim 2008; Stansfeld and Marmot 2002). An individual's allostatic balance deviates from what the body can handle and responds accordingly. Recent studies have demonstrated that the basal cortisol level in children between the ages of 6 to 17 years is similar to cortisol levels in rodents, which exhibit increased basal glucocorticoid levels at the end of the stress-hyporesponive period (Gunnar and Quevedo 2007; Kiess et al. 1995; Legro et al. 2003). In some cases, hypercortisolism and hypocortisolism have been suggested to be the result of extreme stress events that disrupt the normal functioning HPA axis (Kallen 2008; Kaneko 1993; Sanchez 2006; Shea 2005; Tarullo 2006).

Hinkelman et al. (2013) studied the cortisol levels in children who had experience trauma with parents who were clinically diagnosed with depression in Germany. In this study, Hinkelman et al. (2013) found that there is a significant association of childhood trauma with lower long-term cortisol secretion in both depressed patients and non-depressed controls (~7 pg/mg and lower). However, the

threshold to cross and become depressed is not universal and is dependent on individual perceptions and variable cultural constructions of emotions.

However, a long-term study using non-human primates with early maternal separation led to reduced cortisol levels (Feng et al. 2011). Steudte et al. (2013) found that individuals with and without concurrent post-traumatic stress disorder (PTSD) had reduced cortisol levels as well. These results, along with my data, demonstrate similar results of lower baseline cortisol in healthy control participants with childhood trauma (Gerritsen et al. 2010; Helm et al. 2000; 2001; Power et al. 2012). The childhood trauma caused a disturbance inhibiting the corticotropin-releasing factor and result in psychopathological conditions sustained during life (Helm et al. 2008; Gunnar and Quevedo 2007). Studies have shown that the baseline for cortisol is elevated in maltreated children (Tarullo and Gunnar 2006; Gunnar and Quevedo 2007). However, other studies have suggested that victims of sexual abuse demonstrated hypocortisolism (King et al. 2001; Trickett et al. 2010). Chronic hypocortisolism may be associated with the overproduction of the central corticotropin releasing hormone creating a continued spike early in life and then

becoming sensitized to stress events (Helm et al. 2008). Kaufman et al. (1997) found similar results of cortisol levels in depressed and abused children. Their findings suggested that the increase in cortisol levels and ultimate deregulation of the HPA-axis is associated with chronic maltreatment experienced at home.

Wolf et al. (2007) studied children's salivary cortisol that are affected by asthma and children that were clinically healthy Vancouver, Canada. Asthma severity was controlled for in this study as well as age and sex of the children. Wolf et al. (2007) used the UCLA life stress questionnaire to report on low and high chronic home stress. The authors' results showed that the the healthy children showed expected patterns of a flatter cortisol rhythm being associated with higher levels of chronic stress (beginning with ~5.5 nmol/l from awakening and dropping to about ~1 nmol/l), for example work stress (Caplan et al. 1979), parenting a child with cancer (Miller et al. 2002), and socioeconomic status (Chen and Paterson 2006; Cohen et al. 2006a;b, Wolf et al. 2007). Long term effects of chronic stress would impact their health and would increase their risk for infectious diseases and have overall negative health effects. Children with asthma with higher levels of chronic

stress were associated with low levels of salivary α -amylase noting that it is a distinct pattern and suggesting that it is more sensitive to social characteristics (beginning with $\sim 2\text{-}3$ nmol/l at awakening and dropping to ~ 0.9 nmol/l for salivary cortisol and raising to about $\sim 3.5\text{-}3.7$ nmol/l for salivary α -amylase). Both of these findings demonstrate that there are pronounced but distinct biological effects of chronic stress not only in children with asthma but as well in healthy children.

