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Complexity and Power: A Bioarchaeological Analysis of Socioeconomic Change on the Copacabana Peninsula, 800 BC–AD 200

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ABSTRACT Between 800 BC and AD 200, people in the Titicaca Basin of Peru and Bolivia began practicing agriculture, living in sedentary settlements, and engaging in public ritual. The resulting social complexity was likely associated with shifts in power relationships and social hierarchy, as has been noted in other areas of the world. In fact, in the northern lake basin these changes are clearly associated with an increase in violent conflict and competition. However, the archaeological evidence for hierarchy from the southern Titicaca Basin is inconclusive. This article presents analyses of burials from the southern Titicaca Basin to investigate the creation of social hierarchy during this time. These burials came from seven distinct burial locations, suggesting that hierarchy or ritual exclusion was occurring. Indicators of childhood malnutrition, skeletal responses to inflammation, and traumatic lesions were recorded as potential markers of status differentiation. Results showed that no indicators varied significantly between burial groups, with the exception of age and cribra orbitalia. I interpret these results as representative of a lack of social hierarchy, at least as reflected on the skeleton. Instead, groups may have acted cooperatively in order to facilitate these larger socioeconomic changes.

Keywords: Titicaca Basin; social complexity; hierarchy; heterarchy; cooperation; paleopathology

Entre 800 aC y 200 dC, las personas en la cuenca del Titicaca en Perú y Bolivia comenzaron a practicar la agricultura, a vivir en pueblos y a participar en rituales públicos. Esta complejidad social probablemente estaba asociada con cambios en relaciones de poder y jerarquía social, como se ha notado en otras partes del mundo. De hecho, en la cuenca del norte, estos cambios se asociaron claramente con un aumento en violencia y competencia. Sin embargo, en la cuenca del sur, la evidencia arqueológica de jerarquía es ambigua. Este estudio presenta el análisis de entierros de la cuenca sur del Titicaca para investigar la creación de jerarquía social en este momento. Estos entierros vinieron de siete cementerios diferentes, lo que sugiere que la jerarquía o exclusión ritual estaba ocurriendo. Los indicadores esqueléticos de malnutrición infantil y enfermedad y lesiones de trauma fueron registrados para analizar el potencial en diferenciación de estatus social. Los resultados muestran que los indicadores no varían significativamente entre los entierros o grupos de entierros, excepto por edad y cribra orbitalia. Estos resultados indican una falta de jerarquía social, como se refleja en el esqueleto. A lo contrario, los grupos pueden haber actuados cooperativamente para facilitar estas cambias sociales.

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A suite of political, social, and economic changes occurred in the Titicaca Basin of Peru and Bolivia between 800 BC and AD 200, including the development of long-distance trade networks (Burger et al. 2000; Levine et al. 2013; Stanish et al. 2002), an increased reliance on agriculture (Bruno and Whitehead 2003; Moore et al. 2007), and the emergence of a shared ritual tradition (K. Chávez 1988; K. Chávez and Chávez 1997; S. Chávez 2004; S. Chávez and Chávez 1976). In other parts of the world, these developments were often accompanied by status aggrandizing; archaeologists refer to this as emergent social complexity (Earle 1997; Eshed et al. 2010). This article hypothesizes that hierarchy in the Titicaca Basin would have developed differently because (1) the extreme altitude of the region limited agricultural productivity and (2) Andean kinship networks facilitated trade which may have prevented any individual from gaining privileged access to resources. This article investigates how people living at seven sites on the Copacabana Peninsula during the Early Horizon (800–50 BC) and Early Intermediate Period (50 BC–AD 200) navigated these new social institutions and constructed their communities. To do so, I present bioarchaeological markers of status and hierarchy embodied by the skeletons of those buried there (see Agarwal and Glencross 2011; Becker and Juengst 2017; Klaus et al. 2017; Martin et al. 2014). Results reveal that despite the complex socioeconomic changes that occurred at this time, competitive or violent hierarchy did not emerge. Instead, shared ancestry and religion motivated the communal labor necessary to build agricultural terraces and public architecture and to coordinate trade activities. This finding is in contrast to patterns seen in other parts of the Andes, and around the world more broadly. Additionally, this work demonstrates how detailed bioarchaeological investigations, combined with archaeological context and analysis, contribute new insights into the heterogeneity and complexity of social processes across time and space.

The Archaeological Context of the Titicaca Basin during the Early Horizon

At 3,810 m above sea level, Lake Titicaca is the world's highest navigable lake (Fig. 1). The altitude limits the agricultural potential of the region, as many plants do not thrive in these alpine conditions. However, the lake provides numerous edible resources in the form of fish, frogs, fowl, and plant life, and raises local temperatures by as much as 2°C, making lakeside agriculture possible. Because of this, humans have successfully occupied the lake basin for at least 10,000 years (Craig et al. 2010; Haas and Llave 2015), with the establishment of semi-sedentary settlements sometime between 1800 and 800 BC (Bandy 2004).

During the Early Horizon (800–50 BC), plant domesticates such as quinoa and maize were present in the lake basin (Bruno and Whitehead 2003; Murray 2005). Maize may have been locally grown or traded into the region from lower altitudes (Bruno and Whitehead 2003; S. Chávez and Thompson 2006). While fish resources remained central to diet (Capriles et al. 2014), the growing importance of agricultural crops was underscored by the increased investment in agricultural land; extensive terrace systems were built during the Early Horizon, increasing field space and preventing soil erosion (S. Chávez 2012). Herding domesticated camelids was also an important economic strategy during this time (Moore et al. 2007). In addition to increased local agriculture, long-distance trade routes brought exotic goods such as obsidian into the region from as far as 200 km away (Burger et al. 2000; Stanish et al. 2002).

Alongside these economic changes, the first regional ritual tradition, called Yaya-Mama, emerged in the southern lake basin. Defined by Karen Mohr Chávez in 1988, the Yaya-Mama religious tradition[1] was associated with the construction of sunken temple courts, carved stone sculptures often depicting paired male/female human figures, and the presence of ritual paraphernalia like ceramic trumpets (K. Chávez 1988; K. Chávez and Chávez 1997; S. Chávez 2002; S. Chávez and Chávez 1976; Janusek 2008). This religious tradition was present throughout the southern Titicaca Basin by the end of Early Horizon and beginning of the Early Intermediate Period (EIP) (50 BC–AD 200) (Browman 1978; K. Chávez 1988; S. Chávez 2004). The temples were square or rectangular sunken spaces built on high hills, artificial mounds, or at the foot of cliffs (S. Chávez 2004). While temples shared many attributes, other aspects, such as pottery style and exact temple layout, varied significantly throughout the region.

