Funerary Artifacts, Social Status, and Atherosclerosis in Ancient Peruvian Mummy Bundles☆

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ABSTRACT

Background: Evidence of atherosclerotic plaques in ancient populations has led to the reconsideration of risk factors for heart disease and of the common belief that it is a disease of modern times.

Methods: Fifty-one wrapped mummy bundles excavated from the sites of Huallamarca, Pedreros, and Rinconada La Molina from the Puruchuco Museum collection in Lima, Peru, were scanned using computed tomography to investigate the presence of atherosclerosis. Funerary artifacts contained within the undisturbed mummy bundles were analyzed as an attempt to infer the social status of the individuals to correlate social status with evidence of heart disease in this ancient Peruvian group. This work also provides an inventory of the museum mummy collection to guide and facilitate future research.

Results: Statistical analysis concluded that there is little association between the types of grave goods contained within the bundles when the groups are pooled together. However, some patterns of artifact type, material, atherosclerosis, and sex emerge when the 3 excavation sites are analyzed separately.

Conclusions: From the current sample, it would seem that social class is difficult to discern, but those from Huallamarca have the most markers of elite status. We had hypothesized that higher-status individuals may have had lifestyles that would place them at a higher risk for atherogenesis. There seems to be some indication of this within the site of Huallamarca, but it is inconclusive in the other 2 archeological sites. It is possible that a larger sample size in the future could reveal more statistically significant results.

In February and May 2012, as part of a research project looking for evidence of atherosclerosis in ancient people, the Horus Paleocardiology Multidisciplinary Research Team of cardiologists, radiologists, neurobiologists, and anthropologists set out on an expedition to scan using computed tomography (CT) 51 wrapped Peruvian mummy bundles housed at the Puruchuco Museum in the Lima region of Peru.

The city of Lima and its environs are located over the remains of >200 archeological sites, originally settled by people of the ancient Lima culture during the Early Intermediate Period (ca. 200 CE) and later by the Ichma culture during the Late Intermediate Period (ca. 1100 CE). These archeological sites were subsequently incorporated into the Inca Empire during the Late Horizon Period (1000 to 1534 CE) [1].

Most extant archeological sites in the Lima region of Peru were rescued from destruction and restored during the 1950s and 1960s by a philanthropic intellectual movement led by Dr. Arturo Jimenez Borja (Patronato de Cultura). One of the archeological sites rescued during that period was the Palace of Puruchuco, which was the principal local authority of the Ichma culture. Later, the Inca's regional representative resided in the palace. Domestic, economic, administrative, and religious activities were developed here with participation of the community. Today, the site's museum, Arturo Jimenez Borja-Puruchuco, is located adjacent to the ancient palace and is a repository for many of East Lima's archeological findings. The museum houses 180 mummy bundles from the nearby ancient archeological sites of Pedreros and Rinconada La Molina located in the Rimac River Valley and from Huallamarca located in south-central Lima.

At the site of Huallamarca, mummy bundles from the Early Horizon to Late Horizon Periods (900 BCE to 1534 CE) were found. Huallamarca appears to have been used in ancient times as a ceremonial center whose access may have been restricted to the religious elite in light of the fact that the uncovered floors show little wear from use. Huallamarca is an adobe scaled pyramid, which still currently houses mummy bundles. Mummy bundles from Pedreros and

The authors report no relationships that could be construed as a conflict of interest.
Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.gheart.2014.04.004.
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GLOBAL HEART

VOL. 9, NO. 2, 2014
ISSN 2211-8160/$36.00.
http://dx.doi.org/10.1016/j.gheart.2014.04.004

Rinconada La Molina date from the Late Intermediate to Late Horizon Period (1000 to 1534 CE).

Many of ancient Peru's coastal civilizations entered times of deprivation during the Late Intermediate Period, largely due to the decline of Andes runoff water that had been used for desert irrigation. There were several notable exceptions, including the Ichma who lived in the Rimac and Lurin Valleys. The Lurin Valley was also home to the great oracle center at Pachacamac that housed the large wooden 2-faced Janus-like idol of the Pachacamac god of creation, a fearsome deity associated with war and whose anger resulted in tremors and earthquakes. Pachacamac became one of the most important pre-Hispanic religious centers of Peru, attracting pilgrims from as far away as the Ecuadorian coast who carried gold, silver, and clothes offerings to the Peruvian central coast. Elite architectural compounds were erected at Pachacamac during the Late Intermediate Period, indicating a flourishing economy in this area. An alliance of Inca and Ichma people occurred later at Pachacamac during the Late Horizon Period [1].

Because the Andean pre-Hispanic societies did not develop a written language, there is no written record of who the individuals are in the bundles or what role they played in society.

Previous work by the Horus Team investigated 137 mummies from around the world and found evidence of atherosclerotic plaques in 4 different ancient cultures [2]. Although the team's research has shown that heart disease has plagued humans for millennia, questions remain about the causes of the disease. Lifestyle risk factors considered common today such as lack of exercise and a high-fat diet might have also been present in ancient times. The CT scanned bundles were intact, preserving the included artifacts in context with the individual mummies. This contextual preservation provides unique insight into the individual's social status and suggests their possible role in society. We sought to ascertain if any relationship existed between the cultural artifacts in the bundles and the presence of atherosclerotic plaques in the mummies.

METHODS

Fifty-one wrapped Peruvian mummy bundles were imaged to evaluate the presence of atherosclerosis in ancient peoples. CT scanning took place in Lima, Peru, in February and May 2012, at the Instituto Nacional de Ciencias Neurológicas (n = 40, Siemens Somatom Sensation 64-slice scanner, Munich, Germany) and the Hospital de Emergencias José Casimiro Ulloa (n = 11, Philips Brilliance CT 64-slice scanner, Amsterdam, The Netherlands). The 51 bundles selected for scanning were chosen from among 180 mummy bundles stored at the Puruchuco Museum on the basis of size of the bundles and the likelihood of the mummies being adults. Ten of the 180 bundles were too large to fit into the CT scanner gantry, and therefore could not be scanned. The remaining smaller ones, which numbered 120, were thought to most likely contain subadults and were also excluded from scanning. Twenty of the scanned bundles originated from Huallamarca, Early Horizon to Late Horizon Periods (900 BCE to 1534 CE). Twelve bundles were scanned from Rinconada La Molina, 8 bundles from Pedreros, and 7 bundles from unknown sites, all from the Late Intermediate to Late Horizon Period (1000 to 1534 CE). Three of the bundles were from unknown sites and eras.

