

Bioarchaeological Insights on Dental Health and Diet After the Fall of the Wari Empire in the Peruvian Andes

Alysha Tribbett and Tiffany Tung

College of Arts and Science, Vanderbilt University

This research project looked at the dental health of Late Intermediate Period skeletons from the Wari capital to assess their consumption patterns. A high rate of dental disease coupled with carious lesions indicative of coca chewing supports the hypothesis that post-Wari populations maintained many of the agricultural practices and trade networks of the former state, including consumption of large quantities of maize and frequent coca chewing.

Introduction

The Wari state began to flourish at approximately 600 CE in the Andean highlands of Peru, and soon became the region's first expansive empire. From the capital city of Huari in the Ayacucho Basin, Wari incorporated and controlled a wide range of ethnic groups and resources, oversaw impressive feats of city planning, designed elaborate architecture, managed craft and agricultural production, and held state-sanctioned feasting events and ceremonies (Isbell and McEwan 1991).

Around 1000 CE, however, the Wari state collapsed for reasons still unknown. The state's polychrome ceramics and textiles with elaborate iconography were no longer produced, and violence significantly increased, as evidenced by high rates of healed and unhealed cranial trauma (Tung 2008). Additionally, a balkanization of ethnic groups occurred, marred by conflict and little centralized control. Although populations continued to live in sections of the old Wari cities, the populations were much smaller and did not continue the elaborate building projects begun by the Wari (Isbell and McEwan 1991).

This era of little state control, known as the Andean Late Intermediate Period, continued nearly 400 years (1000 – 1400 CE), but many questions still remain about its nature. Aside from the violence and ethnic power struggles, in what other ways did the collapse of the state affect local populations? How were daily life practices affected? For example, was there a post-collapse famine or a disruption in food production or consumption practices? Were feasting rituals abandoned? To answer these questions, we analyzed the dentition of post-Wari skeletons from the Monqachayoq sector at the site of Huari, located in the central highland Andes. This research note describes our preliminary research into these topics, which aim to bring a greater understanding of the after-effects of Wari collapse, which will help elucidate important socio-political processes in Andean prehistory.

Wari State and Decline

The Wari rose to power ca. 600 CE and its influence soon spread across much of the Andean world, stretching from the southern site of Cerro Baúl in the Moquegua valley (Moseley et al, 1991) to northern valleys just shy of modern-day Ecuador. Throughout this area, distinctive Wari-style pottery is found, along with planned structures mirroring the architectural style of the Wari capital (often presumed to be 'administration centers' by which the Wari presided over local affairs) (Isbell and McEwan 1991). The locations of these administrative centers range across the highlands, including Viracochapampa, Honcopampa, Azangaro, Jincamocco, and Pikillacta (Isbell 1989, Topic 1991, McEwan 1991, Anders 1991, Schreiber 1992). Furthermore, terraced-field agriculture and irrigated fields also increased in areas where Wari imperial agents established settlements, allowing for previously barren land to be claimed by farmers (Williams 2002). This greatly increased food production and met Wari demands for state tribute. (See Figure 1 for a map of the proposed area of Wari influence.)

After several centuries of rule, the Wari state began to deteriorate in the eleventh to twelfth centuries. This era, known as the Late Intermediate Period, is identified as a time of political and social instability characterized by a political void within which various polities jockeyed for authority (Tung 2008). Violence, which was already high during the Wari imperial reign, skyrocketed further; cranial trauma rates increased to 70% among adults in the former imperial capital of Huari (Tung 2008). Furthermore, cranial modification—often considered a sign of ethnic or kin identity (Blom 2005)—appears to have increased, which may point to a balkanization of the kin and ethnic groups once under Wari rule (Tung 2011). Although there were changes in material culture, frequency of trauma, and cranial modification practices, the post-Wari population appears to be