Activities at Yaya-Mama temples included mound building, feasting, sharing ritual substances, and human and animal burial (S. Chávez 2004, 2012; Hastorf 2003; Logan et al. 2012; Roddick et al. 2014). Across temples, there seems to have been an emphasis on communal ritual and ancestor veneration, especially during their early use. Evidence for ceremonial activity focused on ancestors included the investment in civic rather than domestic architecture, the inclusion of human burials both within and surrounding temples, and pottery associated with serving rather than cooking or storing (S. Chávez 2004; Hastorf 2003;

1. The Yaya-Mama religious tradition is also called Pa-Ajano by scholars working in the lake basin (Browman 1978).

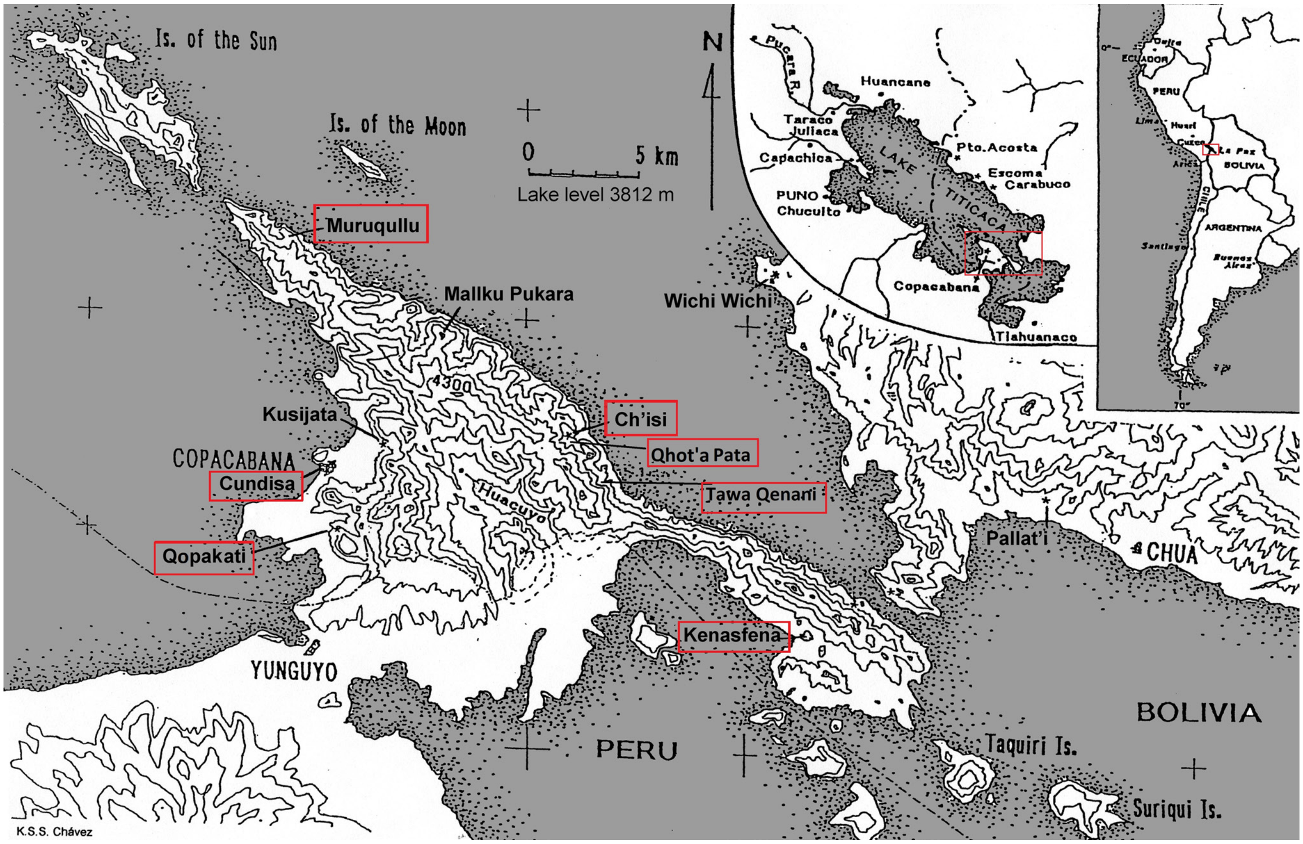

Figure 1. Map of the Copacabana Peninsula with archaeological sites and modern towns (adapted from S. Chávez 2012).

Logan et al. 2012; Roddick et al. 2014). In addition, on the southern Taraco Peninsula, from a small sample of human burials, there was little evidence for violent trauma (Blom and Bandy 1999), mimicking the dearth of archaeological evidence of warfare or raiding from the Copacabana Peninsula (S. Chávez 1992, 2002, 2012). Previous dental biodistance analysis of burials from the Copacabana Peninsula showed that people were fairly closely related, no matter where they were buried (Juengst 2017). Additionally, strontium isotopes (a marker of geographic origin) from these same skeletal samples identified four juveniles and four adult female individuals who were born and lived in other parts of the Andes during their childhoods, suggesting that long-distance kinship networks may have been present during this time (Juengst 2017). These trends suggested that temples and kinship were perhaps mitigating hierarchy normally associated with agricultural and trade developments.

However, scholars have shown that on the north side of the lake a similar suite of socioeconomic changes resulted in increased hierarchy and warfare, ultimately leading to large-scale burning of temples (Levine 2012; Plourde and Stanish 2006; Stanish and Levine 2011). Here, at two large sites called Taraco (different from the previously mentioned Taraco Peninsula) and Pukara, people began living in centralized villages and practicing agriculture between 1400 and 500 BC, similar to the patterns seen in the southern lake basin. However, in contrast to the iconography of Yaya-Mama, around 500 BC, emergent ritual in the northern lake basin appeared to venerate individuals and military prowess. Sites were built in more defensible locations, and excavations at the Pukara temple produced several trophy heads, perhaps taken in battle (Arkush 2005; Stanish and Levine 2011). Evidence for increasing violence culminated in the burning and abandonment of the temple at Taraco around the first century AD, with power clearly shifting to Pukara thereafter (Stanish and Levine 2011). The socioeconomic changes that occurred in the northern lake basin have been interpreted as spurring cycles of competitive violence and hierarchy that led to eventual state formation in the lake basin.

These processes could have also been at work in the southern lake basin as people adopted new ways of living. While the archaeological evidence does not clearly indicate hierarchy, the variation in temple use may indicate that these ritual centers were competing for power across the peninsula. Ritual or religious affiliation may have structured or promoted community organization, as ritual often includes both "perceived ethnic groupings and aspects of activity" (Zakrzewski 2011:186). By affecting the activities people undertake and the way they think about themselves and each other, ritual and use of public space were often central to creating and reinforcing divisions of "us" and "them," creating, reinforcing, and shifting exclusive and inclusive social networks (Barth 1966; Grau Mira 2016; Sharratt 2016; Zakrzewski 2011). Notably, these categories were not always rigid or unchanging (Barth 1966, 1969), but the daily reminder of who participated in certain activities and who was excluded (or deviated from these patterns) created community *habitus* in repetitive ways that were inscribed on the human skeleton (Becker and Juengst 2017; Sofaer 2006, 2011; Zakrzewski 2011). The inclusion of burials at different locations on the landscape may have been linked to the emergence of different classes of people in the southern lake basin, both reflected and reinforced by these mortuary traditions. Analyzing the human skeletal remains buried at these different sites for markers of stress and trauma can help clarify how ritual and social structures were connected in the southern lake basin, especially in the context of the cyclical violence of the northern lake communities.

Bioarchaeology of Social Complexity and Stress

Community structures dictate many aspects of life—whom we interact with, what resources we have access to, what activities we participate in, and the amount of power we wield over others or is wielded against us. Thus, investigating community composition is one way to understand power relationships. Power differences associated with status are not necessarily organized hierarchically; heterarchy, or horizontal power differentiation, is another common way of organizing complex communities (Crumley 1987, 2007; Klaus et al. 2017). Rather than the vertical ranking commonly associated with hierarchy, heterarchy may include differential or shared access to power at various times based on labor, gender, or age, among other possibilities (Becker 2017; Crumley 1987) and may contain hierarchies within these categories (Crumley 1987). Cooperation and consensus are often crucial to heterarchical systems, as people invest in cooperative (rather than competitive) relationships to achieve common goals (DeMarrais 2016). Both hierarchy and heterarchy affect human bodies, as our daily lives, access to resources, and social interactions become inscribed on our bodies in specific ways (Becker and Juengst 2017; Klaus et al. 2017; Sofaer 2006). In particular, risk and experience of stress and disease, access to food, and trauma experiences are closely linked with power relationships.