A consistent CT scan protocol was used for the 51 mummies imaged for this study. Image reformatting and interpretation was performed on Apple platform OsiriX DICOM viewing software (version 5.5.1—64-bit and 3.7.1—64-bit, developed by Antoine Rosset, MD, 2004, Geneva, Switzerland) [2]. A multidisciplinary team reviewed the CT scans and a consensus reading was obtained during weekly web-based conferences using GoToMeeting (developed by the Online Services Division of Citrix, July 2004, Santa Barbara, California).

Identifying information was obtained by a search of museum and other databases by a team of experienced archeologists and anthropologists. Determination of sex was obtained by biological anthropological assessment of the genital or reproductive organs (when present) and the morphology of both pelvis and skull. Age was estimated by analysis of the architectural changes in the clavicle, femur, and humerus, dental attrition, and cranial suture closure. The methods performed for determination of sex and age were identical to the methods performed for the *Lancet* publication [3,4].

Statistical analysis of the artifacts contained within the bundles was carried out using the R statistical environment (version 3.0.2, R Core Team [2013]; R: A language and environment for statistical computing; R Foundation for Statistical Computing, Vienna, Austria). Because atherosclerosis is considered an adult disease associated with the aging process, all children were removed from the analyses. Statistical analysis was performed on the artifacts separated by artifact type and material, grouped by excavation site in Kruskal-Wallis and Mann-Whitney *U* tests in order to first identify groups with significant differences and then pairwise comparisons were performed between the variables to investigate where these differences occurred. Tests with all excavation sites pooled included principal component analysis (PCA), exploratory factor analysis (EFA), and multiple correspondence analysis (MCA). These multivariate tests are methods for reducing the dimensionality of the data, and they attempt to find hidden associations between all of the variables to explain data variation.

Artifact items were grouped into the following categories: adornment, small find, ball, food, *mate*, *spondylus* (bivalve mollusks), tool, and vessel. Most artifacts were easily placed into these groups; for example, adornments contained all of the jewelry, beads, and necklaces. Small finds contained small items and charms. The food category primarily contained seeds, dried fruits, and vegetables such as corncobs. Small metal items placed in the mouth, under the chin, behind the head or in the fists included *naipes* (copper

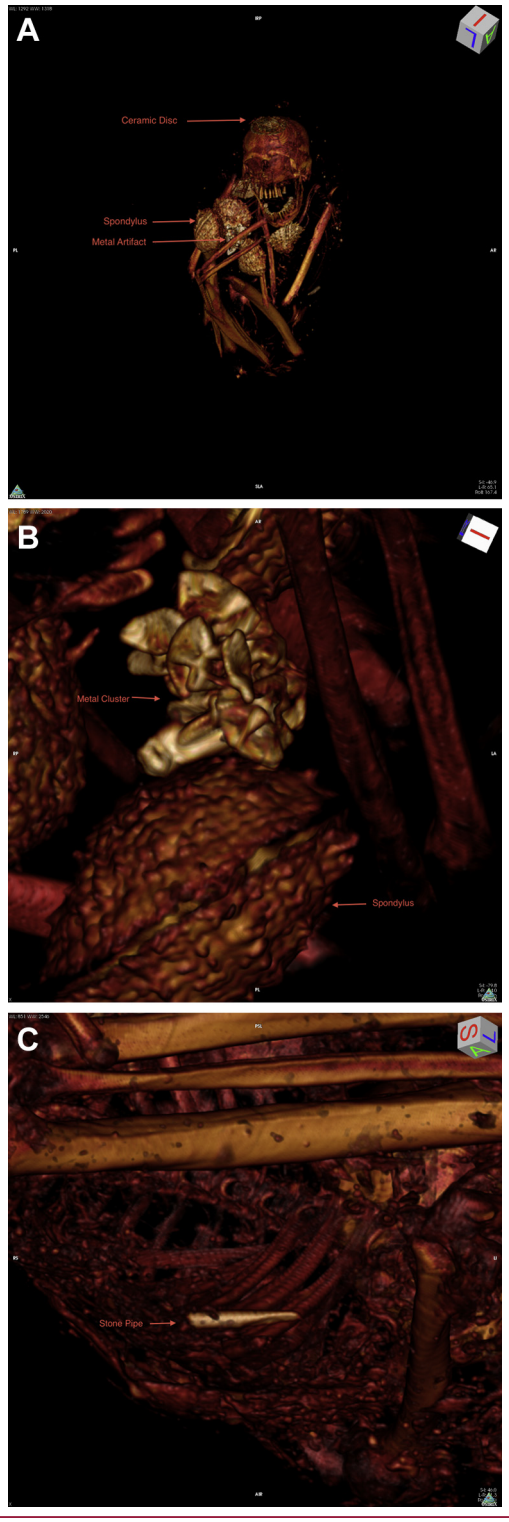

FIGURE 1. FA PP490 E7b: male, 40 to 50 years old, Pedreros. (A) 5 *Spondylus*, ceramic disc on head; (B) crumpled metal cluster between *spondylus*; and (C) stone pipe.