Kiess et al. (1995) investigated salivary cortisol throughout childhood and adolescence to examine the varying stages of life in relation puberty and weight. They divided their sample into five age group categories (S1 – 0- >1 years; S2 – 1-5 years; S3 – 5-8 years; S4 – 8-18 years; S5 – 18-35 years) and took saliva samples at three different times representing morning, midday, and evening (0800h, 1300h, and 1800h). Kiess et al. (1995) also suggest that after the age of 6; cortisol levels correlated significantly with pubertal stages. Their results show that there was a significant positive correlation between the salivary cortisol levels and pubertal stages ($p < 0.0001$ up to $p < 0.03$ analysis of variance) (Kiess et al. 1995:504).

Morning salivary cortisol was highest in pubertal stage 5 and retrogradely declined

to pubertal stage 1. Midday and evening salivary cortisol results followed the same pattern with pubertal stage 5 having the highest levels and retrogradely declined to pubertal stage 1. The uniform variance of cortisol levels in pubertal stage is most likely due to developed circadian rhythms of the individuals included in the study sample as well. Rather than suggesting that these children were stressed out due to chronic stress or disease, these results suggest that the cortisol levels demonstrated in this study are due to pubertal maturation and development than biological or psychosocial stress.

8.1.2 Cortisol Levels at Chotuna – Huaca de Los Sacrificios

The results from this thesis are in accordance with previously discussed results and suggest that the individuals that were sacrificed at Huaca de los Sacrificios experienced similar lived environments. Eight of the ten samples from this study are subadults and could potentially suggest the following possible interpretations: 1) they were currently undergoing some form of traumatic event that enacted a PTSD

physiological response before they were sacrificed. The etiology of this traumatic event does not have to be one single cause but is most likely many things that are triggering this physiological response; 2) they were under duress that impacted cortisol secretion despite being relatively healthy; 3) that they actually were not stressed out and these results are concurrent with pubertal development and circadian fluctuation. The cortisol levels of adults compared to subadults show that post-maturation, cortisol levels increased to similar cortisol values demonstrated in Webb et al. (2010) and Thomson et al. (2009).

Based on the current data set, it would appear that these individuals were not stressed, but the cortisol levels are an artifact of maturation and pubertal development. The age range of the subadult is well within pubertal development and an increased production of hormones would be fluctuating daily. Burial 3; the female, has the highest cortisol levels from this study may also suggest that she was in the earlier stages of pregnancy (see Kalra et al. 2007) and that the fetus did not preserve in the archaeological record.

Revisiting the initial hypotheses of this study yields the following insights:

H₁: Hair cortisol levels representing the months prior to death will not be significantly higher than clinically-normal ranges.

This hypothesis can be provisionally accepted for the male and female but rejected for the subadults. This is because the female individual demonstrated cortisol levels of 248 ± 68 ng/g and are lower than the 329 ± 58 ng/g pregnancy threshold, which suggests that, if she was pregnant, she was potentially in the early stages of pregnancy when she was sacrificed (Karlén et al. 2011). The male's cortisol levels are slightly elevated (150.5 ± 68 ng/g) but well within clinical data (134 ± 40 ng/g) suggesting that perceived stress was around his typical allostatic balance. The subadults' cortisol levels (68 ± 19 ng/g - 18 ± 19 ng/g) are considerably lower than expected across the samples at Huaca de los Sacrificios, across sites (Webb et al. 201), and in comparison to clinical values, S1 – 18 ± 28.3 nmol/L; S2 – 5.4 ± 3.6 nmol/L; S3 – 6.1 ± 4.2 nmol/L; S4 – 6.3 ± 4.9 nmol/L; S5 – 8.6 ± 4.1 nmol/L (Kiess et al. 1995), and (134 ± 40 ng/g) (Thomson et al. 2009).

H₂: Individual hair cortisol levels will significantly vary according to hair carbon and nitrogen isotopic values.

Isotopic data from Turner et al. (2013) indicate that the individuals in this sample were drawn from the region, either from within the Lambayeque Valley or adjacent valleys just outside. Coupled with the cortisol data, it does not appear that those who were sacrificed had different diets from one another. It also appears as though these individuals may not have been “the lowest of the low” in terms of who was selected to be sacrificed. The nitrogen and carbon values do not appear to be associated in any significant way to the cortisol data, and diets were similar across the sample.