Increased risk of disease and trauma are reliable indicators of low social status, especially in association with increasing social complexity (Goodman 1998; Klaus 2012; Klaus et al. 2017). This is due to many factors, including the increased workload of lower social classes, substandard housing, limited access to clean water or good sanitation practices, psychosocial stress caused by discrimination and worry, decreased access to nutrition especially during childhood growth, and being a target for socially sanctioned or acceptable violence (Goodman 1998; Goodman and Martin 2002; Klaus et al. 2017; Marquez-Morfin 1998; Martin et al. 2012; Pérez 2012; Sapolsky 2004). At the core of these patterns is the idea that "social structures impair the ability of groups of individuals to access key resources, rendering them unable to meet their needs" (Larsen 2012:xii). In other words, processes such as public policies, systems of exchange, subsistence strategies, and social roles structure how people access resources and experience violence (Crooks 1998; Farmer 1999, 2003; Goodman 1998; Klaus et al. 2017; Martin et al. 2012, 2014; Swedlund and Ball 1998). While the type of structures and policies in place are variable by population and culture, each of these larger processes leaves people at increased *risk* of disease and trauma and exposes them to more physical and social stress overall.

Skeletally, stress and violence are recorded through the presence of lesions associated with nutrient deprivation, chronic infection, and skeletal trauma (i.e., cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia, periosteal reactions, osteomyelitis, and fractures). Unfortunately, human skeletal remains do not perfectly reflect one's life experience; often, severe and acute infections or extreme nutritional stress may cause death prior to formation of diagnostic lesions (Wood et al. 1992). This complicates interpretations of individuals without lesions, as it is difficult to say whether they encountered infections or malnutrition (DeWitte and Stojanowski 2015; Wood et al. 1992). Conversely, individuals who present skeletal and dental lesions may have been more resilient over the long term, experiencing disease and nutritional insults but rebounding from these insults for long enough to have bony reactions (DeWitte and Stojanowski 2015; Wood et al. 1992). In order to limit the impact of this "osteological paradox," it is important to investigate skeletal pathology within the archaeological context and with as much chronological control as possible (DeWitte and Stojanowski 2015).

Chronic morbidity may be a more productive measure of stress and status than mortality; the chronically ill represent individuals who regularly encountered disease and nutritional insults, whether or not they ultimately died from these insults (Goodman and Martin 2002; Reitsema and McIlvaine 2014; Temple and Goodman 2014). A careful consideration of multiple indicators of chronic stress across skeletal samples and accounting for individual frailty allows bioarchaeologists to reconstruct stress profiles for populations without overreaching (Reitsema and McIlvaine 2014; Wilson 2014). Using this framework of stress and morbidity, I investigate skeletal indicators of chronic stress and disease, and traumatic lesions, described below, to compare the daily life experiences of Copacabana individuals as a proxy for status.

Periosteal reaction and osteomyelitis

Periosteal reactions are caused by trauma to the outer layer of bone (periosteum) and are associated with systemic infection and inflammation. They are marked skeletally by areas of abnormal porosity, new bone formation, hypervascularity, and appositional bone on top of the cortical bone surface (Aufderheide and Rodríguez-Martin 1998; DeWitte 2014; Ortner 2003, 2008). While these indicators can stem from many causes (Weston 2008), the presence of these lesions is generally tied to systemic infections when lesions are found systemically or bilaterally throughout the skeleton. Remodeling or healing of these lesions can indicate the ability of the person to recover from these stressful events, thereby providing a commentary upon overall individual resilience (Ortner 2008). As discussed above, these lesions are chronic; individuals with periosteal lesions may be more resilient than those without, given that they survived the stressor long enough to allow these lesions to form. However, DeWitte (2014) and DeWitte and Wood (2008) show that periosteal lesions are positively correlated with increased mortality. Thus, while individuals may be initially more resilient, the chronic stress associated with these lesions may erode individuals' bodily and immune capability to respond to insults over time, leaving them increasingly vulnerable to future events.

Cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia

Periods of stress and nutrient deficiency in childhood can have effects on the skeleton and dentition that persist into adulthood. Cribra orbitalia (CO) and porotic hyperostosis (PH) are lesions in the eye orbits and on the cranium, respectively, and can co-occur or occur independently of one another (Oxenham and Cavill 2010; Stuart-Macadam 1985, 1992). Linear enamel hypoplasia (LEH) occurs in dental enamel due to episodes of extreme nutritional or immune stress. All three are generally considered to be indicative of stressful episodes in childhood (Goodman and Rose 1990; Hillson 1996; Larsen 1997; Stuart-Macadam 1985, 1992; Walker et al. 2009), stemming from insufficient nutrient intake, disease episodes, and/or high levels of bodily parasites (Blom et al. 2005; Kent 1986; Stuart-Macadam 1992; Walker 1986; Walker et al. 2009). CO and PH have been linked to a variety of nutrient deficiencies such as iron, scurvy, vitamin B12, and folic acid, and probably often result from multifactorial nutrient deficiencies, as these types of malnutrition tend to co-occur (Brickley and Ives 2006; Klaus 2012; McIlvaine 2013; Rothschild 2012; Walker 1986; Walker et al. 2009). Evidence for healing of the cranial lesions gives some indication of whether the stresses were relieved. LEH is different in that it forms upon recovery from a stressful episode (Armelagos et al. 2009). Thus its presence indicates survivorship of a childhood stressful event, although the entry of the person into the skeletal record may represent succumbing to a later episode (Wilson 2014).

Trauma

Skeletal injury may result from accidents or moments of intentional violence, caused by a range of behaviors, including both socially sanctioned and external violence (Buzon and Richman 2007; Redfern and Chamberlain 2011; Tung 2007, 2008; Wakely 1996; Walker 1997, 2001; Wheeler et al. 2013). Violence is often tied to ideological and social control and usually is not equally distributed across society (Farmer 1999, 2003; Martin et al. 2012; Pérez 2012). Not limited to warfare or large-scale conflict, violence may permeate daily life through socially sanctioned targeting of certain individuals or ethnic groups (Pérez 2012), through social structures that put some at higher risk of violence and disease than others (Farmer 2003; Klaus 2012), or through ritualized violence such as cannibalism or ritual fights (Hatch 2012; Tung 2007). The visual impact of broken bodies (living and dead) is culturally dependent but has been used as a way to manipulate the living and reinforce power relationships (Crandall and Martin 2014; Harrod et al. 2012, 2017; Pérez 2012; Tung 2014).

Violent conflict also happens outside "normal" social bounds and often increases during times of changing sociopolitical relationships and environmental stress (Arkush and Allen 2006; Arkush and Tung 2013; Kuckelman 2012; Montgomery and Perry 2012). In these cases, larger-scale violence such as warfare and systemic raiding may occur. However, even in chaotic violent landscapes, violence is not random;

certain groups (typically those with less power) are generally targeted as victims of violence. Low-status individuals are thus targets for violence in instances of daily structural violence, socially sanctioned punishment, and episodes of large-scale war (Arkush and Tung 2013).