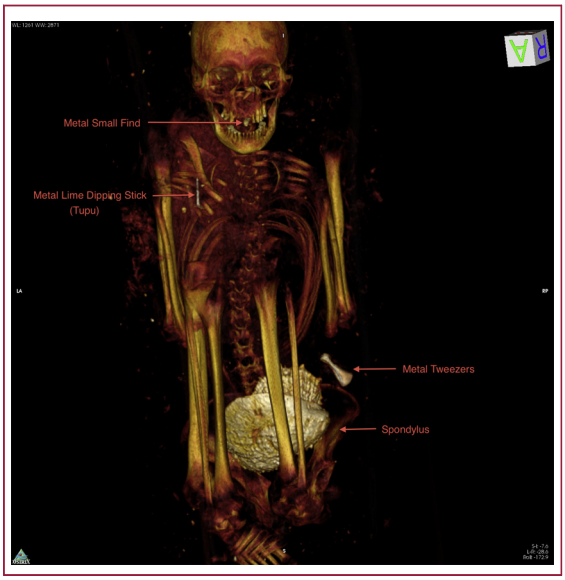

FIGURE 2. FA 049: male, 40 to 50 years old, Rinconada. 2 *Spondylus*, metal (mouth, tupu, hummingbird lime dipping stick, tweezers).

axe money) used as a medium of exchange for a short period around 1000 CE [1] and dipping sticks used to mix lime with coca leaves. The metal items and *spondylus* were kept separate because these items were known to be of high cultural significance, and it was thought that they might provide more information with regard to status [1]. The tool category contained all of the items that could be used for craft or occupation, such as spindles, shuttles, needles, knitting needles, and slings. Many of the bundles contained balls of varying densities, which were difficult to characterize via CT. It was thought that some of these could be made of rubber and others likely made of yarn, but they were included together in their own category of artifact. Finally, all of the vessels, including baskets and ceramics were grouped into the vessel category.

Artifacts were also grouped into categories on the basis of the materials from which they were made. Materials were identified via the CT scans, on the basis of relative densities and references to collections of Peruvian artifacts in the literature and museums. Eight different densities were identified for the artifacts: bone; ceramic; stone; metal; organics; shell; textile; and wood.

RESULTS

Single mummies, either adult or children, were found in 88% (n = 45) of the bundles. Two mummies were found in 8% (n = 4) of the bundles. Three mummies were found in 2% (n = 1) of the bundles. One bundle contained debris.

Of the 51 bundles, 49% (n = 25) contained single adult men and 25% (n = 13) contained single adult women. In 6% (n = 3) of the adult bundles, the sex could not be determined. Children were present in 18% (n = 9) of the 51

TABLE 1. Contents of Peruvian mummy bundles

Museum ID	Site	Age	Sex	Atherosclerosis	Phase	Time Period	Total	Types	Adornment	Small Find	Ball	Food	*Mate*	*Spondylus*	Tool	Vessel
FA 085	Huallamarca	40—50	Female	Definite	EH-EIP	900 BCE–600 CE	6	2	0	3	0	0	3	0	0	0
FA 81	Huallamarca	45—50+	Male	Definite	EIP-LIP	200—1476 CE	18	3	8	0	0	5	5	0	0	0
FA 70	Huallamarca	45—50+	Male	Definite	LIP	1000—1476 CE	6	3	2	2	0	0	2	0	0	0
FA 068	Huallamarca	25—30	Male	Probable	EH-MH	900 BCE–1000 CE	35	5	9	0	0	20	3	0	3	0
FA 80	Huallamarca	35—45	Male	Probable	EIP-LIP	200—1476 CE	34	5	2	2	0	0	4	0	0	0
FA 78	Huallamarca	45—50+	Male	Probable	EIP-LIP	200—1476 CE	8	4	1	1	0	0	2	0	0	0
FA 72	Huallamarca	35—45	Female	None	EIP-LIP	200—1476 CE	15	4	2	0	4	6	3	0	0	0
FA 76	Huallamarca	40—50	Male	None	EIP-LIP	200—1476 CE	7	3	0	2	0	3	2	0	0	0
FA 59	Huallamarca	45—50+	Male	None	EIP-LIP	200—1476 CE	14	3	0	0	0	0	3	0	0	0
FA 71	Huallamarca	45—50+	Male	None	EIP-LIP	200—1476 CE	7	3	0	1	0	5	1	0	0	0
FA 75	Huallamarca	45—50+	Male	None	LIP-LH	1000—1534 CE	32	3	10	0	14	3	0	0	0	0
FA 135	Huallamarca	45—50+	Male	None	LIP	1000—1476 CE	7	3	25	0	5	0	1	4	5	0
FA 074	Huallamarca	5-7	immature	None	LIP	1000—1476 CE	17	5	4	0	0	7	1	2	3	0
FA 74	Huallamarca	50+	Female	None	EIP-LIP	200—1476 CE	10	2	2	0	8	0	0	0	0	0
FA 079	Huallamarca	Adult	Female	None	EIP-LIP	200—1476 CE	10	4	0	0	1	4	3	2	0	0
FA 009	Huallamarca	Adult	N/A	None	LIP-LH	1000—1534 CE	12	2	0	0	0	10	2	0	0	0
FA 77	Huallamarca	Adult	N/A	None	LIP	1000—1476 CE	2	1	0	0	0	0	2	0	0	0
FA 69	Huallamarca	Adult	Male	None	LIP-LH	1000—1534 CE	31	5	11	1	9	0	9	0	1	0
FA 73	Huallamarca	N/A	N/A	None	EH-MH	900 BCE—1000 CE	3	3	0	1	0	0	1	0	1	0
FA 86	Huallamarca	N/A	N/A	None	LIP	1000—1476 CE	9	3	0	3	0	0	2	0	4	0
FA 67	Huallamarca	20—25	Male	N/A	LIP	1000-1476 CE	63	5	5	2	11	0	3	0	0	0
FA PP490 E7b	Pedreros	40—50	Male	Probable	LIP-LH	1000—1534 CE	11	4	0	2	0	0	0	6	2	1
PP 238	Pedreros	45—50+	Female	Probable	LIP-LH	1000—1534 CE	3	3	0	0	0	1	0	0	1	1
FA 490 E7a	Pedreros	50+	Male	Probable	LIP-LH	1000—1534 CE	7	3	3	0	0	0	0	2	2	0
PP490E-7c	Pedreros	50+	Male	Probable	LIP-LH	1000—1534 CE	0	0	1	2	0	0	0	0	0	0
PP 508 E4	Pedreros	25—30	Female	None	LIP-LH	1000—1534 CE	0	0	0	0	0	0	0	0	0	0
PP 604 E6	Pedreros	25—30	Male	None	LIP-LH	1000—1534 CE	0	0	0	0	0	0	0	0	0	0
PP 614	Pedreros	50+	Male	None	LIP-LH	1000—1534 CE	2	2	0	0	0	0	1	0	1	0
FA 10	Pedreros	child	immature	None	LIP-LH	1000—1534 CE	4	3	0	0	0	10	2	2	0	0
FA 049	Rinconada La Molina	40—50	Male	Definite	LIP-LH	1000—1534 CE	5	3	2	1	0	0	0	1	0	0
FA 0060	Rinconada La Molina	35—45	Male	Probable	LIP-LH	1000—1534 CE	23	5	3	12	0	5	1	2	0	0
FA 051	Rinconada La Molina	2—3	immature	None	LIP-LH	1000—1534 CE	17	3	4	0	0	10	3	0	0	0
FA 41	Rinconada La Molina	30—40	Male	None	LIP-LH	1000—1534 CE	16	4	2	0	0	10	3	0	1	1
FA 001	Rinconada La Molina	35—45	Female	None	LIP-LH	1000—1534 CE	12	3	0	3	0	8	0	0	0	1
FA 102	Rinconada La Molina	40—50	Female	None	LIP-LH	1000—1534 CE	1	1	0	0	0	0	0	1	0	0
FA 036	Rinconada La Molina	45—50+	Female	None	LIP-LH	1000—1534 CE	12	3	10	1	0	0	1	0	0	0