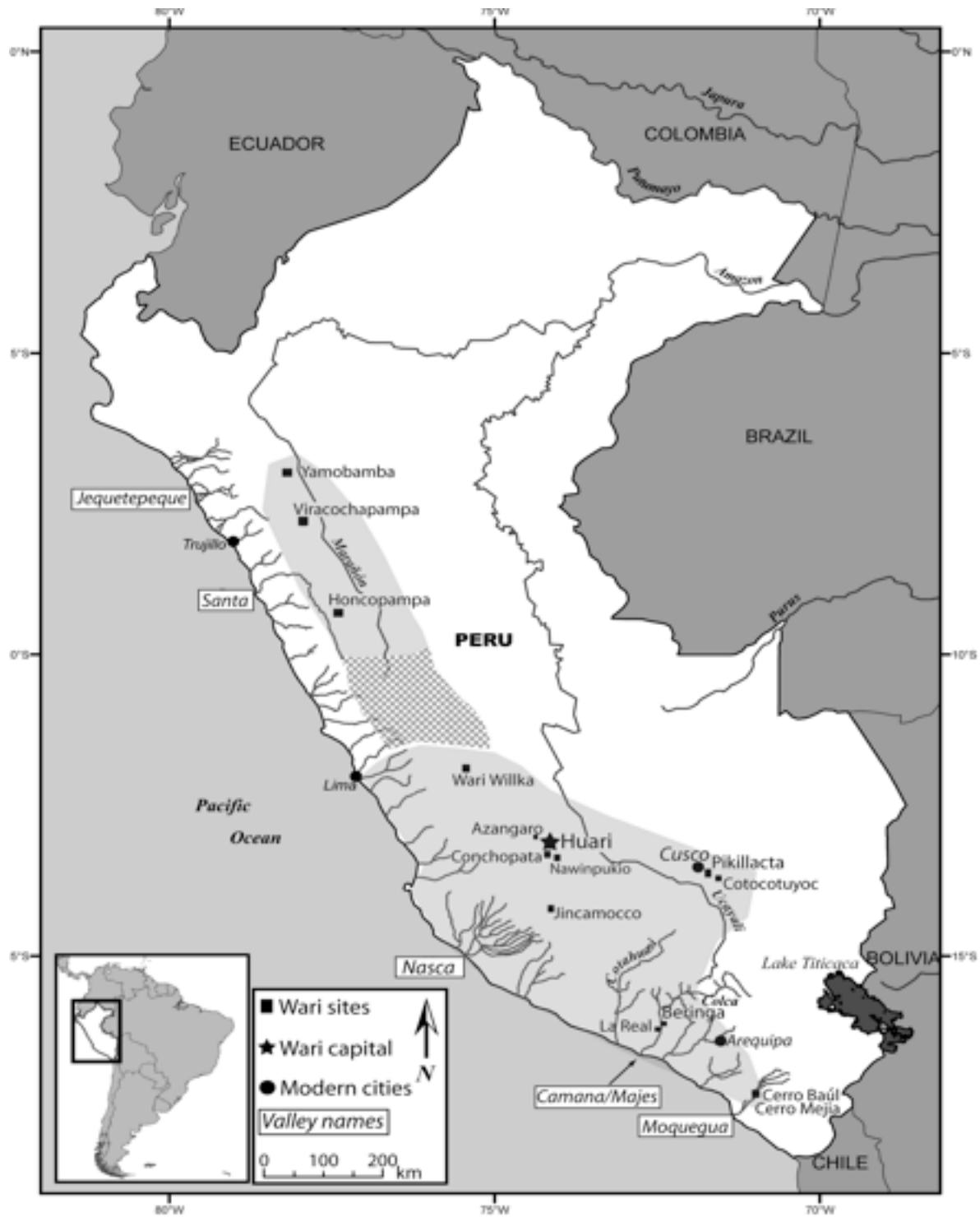


Figure 1: Proposed boundaries of Wari Empire. (Tung)

the biological descendents of the preceding Wari peoples. This is evidenced by ancient mtDNA data, showing similar haplogroup and haplotype frequencies from Wari to post-Wari times (Kemp, Tung, and Summar 2009). This suggests that the Late Intermediate Period population at Huari were likely the biological descendents of the preceding Wari population (i.e., a new biological group did not migrate into the imperial heartland). Thus, any changes in health from

one time period to the next are not likely related to distinct susceptibility to disease or malnutrition, but are likely related to shifts in cultural practices.