Different patterns of skeletal injury help to reveal the experience that produced these traumatic lesions. For instance, trauma to the facial or frontal bones often results from face-to-face conflicts, while injuries to the posterior portion of the skull may occur while one is fleeing from an attacker (Berryman and Haun 1996; Lovell 1997; Tung 2007; Walker 1997, 2001). Fractures on the ulna are often associated with defense, as they may result from raising an arm to ward off a blow. Other distal arm fractures are indicative of falling onto an outstretched hand, which may result from a violent conflict or an accidental fall. Thus, the location and type of cranial and arm fractures can help to distinguish between accidental and violent trauma, patterns that can be traced across a group of people in order to see if certain people were at higher risk of sustaining intentional injury (Berryman and Haun 1996; Brickley 2006; Judd 2008; Lovell 1997; Martin and Frayer 1997; Symes et al. 2012; Tung 2007; Walker 1997, 2001).

By analyzing these lesions and indicators in conjunction with archaeological materials, we can gain insight into both childhood and adult immuno-nutritional insults and risk of intentional violent trauma for different peoples. If the emergence of social complexity in the Titicaca Basin created power disparities among burial groups, I would expect to see significant differences in the experience of stress and trauma between individuals and/or burial groups. To test this, I observed the Copacabana skeletal sample for five indicators of chronic stress and malnutrition and traumatic lesions, and present comparisons at the group level.

Archaeological Background of Copacabana Sites

The skeletal sample for this study was excavated from seven Early Horizon and Early Intermediate Period (EIP) sites on the Copacabana Peninsula: Ch'isi, Cundisa, Muruqullu, Kenasfena, Qhot'a Pata, Qopakati, and Tawa Qeñani (Fig. 1). Cundisa and Kenasfena included the earliest burial samples, with primary occupation during the Early Horizon (800–50 BC), while the other five sites were likely occupied during the latter half of the Early Horizon (400–50 BC) and throughout the EIP (50 BC–AD 200). Each site and burial sample is described in more detail below, but notably, no habitation sites were associated with these remains—all come from cemetery or ritual contexts. These remains were excavated by the Yaya-Mama Project between 1992 and 2009 and are currently undergoing repatriation to local communities in accordance with original excavation agreements (S. Chávez 2008a, 2008b).[2]

Ch'isi was a Yaya-Mama temple located on the western portion of the Copacabana Peninsula and was primarily occupied through the latter half of the Early Horizon and throughout the EIP (i.e., approximately 400 BC–AD 200). The main architectural feature of this site was the sunken court; surrounding the court were rings of burials, in tombs lined with stone. These burials were oriented roughly parallel to the sunken court walls, with four individuals placed at each corner and turned 45 degrees (S. Chávez 2004). Most tombs included one individual, although a few contained commingled remains of several individuals. Some tombs had been reopened occasionally, either to add more individuals or potentially leave offerings of food and drink. Few tombs had associated grave goods (Sergio Chávez personal communication 2012). A total of 52 Early Horizon and EIP individuals were interred at this site.

Cundisa was a site located in modern Copacabana with evidence of continuous occupation and use from the Early Horizon through the modern day (S. Chávez 2008a). This site is currently beneath the modern governmental office of Copacabana. Burials were excavated in 1993 and 2009 from strata associated with the Early Horizon—the earliest included in the analysis here. These burials had worse preservation than burials at other sites, likely because they were not buried in the same stone-lined tombs noted elsewhere (S. Chávez 2008a). These burials included some utilitarian pottery but fewer ritual items than burials at other sites (Stanislava Chávez personal communication 2012). The Cundisa sample included at least 33 individuals.

2. The remains were excavated from these seven sites between 1992 and 2001 under the direction of Karen Mohr Chávez and Sergio Chávez, and from 2003 to 2008 under the direction of Sergio Chávez and Stanislava Chávez. All excavation was done as a part of the International and Interdisciplinary Yaya-Mama Archaeological Project (also called the Yaya-Mama Project). The skeletal remains used in this article were curated by the Yaya-Mama Project in Copacabana, Bolivia. The remains excavated between 1992 and 2006 were initially analyzed and documented by Dale Hutchinson as a member of the Yaya-Mama Project (Hutchinson 1997; Hutchinson and Norr 2002), studies that I build upon in this article. The skeletal remains are currently being returned to local peninsular communities in accordance with the original written agreements with them (S. Chávez 2008b).

Muruqullu, located on the northern part of the peninsula, was primarily used as a Yaya-Mama temple and had two stages of occupation at the end of the Early Horizon and EIP (i.e., approximately 400 BC–AD 200). During both occupations, people used the site for burial. There were three burials around the temple, diagonally placed at corners, as seen at Ch'isi, but the majority of the burials were in the cemetery-like area next to the temple. This cemetery mostly included Early Horizon and EIP burials but also contained remains of several Preceramic (3000–1500 BC) and Middle Horizon (AD 400–1100) burials (not included in this analysis) (Sergio Chávez personal communication 2012; Juengst et al. 2017a). Early Horizon and EIP burials were identified by the inclusion of Yaya-Mama pottery, stone tools, or having a stone-lined tombs. Grave goods were not elaborate but usually utilitarian pottery associated with serving food and drink (Sergio Chávez and Stanislava Chávez, personal communication 2012). Eighty-five individuals were associated with the Yaya-Mama temple occupation of the site.

Kenasfena was a Yaya-Mama temple on the southeastern portion of the Copacabana Peninsula, near the modern town of Huayllani close to the strait of Tiquina. This site had at least three temple construction events during the Early Horizon (800–50 BC). Test excavations revealed two burials, each containing one individual and fragmentary ritual pottery (Sergio Chávez personal communication 2012).

Qhot'a Pata was a site located in the valley adjacent to and contemporaneous with the temple at Ch'isi. Identified by a collection of Early Horizon pottery, stone tools, and two human burials, the use of this site was unclear. Both individuals from Qhot'a Pata were buried in individual earthen pits (Sergio Chávez personal communication 2012).

Qopakati was a Yaya-Mama temple located on the southwestern portion of the Copacabana Peninsula, close to the modern border between Peru and Bolivia. This site was also associated with early rock art, carvings, and painting of camelids and an Andean cross. This art may have been contemporaneous with or postdate the EIP temple. Qopakati excavations only included preliminary test pits and a trench, so less is known about temple structure and orientation. However, the trench uncovered several burials associated with the temple that appeared to have stone-lined graves. Most of these burials contained the remains of one or two individuals, totaling seven individuals (Sergio Chávez personal communication 2012).

Tawa Qeñani was a small site on the eastern portion of the Copacabana Peninsula, just south of and contemporaneous with Ch'isi. Limited excavation was performed at this site, but test pits revealed several burials associated with ritual pottery and Yaya Mama–style tombs (Sergio Chávez personal communication 2012). There were three juvenile individuals buried at Tawa Qeñani.

Materials and Methods

The skeletal sample from this study includes 184 individuals from the sites described above. Sample size varied between sites: Ch'isi ($n = 52$), Cundisa ($n = 33$), and Muruqullu ($n = 85$) contributed the majority of individuals, while text excavations at Kenasfena ($n = 2$), Qhot'a Pata ($n = 2$), Qopakati ($n = 7$), and Tawa Qeñani ($n = 3$) contributed 14 additional individuals.

Age at death was determined for each individual based on a number of dental and skeletal traits. I used tooth eruption and wear as the primary indicators of age when dentition was available for the individual. Tooth eruption and tooth root formation were scored using the standard eruption chart (Ubelaker 1989). I paid special attention to the eruption of the adult first, second, and third molars, erupting at approximately 6, 12, and 18–22 years, respectively. Additionally, I scored dental wear based on scoring systems developed by Murphy (1959) and Smith (1984) and diagram widely used for age estimation (Buikstra and Ubelaker 1994). When possible, I used both dental eruption and dental wear to estimate age.