FA 040	Rinconada La Molina	50+	Male	None	LIP-LH	1000–1534 CE	18	5	5	0	0	3	1	7	2	0
FA 17	Rinconada La Molina	50+	Female	None	LIP-LH	1000–1534 CE	56	5	30	0	0	0	1	1	24	1
FA 052	Rinconada La Molina	N/A	N/A	None	LIP-LH	1000–1534 CE	0	0	0	0	0	0	0	0	0	0
FA 50	Rinconada La Molina	4–6	immature	N/A	LIP-LH	1000–1534 CE	21	4	5	9	0	4	5	11	0	0
FA 026	Rinconada La Molina	7–9	immature	N/A	LIP-LH	1000–1534 CE	12	5	3	0	0	2	2	4	1	0
FA 84	Unknown	35–45	Male	Definite	LIP-LH	1000–1534 CE	16	4	7	3	0	0	5	0	1	0
FA 053	Unknown	4–5	Immature	None	LIP-LH	1000–1534 CE	3	2	1	1	0	20	0	0	0	0
FA 065	Unknown	25–30	Female	None	LIP	1000–1476 CE	0	0	0	0	0	0	0	0	0	0
FA 25	Unknown	3–5	immature	None	Unknown	Unknown	15	3	4	4	0	50	3	2	0	0
FA 054	Unknown	30–40	Female	None	LIP-LH	1000–1534 CE	13	5	1	2	0	8	1	0	1	0
FA 04	Unknown	4–6	immature	None	Unknown	Unknown	75	4	21	0	0	50	1	2	0	0
FA 065	Unknown	40–50	Male	None	LIP-LH	1000–1534 CE	40	5	0	4	0	10	0	1	0	0
RT 0688	Unknown	45–50+	Male	None	Unknown	Unknown	0	0	0	0	0	0	0	0	0	0
FA 56	Unknown	50+	Female	None	LIP-LH	1000–1534 CE	15	3	15	7	0	0	0	0	10	0
FA 62	Unknown	50+	Female	None	LIP-LH	1000–1534 CE	3	1	0	0	0	10	3	2	0	0
	Unknown	Infant	immature	None	Unknown	Unknown	22	3	5	0	0	0	1	1	0	0
PP 487 E3	Unknown	N/A	N/A	N/A	LIP-LH	1000–1534 CE	4	1	0	0	0	0	4	0	0	0

Total = the total number of artifacts in the bundle; Type = the number of different types of artifacts in the bundle.
EH, Early Horizon; EIP, Early Intermediate Period; FA, fardo (bundle); LH, Late Horizon; LIP, Late Intermediate Period; MH, Middle Horizon; MIP, Middle Intermediate Period; N/A, not available; PP, Predreros Project.

bundles. Of these 9 bundles, 56% (n = 5) contained 1 child, 33% (n = 3) contained 2 children. One bundle contained a child of unknown sex and an adult woman. One bundle contained a subadult of unknown sex and an adult man.

In general, the largest bundles contained multiple mummies or single children. The large size of the bundles containing single children was thought to be due in part to the extended position of the children, a common funerary practice in this area during these time periods. All of the adult mummies from all periods were in the flexed-seated position. All mummies were padded with raw cotton balls containing cottonseeds surrounded by multiple layers of textiles and secured with cord.

Over 750 total funerary artifacts were identified in 92% (n = 47) of the 51 mummy bundles (Table 1). Common to 45% (n = 23) of the bundles were artifacts associated with nourishment of the deceased, such as bowls made from gourds filled with fruits, seeds, and corncobs.

Spondylus shells were present in 29% (n = 15) of the bundles. These shells were held sacred by ancient Peruvians and Inca nobility and were obtained through trade with Ecuador [1] (Figs. 1 to 3, Videos 1 and 2). Metal rectangular sheets were found over the eyes, in the mouths and hands or around the neck of mummies in 29% (n = 15) of the bundles (Figs. 3C to 5, Video 3). Ceramic, shell, or bone artifacts in the form of beads, necklaces, bracelets, cuffs, ear spools, discs, rings, and pectorals were present in 51% (n = 26) of the bundles (Figs. 6A, 6B, Video 4).