H₃: Individual hair cortisol levels will be distinctly different between adults and subadults.

Despite the small sample size for this thesis, the cortisol levels between adults and subadults provide good insight of the duress they were experiencing before death. The female (Burial 3) and the male (Burial 19) had cortisol levels that would be in expected ranges. The female cortisol level was 248 ± 68 ng/g which suggest the spike may be caused by either a stressful event that she experienced or is in the

early stages of pregnancy as noted above and within the range of Webb et al. (2010) Peruvian cortisol data; the male cortisol level was 150.5 ± 68 ng/g and well within range of the clinical data from Tompson et al. (2009) of white 'healthy' males.

The subadult cortisol data set is comparatively very low (see Table 4). The subadults included in this thesis are in the pubertal developmental stages of their life when they were sacrificed. During maturation, the cortisol hormone is in constant fluctuation from high at awakening to gradual lowering throughout the day. Rather than being under duress before sacrificed, it appears that these are the result of maturation and the possible reason of why the subadult cortisol ranges distinctly different.

Indirectly interpreting the cortisol data for psychosocial stress is difficult because the stressors are unknown. What is known is that the context of this site, the local Muchik, was going through political transition from the Chimú to the Inka Empire. However, extensive literature suggests that this transition wrought relatively minor changes to the lives of coastal communities.

9 Conclusion

9.1 Contributions of Research

A chief contribution of this research lies in its novelty. It represents the first bioassays of psychosocial stress in an archaeological sacrifice assemblage. Using the ELISA assay allowed for new methods to be applied to sacrifice contexts and additional exploratory interpretations. Nuanced methods should be utilized in bioarchaeology to obtain additional lines of evidence for further interpretations to come closer to the lived experiences of those who died hundreds of years ago.

In particular, this study provides insights into the bioarchaeology of childhood. Further research of cortisol levels in both living and archaeological children could potentially obtain a better picture of childhood in the ancient Andes. Childhood has recently been explored for mortality (Blom et al. 2005) and during times of conflict, warfare, and sacrifice (Tung and Knudson 2010). Assaying cortisol from hair that has been preserved from children can provide additional lines of evidence for reconstructing daily life in varied archaeological and social contexts. Moreover, if

these levels more accurately characterize development and pubertal maturation than they do of psychosocial stress per se, then this method may prove useful in exploring gender and queering the bioarchaeological record (Gellar 2005; 2007; 2009).

9.2 Bioarchaeological Praxis

Anthropological praxis insists on the holistic approach to understanding humanity. As Kozaitis (2000:45) states, "this approach integrates epistemologies and attention to history, structure, and human evolution across time and space." In doing so, anthropological praxis draws upon ethically-based collaboration with other scholars but more importantly the community, and research driven approaches to shift paradigms and optimize the social agency of humans. In essence, anthropological praxis is meant to enact social change that contributes to society.

Bioarchaeology is at the intersection of archaeology and biological anthropology and draws from diverse literature to understand past biological responses to the lived environment. Applying anthropological praxis to

bioarchaeology can further provide new methodological approaches. Specifically, for this archaeological hair research, the context is interesting and a unique line of evidence that can infer about stress and psychosocial stress.

The forensic component of this exploratory research can be used in archaeological assemblages and in contemporary human rights cases. The political history of Latin America has highlighted social injustices and mass killings of civilians and indigenous peoples from Argentina and Peru during the 1970s and 1980s to recent disappearances in Mexico in 2015. Recent excavations have found some clandestine burials of these *desaparecidos*, or "the disappeared" as coined in the Dirty War (1974-1983) in Argentina. By assaying hair recovered from recent homicides and mass graves, cortisol data can be ascertained to elucidate stress leading up to death. This method can reconstruct the psychosocial environment that these peoples lived through during militant regimes or groups that ensued conflict, as well as provide richer contextual datasets for studying similar processes in archaeological human remains.