When dentition was not available, I estimated age based on cranial suture closure, the appearance of the pubic symphysis, and fusion of the epiphyses of long bones. The sutures of the cranium slowly fuse over one's lifetime; they are open at birth, remain relatively open throughout childhood, and undergo fusion through middle and old adulthood. They are typically fully obliterated by 55 years of age. When articulated crania were present, I compared suture patterns to a standard set of images of progressive suture closure (Meindl and Lovejoy 1985; photos by P. Walker in Buikstra and Ubelaker 1994).

The pubic symphysis of both males and females undergoes a series of standard changes throughout the life course. I compared intact pubic symphyses to the Todd (Todd 1921a, 1921b) and Suchey-Brooks (Brooks and Suchey 1990; Suchey and Katz 1986) pubic symphysis mold series and subsequently gave them the corresponding score and age category. The epiphyses of long bones fuse throughout childhood and adolescence. This pattern of fusion is notably regular across populations, within a certain range, and can be used to estimate approximate age for young individuals. Notable epiphyses were the proximal and distal tibia (fusing around 12–16 years), the distal femur (14–16 years), the iliac crest (17–20 years), and the medial clavicle (20–25 years), as these unions mark the upper limits of childhood and adolescence, often an important social moment in one's life (Buikstra and Ubelaker 1994; Sofaer 2006; Ubelaker 1989).

The age categories include mature and old adult (over 25 years of age), young adult (18–25 years), adolescent (13–17 years), juvenile (3–12 years), infant (birth–2 years), and fetus (prenatal). When an age range could not be estimated or groups were lumped for analysis, I used adult (18 years and older) and subadult (under 18 years). These age categories were selected because they represent moments of significant biological change over the life course which often have social consequences. Biological processes like weaning and puberty are often cross-culturally important to social status, as they reflect new periods of independence and a significant shift in relationships between people (Halcrow and Tayles 2011:336; Sofaer 2006, 2011).

Sex was estimated for all adolescent, young adult, and adult individuals when pelvic and cranial remains were present. Pelvic remains were privileged during sex estimation, as these bones are most affected by reproductive needs and consequences. Female pelves tend to be wider overall and marked by the presence and appearance of the following features: the subpubic concavity, the ischiopubic ramus, the ventral arc, the greater sciatic notch, the pelvic outlet, and the preauricular sulcus. I scored these features following methods developed by Bass (1995), Buikstra and Meilke (1985), and Phenice (1969). I assigned definitive sex categories (female, male) only to those with well-preserved pelvic characteristics. Individuals with ambiguous pelvic traits but suggestive cranial traits were assigned probable sex categories (probable female, probable male) according to standards in Buikstra and Ubelaker (1994) following methods developed by Acsadi and Nemeskeri (1970). I did not estimate sex for individuals without crania or pelves or for those under 15 years of age. For statistical analyses I combined probable and definite sex categories (i.e., combining probable females and females). In my qualitative observations I maintained these as separate categories.

I recorded periosteal reactions and osteomyelitis by skeletal element, location on element, and extent of the lesion. Periosteal reactions were identified by new bone formation, hypervascularity, and appositional bone deposits. While periosteal reactions stemming from systemic infection generally affect more than one skeletal element, I recorded all present periosteal reactions, since many burials were incomplete or fragmentary. Healing of periosteal reactions was recorded as fully healed (woven bone was remodeled although defect was still notable), some healing (woven bone was partially smoothed but active areas were still observable), and active (no evidence for healing) (Buikstra and Ubelaker 1994:118; Ortner 2008:196). I additionally recorded osteomyelitis by obstruction of the marrow cavity (if observable) and the presence of draining sinuses or cloaca (Buikstra and Ubelaker 1994:119; Ortner 2008:195).

Porotic hyperostosis and cribra orbitalia were recorded according to location and size of the defect following standard methods in Buikstra and Ubelaker (1994:120–121). Additionally, these lesions were observed for signs of healing, recorded as fully healed (smoothed bony surface without remaining pits and remodeled diploic expansion), some healing (some pits visible, diploie expanded), or active (no evidence for remodeling).

I recorded linear enamel hypoplasia as present or absent. I did not measure distance of the defect from tooth crown but counted in frequency per tooth and per individual (Hillson 1996). Only horizontal grooves were recorded, following Goodman and Armelagos (1988) and Boldsen (2007).

Trauma was recorded by individual and skeletal element following methods described by Berryman and Haun (1996). I observed the skeletons for evidence of antemortem or perimortem trauma following methods described by Berryman and Haun (1996), Buikstra and Ubelaker (1994), and Walker (1997, 2001). Fractures were described as complete or incomplete, and any bony remodeling was recorded as indicative of healing and timing of the injury. Healing was recorded as none (sharp fracture edges, no bone remodeling), partial (some new bone growth evident), or fully healed (extensive remodeling).

I used Monte Carlo chi-square significance tests to look for significant patterns of lesion and indicator distribution between burial samples. I also looked for variation within samples according to demographic data. Monte Carlo tests were used because they are able to statistically compare multiple variables from small data sets and still provide significant results. Significance was attributed to comparisons when $p > 0.05$. While there is controversy over the reliability or significance of p-values, these statistical analyses remain a standard in the field and are thus included here. Interpretations of the results consider both statistically significant differences and qualitative trends.

Results

Results from demographic analyses are presented in Tables 1 and 2, followed by paleopathological (Tables 3 and 4) and trauma analyses (Table 5). Statistical analyses are included at the end of each section.

Table 1. Age distribution at Copacabana Peninsula sites.

Site	Adult	Young Adult	Adolescent	Juvenile	Infant	Fetus	Total
Ch'isi	26	2	1	13	10	0	52
Cundisa	26	1	4	2	0	0	33
Kenasfena	1	0	1	0	0	0	2
Muruqullu	47	11	8	14	4	1	85
Qhot'a Pata	2	0	0	0	0	0	2
Qopakati	2	3	0	2	0	0	7
Tawa Qeñani	0	0	0	3	0	0	3
Total	104	17	14	34	14	1	184

Table 2. Sex distribution at Copacabana Peninsula sites.

Site	Female	Probable Female	Male	Probable Male	Indeterminate	Total
Ch'isi	2	4	4	9	9	28
Cundisa	1	5	2	10	8	26
Kenasfena	1	0	0	0	1	2
Muruqullu	3	10	3	17	23	56
Qhot'a Pata	0	1	0	0	1	2
Qopakati	2	2	0	3	0	7
Tawa Qeñani	NA	NA	NA	NA	NA	NA
Total	9	22	9	39	42	121

Table 3. Frequency and percent of individuals with active and healed inflammatory lesions.

	Periosteal Reactions				Osteomyelitis			
Site	Subadult	Adult	Percent Active	Percent Healed	Subadult	Adult	Percent Active	Percent Healed
Ch'isi	1/4 (25%)	10/17 (58%)	81%	19%	0/4 (0)	3/17 (17%)	100%	0
Cundisa	1/3 (33%)	6/16 (38%)	29%	71%	0/3 (0)	1/16 (6%)	100%	0
Kenasfena	1/1 (100%)	0/1 (0)	0	100%	0/1 (0)	0/1 (0)	0	0
Muruqullu	5/18 (27%)	18/42 (42%)	78%	22%	0/18 (0)	3/42 (7%)	100%	0
Qhot'a Pata	—	2/2 (100%)	0	100%	—	0/2 (0)	0	0
Qopakati	2/2 (100%)	2/4 (50%)	0	100%	0/2 (0)	0/6 (0)	0	0
Tawa Qeñani	1/2 (50%)		100%	0	0/2 (0)		0	0
Total	11/30 (36%)	38/82 (46%)	61%	39%	0/29 (0)	7/82 (9%)	100%	0

Table 4. Frequency and percent of individuals with indictors of childhood stress.