Multivariate analyses were performed on the data in an attempt to identify latent patterns hidden within the variables and determine associations that might not be apparent from univariate analyses. The first 3 factors of the EFA on artifact type only accounted for a cumulative 58% of the variance in the sample. The first factor showing the strongest associations was between the tools, adornments, and vessels in the bundles, whereas the second factor associated the balls, *mate,* and some adornments. Factor 1 accounts for 22% of the observed variance, and factor 2 for 14% (Table 2). EFA of the artifact materials reveals a slight latent factor between the shell and wood artifacts on the first factor and between metal and organics on the second. The first 4 factors of this test only account for 57% of the variance in the sample and factors 1 and 2 for 19% and 17%, respectively (Table 3).

The PCA of artifact types yields slightly different and more significant results. The first 3 PC explain 91% of the variation in the sample, with the first and second encompassing 86%, and the third 59%. In this test, the most significant category in the first PC is the food, with adornments as a far second. The variation of the second PC is attributed to adornments, tools, and balls (Table 4). PC1 and PC2 were then graphed with sex and presence of atherosclerosis in an attempt to further discern additional meaningful patterns. PCA on the materials has a modest association between the shell and wood variable on PC1, and very weak associations between ceramics, textiles, and unknown materials on PC2. The first 3 PC account for 92% of the sample variation, with 40% in PC1 and 33% in PC2 (Table 5).

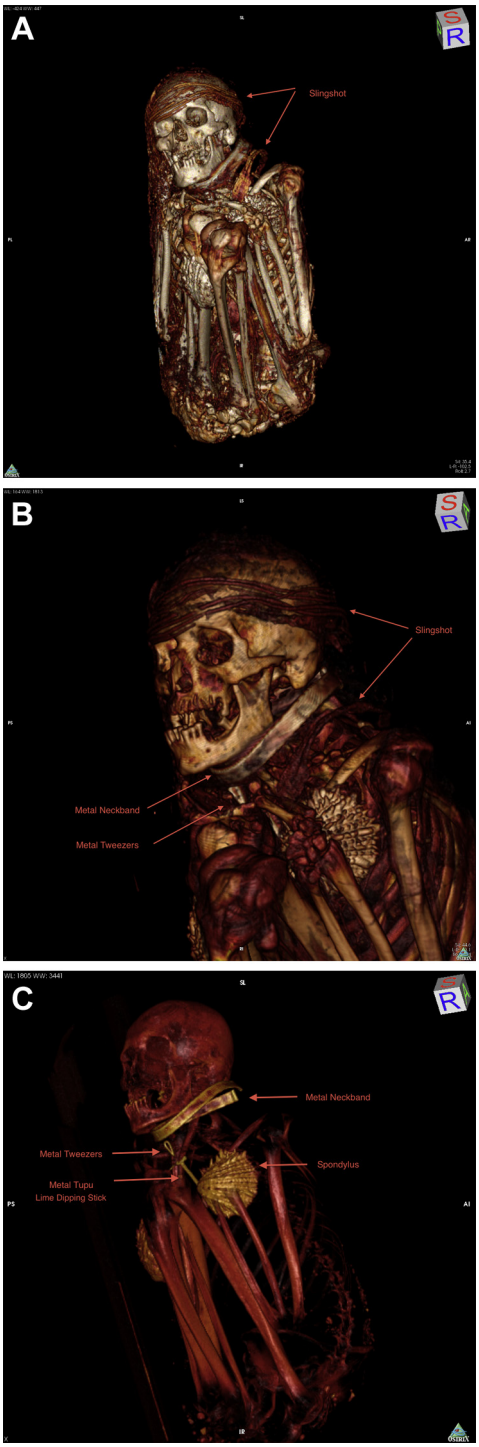

FIGURE 3. FA 490 E7a: male, ≥50 years old, Pedreros. (A) Slingshot head and left shoulder; (B) slingshot head and left shoulder, 2 *spondylus*, metal band around neck; and (C) 2 *spondylus*, metal band around neck, tupu, hummingbird lime dipping stick, and metal tweezers.

Finally, multiple correspondence analysis (MCA) was carried out on the presence/absence of both artifact types and materials. The first dimension suggests a connection between the presence of tools, vessels, and *spondylus* shells, as well as the absence of adornments, but only 19% of the variance is explained. The second dimension includes 19% of the variance, but the values of the loadings are so small it is difficult to tell which artifacts are associated. When graphed, connections between artifacts do not become clearer. MCA of artifact materials shows a slight association between metals and shells, but this connection is tenuous as the first dimension only encompasses 8% of the variation, and the first 8 dimensions make up only 50% of the variance.

Kruskal-Wallis (significance: $p < 0.05$) tests indicate that for adults, significant relationships exist between the types of artifacts in bundles in Pedreros ($n = 7$) and Rinconada La Molina ($n = 9$), the types of materials in bundles at the sites of Huallamarca ($n = 19$) and Pedreros, sex and artifact type in Huallamarca and Pedreros, and among the presence of atherosclerosis and artifact type and artifact materials in Huallamarca and Rinconada La Molina. These associations were further investigated with pairwise Mann-Whitney *U* tests (significance: $p < 0.05$). Of adult mummies scanned from Huallamarca, 32% ($n = 6$) have probable or definite atherosclerosis, 57% ($n = 4$) of Pedreros, and 22% of Rinconada La Molina ($n = 2$).