As the Wari had no known writing system, much debate continues over the cause and nature of the state's decline. Beyond the collapse of the political aspects of the state, more research is needed regarding how other aspects of social life, such as daily habits and lifeways, were af-

fectured. Research projects such as this contribute towards building a more complete understanding of the Wari Empire and the socio-political impact of its decline.

Political Collapse and Diet

By studying changes in food use in the post-Wari period, it is possible to reconstruct aspects of social organization that emerged in this new era. If new social institutions, perhaps organized around local kin groups, formed to fill the organizational and power vacancies left by the collapsed state, then many former social practices and consumption patterns may have been continued relatively uninterrupted (Schwartz and Nichols 2006; McAnany and Yoffee 2010). Conversely, with the decline of the Wari state, the management of labor and agricultural activities may have also declined, contributing to significant changes in food production and trade. These changes, in turn, could have led to shifts in food consumption.

One aspect of food consumption that may have changed was the ingestion of agriculturally intensive crops such as maize, which appears to have had a particularly important function within the Wari state. Maize was a socially valued crop; indeed, the Wari created new agricultural terraces and water canal systems near and far to the capital, allowing them to grow maize in an expanded area (Williams 2002). They brought this technology with them to the new areas they conquered, and resettled populations in areas where maize could be grown (Covey 2008). Maize was consumed in large quantities (Finucane, et al. 2006), often in a ceremonial and ritual manner, such as the drinking of maize beer (*chicha*) at state festivals and feasts. In fact, maize beer was a key component in the feasting and reciprocity that was important to the functioning of the Wari state (Cook and Glowacki 2003). With the collapse of the Wari Empire, the social importance of maize and its production may have diminished. That is, with the lack of Wari state oversight of agricultural production and trade networks, maize production, distribution, and consumption may have declined. Additionally, post-Wari peoples may have rejected previous social rituals that were associated with Wari society. Conversely, post-Wari populations may have continued the intensive production of maize and incorporated into their daily and/or ritual consumption activities.

Other important social consumption practices also may have changed after Wari collapse. For example, coca leaves (*Erythroxylum coca*), were a socially valued crop, often chewed in ritual settings (Allen 2002), as evidenced by the thousands of coca leaves recovered from Wari sites

(Tung 2007). Coca was not grown in the capital highlands area, however, and was most likely imported from distant areas of the state during the empire's reign. However, with the significant changes in socio-political organization that occurred with the collapse of the Wari state, the importation of coca may have ceased. Coca chewing may have been consciously rejected as a cultural practice associated with the previous state, or chewing may have been impossible due to new difficulties in obtaining the highly prized commodity. For example the collapse of state's trade networks or the breakdown of state-led agricultural production could have inhibited access to coca plants and led to a decline in its consumption.

Hypotheses

Based on previous research postulating that state collapse leads to changes in social structure and norms, not a complete abandonment of previous lifeways (Schwartz and Nichols 2006; McAnany and Yoffee 2010), Huari inhabitants most likely continued many socially important activities, particularly those related to dietary and ritual consumption. The people that lived at the former Wari capital—the site of Huari—likely continued to be an agricultural society, with ongoing emphasis placed on the previously socially valued foods, such as maize and coca. Through an analysis of dental disease data, the diet of the post-Wari individuals will be reconstructed and compared to other Andean populations to address two key issues:

- If the agricultural production of carbohydrate-rich foods continued into post-Wari times, then there should be high frequencies of dental caries (more than ~10%), as the consumption of carbohydrate-rich foods leads to greater dental disease (Larsen 1997).
- If coca chewing remained a habitual practice in post-Wari times, rates of mandibular oral disease will be higher than that of the maxilla, and a high prevalence of caries at the tooth root and cemento-enamel junction will be observed, traits often seen only amongst coca chewers (Indriati and Buikstra, 2001).