	CO		PH		LEH	
Site	Subadult	Adult	Subadult	Adult	Subadult	Adult
Ch'isi	8/14 (53%)	6/11 (54%)	2/9 (22%)	2/21 (10%)	4/14 (29%)	0/25 (0)
Cundisa	1/4 (25%)	2/13 (15%)	1/4 (25%)	2/13 (15%)	1/5 (20%)	3/15 (20%)
Kenasfena	—	0/1 (0)	—	0/1 (0)	—	0/1 (0)
Muruqullu	5/18 (28%)	7/32 (22%)	5/20 (25%)	6/34 (18%)	9/25 (36%)	2/33 (6%)
Qhot'a Pata	—	1/1 (100%)	0/1 (0)	0/2 (0)	0/0 (0)	0/2 (0)
Qopakati	2/2 (100%)	0/2 (0)	1/2 (50%)	0/1 (0)	2/4 (50%)	0/2 (0)
Tawa Qeñani	1/1 (100%)	0 (0)	1/1 (100%)	—	3/3 (100%)	—
Totals	17/39 (44%)	16/60 (27%)	10/37 (27%)	10/71 (14%)	19/51 (37%)	5/78 (6%)

Age and sex (Tables 1 and 2)

Mature and old adults (25+ years) comprised approximately half of the entire skeletal sample (104/184, or 57% of individuals), with juveniles the second-most-numerous group (34/184, or 18%) (Table 1). Young adults ($n = 17$), adolescents ($n = 14$), and infants ($n = 14$) were 9%, 8%, and 8% of the sample, respectively. One site (Muruqullu) had fetal remains of one individual. Tawa Qeñani, Ch'isi, and Muruqullu were notable for including the largest proportions of juveniles (100% of the sample from Tawa Qeñani, 25% of the Ch'isi sample

Table 5. Frequency and percent of individuals with violent trauma. Asterisks denote samples that included an individual with surgical intervention.

	Trauma			
	Subadult		Adult	
Site	Frequency Affected	Percent Affected	Frequency Affected	Percent Affected
Ch'isi	0/24	0	5/28*	18%
Cundisa	1/6*	16%	1/27	4%
Kenasfena	1/1	100%	0/1	0%
Muruqullu	1/25	4%	3/58*	5%
Qhot'a Pata	0/0	0	0/2	0
Qopakati	1/2	50%	1/4	25%
Tawa Qeñani	0/3	0	0/0	0
Total	4/61	7%	10/120	8%

and 16% of the Muruqullu sample) and infants (19% of the Ch'isi sample and 5% of the Muruqullu sample). This was a statistically significant variation from the demographic distribution at other sites ($p = 0.033$).

Sex was estimated for 121 individuals (Table 2). I estimated 7% of this sample to be female ($n = 9$), 18% probable female ($n = 22$), 7% male ($n = 9$), and 32% probable male ($n = 39$). Thirty-four percent of these adults were of indeterminate sex ($n = 42$). Females and probable females were underrepresented in the three largest samples (Ch'isi, Cundisa, and Muruqullu). Probable males were the most common burials at four of six sites, comprising 30–42% of the samples when present. This was statistically significant difference ($p = 0.035$).

Skeletal indicators of inflammatory response (Table 3, Figs. 2 and 3)

Of 112 observable individuals, 49 (43.8%) had periosteal reactions on at least one skeletal element; 11 (36%) of 30 subadults and 38 (46%) of 82 of adults were affected. Thirty (61.2%) of 49 cases were active. I estimated that 14 affected individuals were females or probable females, 20 were males or probable males, and 8 were subadults. I could not estimate sex for 7 individuals with periosteal reactions. Periosteal reactions did not vary significantly by burial location, sex, or age.

Osteomyelitis was present on 7 (6.3%) of 112 observable individuals. Only adult individuals experienced osteomyelitis, and all cases of osteomyelitis were active. I estimated the 2 affected individuals were females or probable females, 4 individuals were males or probable males, and I could not estimate sex for 1 affected individual. Osteomyelitis did not vary significantly by burial location or sex.

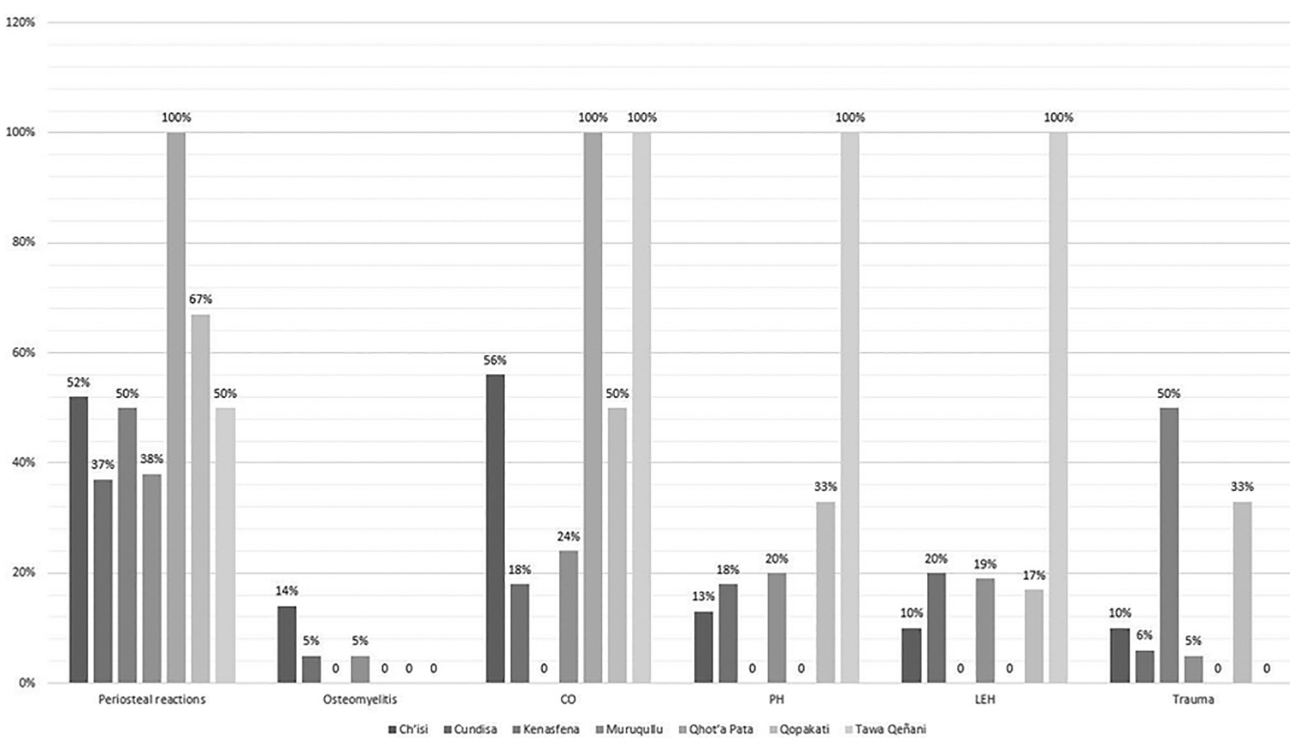

Figure 2. Percentage of samples affected by inflammatory responses, childhood stress indicators, and trauma.