This further testing revealed significance in Huallamarca between the presence of balls with *mate* and between vessels and all objects except *mate,* as well as between bone/stone with metal/textile/shell/organics, metal with organics and wood, organics with shell/textile/wood, and finally between shell and wood. Pedreros had significant relationships in bone with organics, ceramic with organics and shell, metal with organics, and organics with textile and wood. Rinconada La Molina had associations between small finds with adornments, small finds with ball, small finds with *mate,* adornments with *spondylus, mate* with *spondylus*, and vessels with both adornment and *mate*. Sex differences in artifact type were found with balls being more associated with male mummies in Huallamarca (Figs. 6C, 7), and *spondylus* shells with men in Pedreros. Significant relationships with atherosclerosis and artifact types and materials exist in Huallamarca with small finds, *mate,* vessels, bone, ceramic, metal, organics and shell, and in Rinconada La Molina with adornments, *mate,* organics, and unknown materials.

DISCUSSION

This is the first study to investigate the association of funerary objects with the presence of atherosclerosis in ancient people. The study observed that a majority of the bundles contained single individuals, 88% ($n = 45$). The presence of bundles containing multiple individuals raises questions of cultural and/or biological relationships among the individuals. Deoxyribonucleic acid analysis of Inca

period mummies does not show close familial or biological relationships [5,6]. It is possible that secondary individuals may represent offerings to the principal individual of the bundle. However, there is very limited information on the frequency and meaning of bundles containing multiple individuals [7].

From the CT scans, it was possible to establish that the adult individuals within the bundles were all in flexed-seated positions, padded with raw cotton balls containing cotton seeds, surrounded by multiple layers of textiles and secured with cord. The funerary position of the individual expresses the local tradition of this population and is consistent in the different periods of the sample. This funerary position has also been reported for other sites of the Peruvian Central Coast, such as the Necropolis of Ancon, during the Late Intermediate and Late Horizon Periods [7–9].

It is important to point out that >50% of the bundles contained elite objects such as metal artifacts and *spondylus* shells, which suggests the individuals within these bundles belonged to a high-status group.

The presence of large amounts of food stuffs comes from the tradition of providing nourishment for the deceased in "life after death," as described in the Spanish chronicles of the 16th century [10–14]. The idea of life after death also includes the deceased ancestor's participation in living society [14–19]. One of the functions of the mummy was to take part in the ancestral ceremonies of the community [20].

Statistical analyses of the pooled sample reveal very little about any associations between the different artifacts in the mummy bundles across the excavation sites. Although each type of multivariate test yields slightly different groupings, none provides significant results. We surmise the connections drawn between artifacts and materials are quite tenuous at best and may be due to the small sample size. The types of artifacts and materials have no discernible relationship to age or sex of the individuals, suggesting that grave goods are not apportioned due to these criteria. Similarly, there is no association between the artifacts themselves that would suggest a particular social standing. There is also no link between these variables and the presence/absence of atherosclerosis.

Although no clear patterns emerge across the entire sample, univariate testing showed some small patterns within excavation sites. Although many relationships between artifacts were found to be statistically significant, in reality the significance is limited due to the small sample sizes and distribution of artifacts. For instance, vessels are associated with all types of artifacts except *mate* in Huallamarca; however, there is only 1 vessel found at this site, and it happens to be in a bundle that contains artifacts of all types. Whereas this relationship is marginally statistically significant, it is unlikely to be "clinically significant" or to have any logical meaning. Only the findings that appear to be useful in interpreting the bundles are discussed further.

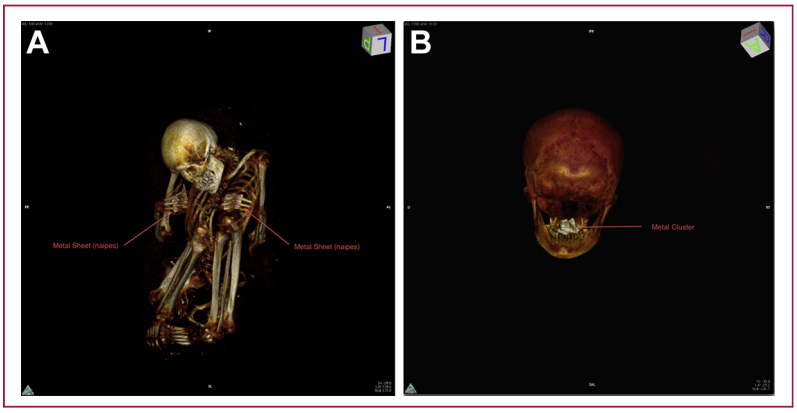

FIGURE 4. FA 085: female, 40 to 50 years old, Huallamarca. (A) Metal sheets in each hand; and (B) metal in mouth.

At the site of Huallamarca, there are no meaningful relationships between any of the artifact types, but there are some interesting patterns that emerge from the artifact materials. It would seem that organic materials are the baseline artifacts for this group. All bundles except for 2 contain organic goods. Bundles containing metal or shell usually have one or the other, but not both. There are 3 exceptions to this, but 2 of those appear to be the most artifact-rich bundles from this site. Finally, wooden objects