9.3 Future Directions

This thesis approaches sacrifice from a specific line of evidence that contributes to a multidimensional and interdisciplinary approach in order to elucidate ritual violence in the Andes. Future directions include building an archaeological cortisol database in the Andes; one planned contribution is cortisol estimation from remaining hair from Huaca de los Sacrificios, samples (n=14) from the site of Estuquiña in southern Peru near the modern city of Moquegua, and other collaborations. The remaining hair samples from Huaca de los Sacrificios that are currently housed in the Bioarchaeology Lab at Georgia State University will be assayed over the summer of 2017. The hair samples from Estuquiña will be assayed for comparative analyses.

Future research goals are: 1) to obtain additional cortisol data to add to our understanding of stress and how it can be embodied internally when skeletal markers of are absent; 2) to see if the difference in cortisol levels varies from childhood to adulthood and if social processes help mitigate or exacerbate periods of stress; and 3) resampling hair from the Huaca de los Sacrificios sample and

assaying for segmental cortisol to show how stress changed from month to month leading up to death; 4) to investigate the stress response of political reorganization, and how that is affected in multiethnic communities.

Additionally, I would like to assay cortisol in preserved hair from the Lullaillaco maidens, who have been confidently associated with the Inka *capacocha*, with permission from Drs. Andrew Wilson and Tomas Besom. Obtaining other sacrifice hair samples will allow me to build a more robust cortisol data set for known *capacocha* settings. Additionally, it will foster comparative studies of Inka and non-Inka sacrifice events to potentially answer the question of whether or not the sacrificed individuals were knowledgeable participants.

Even though I wanted to fully answer my research questions and hypotheses, this exploratory research opened more doors about sacrifice and the social embodiment of stress than I had anticipated. This nuanced method to interpret stress and understand sacrifice is still in its infancy and further research is needed to better constrain both the parameters of interest and their likely causal mechanisms. Ultimately, I hope that this exploratory research influences future scholars and

students to persist and investigate complex problems through new methodologies.

Though this thesis has come to a close, the final chapters on the bioarchaeology of sacrifice in Peru are far from complete.

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APPENDICES

Salimetric ELISA Assay Data

Sample Assay 1	Wells	ABS1	ABS 2	CV%	
3.0 STANDARD	A1, A2	0.152	0.157	2.3	CURVE POINTS
1.0 Standard	B1, B2	0.340	0.341	0.2	CURVE POINTS
0.333 Standard	C1,C2	0.693	0.718	2.5	CURVE POINTS
0.111 Standard	D1, D2	1.122	1.146	1.5	CURVE POINTS
0.037 Standard	E1, E2	1.433	1.573	6.7	CURVE POINTS
0.012 Standard	F1, F2	1.622	1.697	3.0	CURVE POINTS
Zero	G1,G2	1.742	1.827	3.0	
Blank	H1, H2	0.049	0.050	1.4	Blank (NSB) subtracted from all samples
Lo Control	A3, A4	1.184	1.183	0.1	
Hi Control	B3, B4	0.318	0.335	3.7	
#29	C3.C4	1.758	1.741	0.6	
#29 1:2	D3,D4	1.720	1.747	0.9	
29 1:4	E3,E4	1.738	1.797	2.3	
30	F3,F4	1.720	1.658	2.6	
31	G3,G4	1.679	1.692	0.5	
31	H3,H4	1.762	1.827	2.6	
32	A5,A6	1.730	1.743	0.5	
33	B5,B6	1.726	1.726	0	
34	C5,C6	1.665	1.680	0.6	
35	D5,D6	1.675	1.698	0.9	
35	E5.E6,	1.717	1.713	0.2	
36	F5,F6	1.682	1.708	1	
38	G5,G6	1.813	1.700	4.5	
Saliva	H5,H6	0.579	0.582	0.4	0.4562