Figure 3. Representative examples of inflammatory responses: periosteal reactions (*top and middle*) and osteomyelitis (*bottom*) in the Copacabana sample.

Figure 4. Representative examples of childhood stress indicators: cribra orbitalia (*top*), porotic hyperostosis (*middle*), and linear enamel hypoplasia (*bottom*) in the Copacabana sample.

Childhood indicators of stress (Table 4, Figures 2 and 4)

I observed 99 individuals for cribra orbitalia, finding 33 individuals (33.3%) with these lesions. Seventeen (44%) of 39 observable subadult crania and 16 (27%) of 60 adult crania were affected. I documented 7 females or probable females, 8 males or probable males, and 1 indeterminate adult with CO. Burial populations at Ch'isi and Muruqullu had significantly more individuals affected by CO than non-temple populations ($p = 0.0043$). CO also varied significantly by age; more CO lesions, healed and active, were observed in subadult individuals compared to adults (although this is not surprising given the etiology of these lesions, discussed more below).

One hundred and eight crania were complete enough for me to observe for PH; of these, 20 (18.5%) had PH lesions. Ten (27%) of 37 observable subadult crania and 10 (15%) of 71 adult crania were affected. Three females or probable females, 6 males or probable males, and 2 adults of indeterminate sex had PH. PH did not vary significantly by burial location, age, or sex.

I observed 129 (73.7%) of 175 individuals for linear enamel hypoplasia. Twenty-three (17.8%) had these enamel lesions, with an average of one per tooth and 2.6 per mouth. Nineteen (37%) of 51 observable subadult dentitions and 5 (6%) of 78 adult dentitions had at least one LEH present. I estimated that 1 affected individual was female, 4 were males or probable males, 1 was an adult of indeterminate sex, and 16 were subadults. LEH did not vary significantly by burial location, age, or sex.

Trauma (Table 5, Figure 5)

Fourteen (7.7%) of 181 individuals had evidence of trauma. Four traumatized individuals were subadults while ten were adults. Fractures were found on six

Figure 5. Representative examples of perimortem (*top*), antemortem (*middle*), and sharp-force (*bottom*) trauma from the Copacabana sample. Top image also includes trepanation.

crania, two vertebrae, three ribs, one ulna, and one radius. Cut marks were found on two tibiae, five ribs, and one femur. Three cranial fractures and all cut marks were perimortem wounds; all of the other traumas were healed. Two individuals showed evidence for trepanation in association with parietal depression fractures (Juengst and Chávez 2015). The ulnar and radial fractures were classified as Colles' fractures, associated with falling on an outstretched arm (Walker 1997). One cut mark was closely associated with active osteomyelitis. Twelve injured individuals were adults and two were subadults. Three males, four probable males, five females, and two probable females experienced trauma, with random distribution of location and type of trauma across these groups. Rates or type of trauma did not vary significantly by burial location, age, or sex.

Discussion

Compared to the other Early Horizon and EIP lake basin skeletal assemblage, the Copacabana sample had lower rates of all stress indicators. Approximately 50% of the adult skeletal sample (total $n = 7$) from the southern Taraco Peninsula demonstrated periosteal reactions (Blom and Bandy 1999), compared to 43.8% (total $n = 49$) from the Copacabana sites presented here. With the exception of CO and PH, the Copacabana individuals experienced all lesions 20–30% less often than Taraco Peninsula individuals (Blom and Bandy 1999). This may be a factor of the relatively small sample size from the Taraco Peninsula (14 individuals); more samples from throughout the lake basin would strengthen these comparisons. Compared with Andean groups more broadly, the Copacabana sample showed lower rates of LEH, CO, and PH but similar to or higher rates of periosteal reactions. For example, Blom et al. (2005:160) found that 35–85% of burials from the south-central Andean coast experienced CO and PH, depending on age and location on the landscape. Similarly, Tung and Del Castillo (2005) report that 43% of a Peruvian sample experienced CO and PH. Scaffidi (2017) summarized CO and PH data from around the Andes and reports that most Early Horizon and EIP samples demonstrate these lesions on more than 50% of individuals. Clearly, the Copacabana CO and PH rates (44% and 27% of juveniles, 27% and 15% of adults, respectively) were comparable to or lower than these comparative studies. Conversely, periosteal reactions occurred at rates similar to or higher than other Andean samples. Pechenkina and Delgado (2006:222) reported that 43% of adult males and 13% of adult females from Villa El Salvador in the Lurin Valley, Peru, experienced periosteal reactions, similar to the rates reported here (although this study did not find differences in these lesions by sex groups). Ubelaker and Newson (2002) found that rates of periosteal lesions in pre-Hispanic coastal and highland Ecuador varied between 3.4 and 34.8% of burial samples, perhaps influenced by group mobility and local environments. Similarly, 24.4% of burials from the highlands of south-central Peru had periosteal reactions (Juengst and Skidmore 2016). While periosteal reactions vary widely around the Andes, the rate reported here (43% of the total sample) was significantly higher than many examples, perhaps due to different levels of mobility and issues with sanitation commonly associated with sedentary settlements.

Importantly for this study, disease risk and stress load did not vary significantly within or between burial samples, based on burial location or demographic factors. Cross-culturally, stress has been shown to be one of the most reliable indicators of social hierarchy, as those with power were able to access more resources and generally avoid strenuous labor (although there are certainly exceptions to this general rule) (Goodman 1998; Klaus et al. 2017). If temples represented the emergence of a class of people with access to more resources and/or power, it would be reasonable to expect that certain individuals would have heightened stress responses and, as a result, increased rates of skeletal and dental lesions associated with stress and disease. However, the data here showed very little difference in stress markers between burial samples or between individuals. Perhaps these patterns reflect the general disease risks associated with sedentary settlements rather than the result of discrimination against one particular class of people (see Juengst et al. 2017c for a more in-depth argument regarding the impacts of sedentism and agriculture on periosteal reactions).

The one exception to this pattern was CO, which was statistically more common among certain burial samples. However, this was a factor of demography rather than disease or stress risk. Significantly more subadults were observable for CO at Ch'isi and Muruqullu than at other sites. The biological processes that create CO and PH lesions were only possible during childhood; lesions on adult individuals indicated survivors of childhood stress and may have been unobservable due to healing over time. Subadults with active lesions may not have survived the stress incident long enough for these lesions to heal, leaving them more readily visible. In fact, linear regression models to smooth this data suggested that age and CO were significantly connected, thus driving the overall significance between sites. The higher frequency of CO at Ch'isi, Muruqullu, and Tawa Qeñani was linked to the etiology of CO rather than a lived experience of those buried at these sites. The overrepresentation of subadults buried at Ch'isi, Muruqullu, and Tawa Qeñani, however, was an interesting pattern to be explored more fully below.

Evidence for violent trauma, or lack thereof, suggested two important trends. First, violent interactions that resulted in skeletal trauma were relatively rare for everyone in the skeletal sample. Second, this lack of trauma was equally rare across all sites, with few examples of violent trauma at any burial location. This absence of evidence does not necessarily mean violence did not occur: violence that did not affect the skeleton cannot be excluded, and it is possible that disposal of those who suffered violence may have happened at heretofore undiscovered locations. However, this lack of trauma is in stark contrast with later Copacabana burial assemblages (Juengst et al. 2017b) and the archaeological evidence of violence and warfare from across the lake at Pukara (trophy heads, evidence of site destruction) (Levine 2012; Stanish and Levine 2011). There is no doubt that the socioeconomic changes happening in the northern lake basin promulgated and escalated violent interactions; however, that pattern does not seem to hold for the southern lake basin. In fact, in the southern lake basin, in two of the cases of violent skeletal trauma (14%), there was evidence for medical intervention, in the form of trepanation (Fig. 5), at two different sites (Juengst and Chávez 2015). The attempts at healing traumatic injury through trepanation present a very different picture of violence associated with competition and status than we see in the northern lake basin.