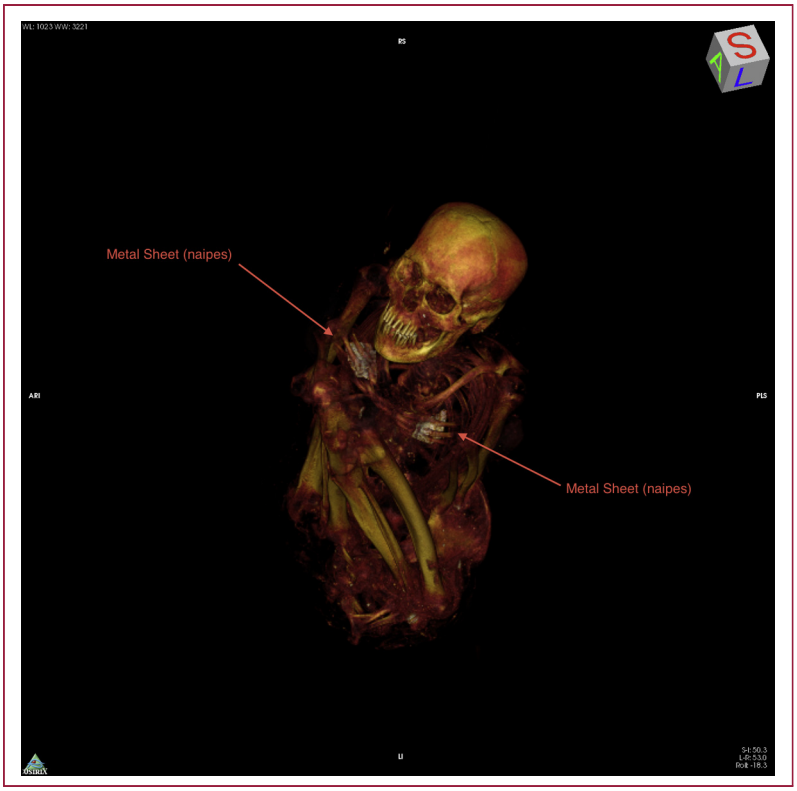

FIGURE 5. FA 80: male, 35 to 45 years old, Huallamarca. Metal sheets in each hand.

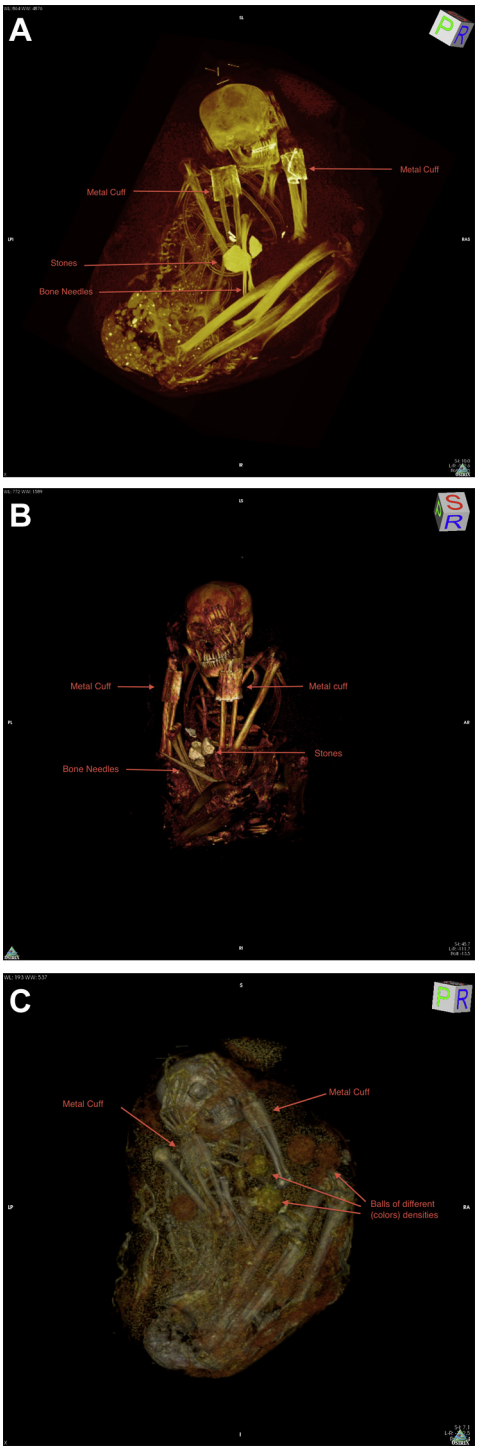

FIGURE 6. FA 068: male, 25 to 30 years old, Huallamarca. (A) Side view of metal cuffs both wrists, 3 stones, 3 bone needles; (B) front view of metal cuffs both wrists, 3 stones, 3 bone needles; and (C) multiple balls of different densities.

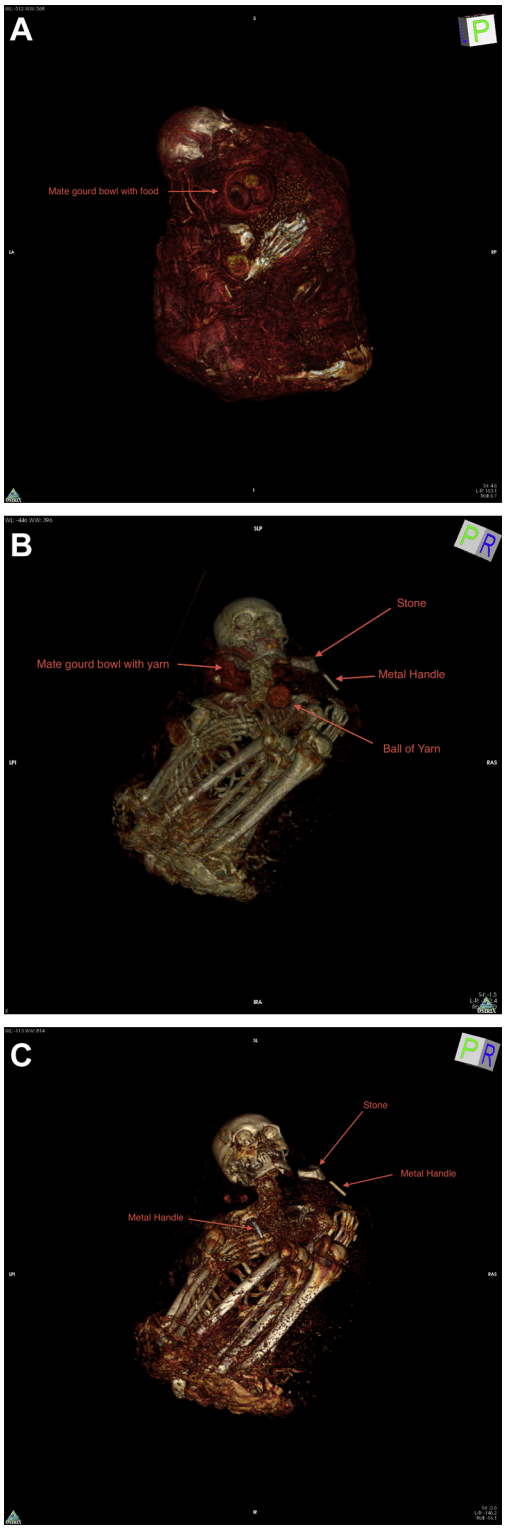

FIGURE 7. FA 81: male, 40 to ≥50 years old, Huallamarca. (A) *Mate* bowl with food; (B) *mate* bowl with yarn, ball of yarn; and (C) stone, metal handles.