Materials/Methods

During July and August of 2007 and 2009, dental health data from post-Wari citizens buried at the site of Huari were collected (the individuals derive from the Monqachayoq sector of Huari). In total, the dentition from 48 individual adult maxilla and 83 individual adult mandibles were examined, each bone half (right and left) was analyzed

separately because some were only partially complete. This led to a total observation of 96 maxilla and 166 mandible halves. Each bone was examined following data collection standards outlined by Buikstra and Ubelaker (Buikstra and Ubelaker 1994). The following dental observations were made:

1. Antemortem tooth loss: Occurs when a tooth is lost before death, most often due to dental disease or trauma. The alveolar bone around the tooth socket begins to close, obliterating the socket as healing progresses (Hillson 2000).
2. Oral abscesses: Occurs when bacteria infects the gums, mouth tissue, and eventually the bone, leading to pus-filled perforations in the alveolar bone.
3. Dental Caries: Also known as a cavity. Occurs when bacteria continually attacks a tooth's surface, eventually breaking down its structure. This produces holes through the hard outer shell of the enamel, and eventually exposes the tooth's inner dentin and pulp center.

Results

Preliminary results show that the dental caries frequency was high. Twenty-one percent of the 57 maxilla halves (with at least two teeth present) exhibited at least one carious lesion, and 30% of the 93 mandible halves (with at least two teeth present) displayed at least one carious lesion. This is far greater than the 10% baseline for agriculturists.

Of these caries, most were located on at the cemento-enamel junction (CEJ) or on the root (28% and 10%, respectively). Abscesses and antemortem tooth loss was also frequent: 21% (N=96) of maxilla halves (with at least three sockets) and 26% (N=165) of mandibles halves with at least three sockets had at least one abscess. Forty percent (N=94) of maxilla halves (with at least three sockets) and 62% (N=162) of mandible halves (with at least 3 sockets) displayed antemortem tooth loss.

Discussion and Conclusion

In light of the high percentage of dental caries, we suggest that the post-Wari population continued to engage in the agricultural production and consumption of carbohydrate-rich foods, such as maize; they did not return to complex foraging-hunting subsistence practices. This is all the more apparent when compared to hunter-gatherers, fisherman, and agricultural populations throughout the Americas. The rate of caries among adults buried at Huari-Monqachayoq is much higher than those of foraging or fishing societies, and falls comfortably within the range of other

Native American maize agriculturalists (Larsen 1997), including Wari-era periphery sites, which had a caries rate of around 44% (Tung and Del Castillo 2005). Perhaps small coalitions of people, such as those with kinship ties, continued to work together to manage the water canals and agricultural terraces necessary for intensive agricultural production.

Furthermore, the high caries rate may indicate coca usage; several researchers (Indriati and Buikstra 2001) (Langsjoen 1996) have speculated that such a high rate of caries in the Andes is a result not only of agriculture dependence but also of coca chewing. In particular, a large number of mandibular molar caries in this population tend to be either at the CEJ and/or root, and as Indriati and Buikstra (2001) and Langsjoen (1996) have suggested, caries in these particular locations are indicative of coca chewing. Given the high rate of caries and their locations around the CEJ and root, it appears that coca chewing likely continued as a habitual practice for the Monqachayoq population.

Taken together, these findings indicate that the inhabitants of Huari continued many of the same dietary practices of their ancestors, even after Wari's political collapse. Maize continued to be grown and consumed, perhaps on a large scale. Similarly, the former socially and ritually important practice of coca chewing appears to have been maintained as well. As stated above, the continuation of such activities indicates that local communities continued to organize labor and landscape for the production of these agricultural products. Also, given that coca was likely imported from the eastern slopes of the Andes or other low-lying areas, its use suggests that post-Wari peoples maintained Wari era trade networks or established new ones that continued to ensure access to this ritually and socially valued crop. In sum, it appears that local inhabitants labored to keep their dietary consumption patterns as they were during the time of Wari state rule, even if the overall governmental mechanisms had altered.

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