The Early Horizon around the Andes was a period of regional variability in terms of violence, although overall, cranial trauma rates were low until the EIP (Arkush and Tung 2013). Among their small skeletal sample, Blom and Bandy (1999) report no instances of cranial trauma for Early Horizon individuals excavated from the southern lake basin; this study added six examples of cranial trauma to the highland Bolivia skeletal record. While the Copacabana sample did include some evidence for interpersonal violence, it appeared to have been limited in scope and equally distributed across burial location and demographic categories, suggesting that these examples represented sporadic interactions, that violence tended not to affect the skeleton, or that traumatized individuals were differentially disposed of at other locations.

The only pattern that may suggest emerging status was the inclusion of significantly more male and probable male individuals at certain temples and in the sample overall. While Yaya-Mama imagery often included juxtaposed male and female figures (S. Chávez 2004; Janusek 2004), this balance was not reflected in the burial sample. It seems that burial at temples was more available to males, suggesting that these individuals held some kind of power in the ritual sphere or were more closely linked to the ritual tradition. Division of labor and power based on sex was not rare in the Andes or elsewhere in the world: reciprocal relationships between males and females have been noted in many modern, ethnohistoric, and archaeological contexts (Arnold and Hastorf 2008; Becker 2017; Geller 2017; Silverblatt 1987). Males were not more protected in terms of stress or trauma than females, but it is possible that males held more ritual power or participated more closely in Yaya-Mama, while females perhaps held power in other social realms.

The inclusion of numerous juvenile burials suggests that kinship and lineages played a role in labor sharing. In the Andes more broadly, deceased children and infants often became symbolic ancestors to the whole community and were thus buried at places significant to community identity (Moseley 2001). Sharratt (2014) noted that Tiwanaku infant burials at a Tiwanaku colony site mimicked adult burial in the *altiplano*, evoking imagery of highland ancestry and connecting these infants to Tiwanaku ancestors. Likewise, during Spanish colonization of the Andes, Catholic priests attempted to take advantage of this tradition and replaced local ancestor cults with Christianity by including children in church burials. Burying children in and around churches associated Christianity and Christian spiritual figures with important ancestors, embodied through these children (Wernke 2007). By mimicking adult burial and burying juveniles at significant locations, Andean peoples created and reinforced ancestral lineages. In the modern day, Bolivian indigenous Aymara peoples celebrate infants (*wawas*) and children at naming ceremonies and/or when they receive their first haircut and are considered to be officially members of the family and society (Allen 2002; Blom and Knudson 2014). While the antiquity of this practice is unknown, the emphasis on the importance of young children and family lineages remains today. Perhaps the high proportion of infant and juvenile burials at Yaya-Mama temples presaged such practices. Burying young individuals at ritually significant centers linked them to their ancestral lineage. This action simultaneously created these young dead as symbolic ancestors for individual lineages while also reinforcing ties to community lineages more broadly.

Given the lack of significant differences between individuals and burial groups, power may have been shared heterarchically, with groups cooperating to provide the labor required to cultivate fields, build terraces, and maintain trade networks (K. Chávez and Chávez 1997; S. Chávez 2012:449; DeMarrais 2016). Ancestry and kinship may have been integral to this process, alongside ritual participation. Heterarchy of labor and kinship has been well documented in the lake basin during later time periods, under the Tiwanaku state (AD 400–1100). Tiwanaku was an influential state that colonized several areas of the Andes, with its social and ritual capital (also called Tiwanaku) in the southern lake basin. Labor organization under Tiwanaku was likely heterarchical, with different groups performing different tasks for the state and their livelihoods (Becker 2016, 2017; Janusek 2008). At the core site of Tiwanaku, ethnic neighborhoods devoted to different craft or economic production have been identified, based on the presence of different artifact types (Janusek 2008). Becker (2017) supported this interpretation by showing that muscle markers related to repetitive labor also differed for these groups, indicating that they were engaging in different daily activities. In fact, Becker noted that at several Tiwanaku sites, males and females appeared to have habitually performed different tasks. While skeletal markers of labor were not included in this study, perhaps this tradition of labor divisions between sexes and local groups can be traced further back in time to the Early Horizon in the southern lake basin. As DeMarrais (2016) suggested, this may be a case where ritual and kinship enabled and/or maintained cooperative relationships to achieve common tasks, rather than relying on hierarchical systems of power.

Conclusion

The complex socioeconomic changes of the Early Horizon in the southern Titicaca Basin would have necessitated communal labor in order to build terraces, civic architecture, and coordinate trade relationships. These changes, along with the emergence of ritual, have been closely linked with the development of social stratification in many regions globally, as ideology and control over resources lent power to some people and restricted others from access. On the northern shores of Lake Titicaca, scholars (Cohen 2010; Plourde 2006; Stanish and Cohen 2005; Stanish and Levine 2011) have shown just this: the construction of elaborate ritual structures was paralleled by an increase in social stratification and violent domination by an elite class. It has thus been suggested that the emergence of Yaya-Mama in the southern lake basin represented a similar process (Janusek 2008; Stanish 2003). However, the mortuary and skeletal indicators do not suggest that violence or individualism emerged during this transition in the southern lake basin. People buried at sacred locations were not protected from disease, and everyone seems to have been relatively buffered from violent trauma. When trauma did occur, people across burial locations were eligible to receive care. This confirms the results of other investigations of hierarchy on the peninsula; no archaeological material remains indicate increased violence or elite social classes (S. Chávez 2012:446–449).

If people in the southern lake basin did not motivate labor through violent competition, how did they build complex structures and trade relationships? This distribution of burials, and the similarity of lived experiences between groups, suggests heterarchical or cooperative power distributed across groups rather than hierarchical power limiting access to resources for some. Temple activities may have reinforced kinship relationships, both biological and symbolic, by including burials of the young and marshalled the labor necessary to support the new social complexity. Through ritual construction of shared power and cooperation, people in the southern Titicaca Basin seem to have avoided the violent competition of the northern lake basin while still developing complex trade, ritual, and agricultural practices. Importantly, these power manipulations (consensus, heterarchy, and reliance on ancestry) were also commonly practiced by later Andean peoples; perhaps these traditions developed during this time and endured into future generations, setting the stage for nonhierarchical power for generations to come.

Bioarchaeological methods contribute valuable data to conversations of social organization and power in the past (Klaus et al. 2017). In cases of hierarchy, marginalized peoples may be readily observable through unorthodox burials, fractured bones, and extensive pathological lesions. Even more subtle types of power disparities may be visible through lesions of systemic stress and limited access to resources. Identifying instances of cooperation and/or heterarchy is also possible but may be more difficult, as skeletal markers of shared power may not be as dramatic. Many interpretations of past heterarchy have relied on archaeological evidence, with limited contributions from skeletal remains (although see Becker 2017 for innovative use of skeletal labor markers as indicative of heterarchy). This article thus strives to demonstrate how bioarchaeology can investigate power in the past when archaeological evidence is ambiguous. By combining pathology, trauma, and demographic analyses of dispersed burial groups with the archaeological evidence, this article proposes a new framework for investigating heterarchy and cooperation in the past.

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