SAMPL	WELLS/ ID	ABS1	ABS 2	CV%	
E					

ASSAY 2					
3.0 STANDAR D	A1,A2	0.137	0.140	1.5	CURVE POINTS
1.0 Standard	B1, B2	0.305	0.306	0.2	CURVE POINTS
0.333 Standard	C1,C2	0.617	0.653	4	CURVE POINTS
0.111 Standard	D1, D2	1.064	1.067	0.1	CURVE POINTS
0.037 Standard	E1, E2	1.346	1.338	0.4	CURVE POINTS
0.012 Standard	F1,F2	1.488	1.521	1.5	CURVE POINTS
Zero	G1,G2	1.650	1.644	0.2	
Blank	H1, H2	0.046	0.046	0	Blank (NSB) subtracted from all samples
Lo Control	A3, A4	1.080	1.058	1.4	
Hi Control	B3, B4	0.303	0.282	5	
C1	C3.C4	0.879	0.797	7	
C1 1:2	D3,D4	1.177	1.092	5	
C2	E3,E4	1.137	1.038	6	
C2 1:2	F3,F4	1.307	1.166	8	
C3	G3,G4	0.634	0.576	7	
C3 1:2	H3,H4	0.889	0.881	0.6	
C4	A5,A6	1.543	1.520	1	
Saliva	B5,B6	0.526	0.486	6	
Saliva	C5,C6	0.422	0.398	4	
30 spike	D5,D6	0.485	0.456	4	
30	E5.E6,	1.490	1.353	7	
31 spike	F5,F6	0.471	0.456	2	
31	G5,G6	1.526	1.537	0.5	
34	H5,H6	1.635	1.656	0.9	

SPSS Statistical Data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CarbKeratin	10	-15.50	.00	-12.0203	4.56360	2.345	.687	6.390	1.334
NitrogenKeratin	9	9.08	12.38	10.8317	1.08305	-.396	.717	-.738	1.400
Cortisol	10	18.02	247.95	75.0075	71.40467	1.957	.687	3.639	1.334
Valid N (listwise)	9								

Correlations

		Cortisol	CarbKeratin	NitrogenKeratin
Cortisol	Pearson Correlation	1	.068	.501
	Sig. (2-tailed)		.852	.170
	N	10	10	9
CarbKeratin	Pearson Correlation	.068	1	.499
	Sig. (2-tailed)	.852		.171
	N	10	10	9
NitrogenKeratin	Pearson Correlation	.501	.499	1
	Sig. (2-tailed)	.170	.171	
	N	9	9	9

Correlations

			Cortisol	CarbKeratin	NitrogenKeratin
Spearman's rho	Cortisol	Correlation Coefficient	1.000	.365	.300
		Sig. (2-tailed)	.	.300	.433
		N	10	10	9
	CarbKeratin	Correlation Coefficient	.365	1.000	.276
		Sig. (2-tailed)	.300	.	.472
		N	10	10	9
	NitrogenKeratin	Correlation Coefficient	.300	.276	1.000
		Sig. (2-tailed)	.433	.472	.
		N	9	9	9

T-Test

Group Statistics

	Age_Category	N	Mean	Std. Deviation	Std. Error Mean
Cortisol	1	8	43.9430	19.07668	6.74462
	2	2	199.2658	68.84695	48.68215
NitrogenKeratin	1	7	10.6079	1.05163	.39748
	2	2	11.6150	1.08187	.76500
CarbKeratin	1	8	-11.9938	5.16407	1.82577
	2	2	-12.1267	.85796	.60667

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	1	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Cortisol	Equal variances assumed	42,242	.000	-6,510	8	.000	-155,32285	23,86050	-210,34526	-100,30044
	Equal variances not assumed			-3,160	1,039	.188	-155,32285	49,14714	-727,40780	416,76211
Nitrogenkreatin	Equal variances assumed	.195	.672	-1,190	7	.273	-1,00714	,84669	-3,00824	,99496
	Equal variances not assumed			-1,168	1,593	.388	-1,00714	,86210	-5,78977	3,77448
CarbKreatin	Equal variances assumed	1,029	.340	.035	8	.973	-.13292	3,82640	-8,69079	8,95662
	Equal variances not assumed			.069	7,952	.947	-.13292	1,92393	-4,30829	4,57412