TABLE 2. EFA (artifact type)

	Factor 1	Factor 2	Factor 3
Adornment	0.829	0.183	0.524
Amulet	—	—	—
Ball	—	—	0.560
Food	—	—	—
Mate	—	−0.127	0.349
Spondylus	—	0.947	−0.139
Tool	0.992	—	−0.101
Vessel	0.361	−0.104	−0.303
Eigenvalues	1.822	0.959	0.833
Proportion variance	0.228	0.120	0.104
Cumulative variance	0.228	0.348	0.452

Dashes indicate that the test found no association between those 2 categories. EFA, exploratory factor analysis.

TABLE 4. PCA (artifact type)

	PC1	PC2	PC3
Adornment	0.8775	0.0747	0.1362
Amulet	0.007	0.0282	−0.1206
Ball	0.1159	−0.1111	0.8406
Food	−0.0670	0.9884	0.0893
Mate	0.0196	0.0577	0.1883
Spondylus	0.0371	0.0039	−0.0514
Tool	0.4583	0.0261	−0.4619
Vessel	0.0092	0.0104	−0.0257
Standard deviation	7.3064	4.3277	3.4586
Proportion variance	0.5485	0.1924	0.1229
Cumulative variance	0.5485	0.7409	0.8638

PC, principal component; PCA, principal component analysis.

are only found in those bundles that have the highest amounts of metal in them. Although there are few of these wooden objects, most are weaving shuttles, highlighting these objects as status indicators. All of these associations were found in the Mann-Whitney *U* tests and further clarified by a review of the data. The Huallamarca site appears to contain the most elite group of individuals of the 3 sites. Some bundles contain large numbers of organic objects as well as large numbers of precious materials such as metal, shell, and wood, which are likely status indicators. Both male and female mummies of Huallamarca are associated with ball artifacts, although a significantly greater number of balls are seen in the bundles of male mummies; there are 5 to 14 balls in each of 4 male mummy bundles compared with 1 to 4 balls in each of 2 female mummy bundles. Many of the balls appeared to be made of yarn, which could be associated with weaving. There is a statistically significant association between the presence of atherosclerosis and artifacts made of metal and shell. All of those individuals positive for atherosclerosis have either metal or shell in their bundles, including most of those that have large quantities of these types of artifacts, suggesting that these are more elite individuals.

Organics also seem to comprise basic level artifacts at the site of Pedreros. However, this site has very little metal or shell when compared with Huallamarca. Three of the bundles from Pedreros each contain 1 wooden object: a needle, a textile tool, and a comb. Though little metal is present at this site, 2 of the bundles containing wood have 1 metal artifact but the third has none. Similar to Huallamarca, these wooden objects would appear to indicate elevated status associated with the weaving trade. It would seem that individuals from Pedreros have a less elite status than those of Huallamarca; these bundles contain high numbers of organic materials, but very few objects of any other material. At the Pedreros site, there is no significant relationship between atherosclerosis and artifacts or materials.

Organic materials seem to be a basic funerary artifact at Rinconada La Molina, as is seen at the other 2 sites.

TABLE 3. EFA (artifact material)

	Factor 1	Factor 2	Factor 3	Factor 4
Bone	0.141	—	0.398	—
Ceramic	—	—	0.361	—
Lithic	—	—	0.560	—
Metal	—	0.902	0.138	−0.404
Organic	−0.160	—	0.954	0.244
Shell	0.993	—	—	—
Textile	—	0.852	−0.217	0.466
Unknown	0.361	−0.104	—	−0.178
Wood	0.849	—	0.124	—
Eigenvalues	1.771	1.554	1.179	0.627
Proportion variance	0.197	0.173	0.131	0.070
Cumulative variance	0.197	0.369	0.500	0.570

Dashes indicate that the test found no association between those 2 categories. EFA, exploratory factor analysis.

TABLE 5. PCA (artifact material)

	PC1	PC2	PC3
Bone	0.0041	−0.1272	0.04372
Ceramic	−0.0003	0.0034	0.0022
Lithic	−0.0052	−0.0057	0.0090
Metal	−0.0254	−0.0879	−0.9722
Organic	−0.3588	−0.9208	0.0855
Shell	0.8026	−0.2907	0.0682
Textile	0.0164	0.0046	−0.1725
Unknown	−0.0101	0.0226	−0.0365
Wood	0.4752	−0.2075	−0.0979
Standard deviation	6.4809	5.8847	4.5384
Proportion variance	0.3956	0.3261	0.1940
Cumulative variance	0.3956	0.7217	0.9156

PC, principal component; PCA, principal component analysis.

However, there are 3 bundles with no organics. The mummy bundles in this group appear to be the least elite individuals of the 3 sites. There are very few organics compared with the others and little metal or shell. In this site, 2 bundles have large amounts of wood and shell, but the wood here is not associated with metal. Again, the wooden artifacts relate to textile manufacture and include knitting needles and spindles. There is a statistically significant relationship between adornment artifacts and *spondylus* shells in this site; 5 bundles have *spondylus* shells. Rinconada La Molina had no statistically significant relationships between atherosclerosis and artifact types or materials.

CONCLUSIONS

CT scanning of 51 mummy bundles from the Puruchuco Museum in Lima, Peru, yielded over 750 artifacts of varying types and materials. Analyses of these artifacts have shown very little in the way of overall patterns between artifact types, materials, age, sex, and atherosclerosis when pooled together, but some small patterns emerge by archeological site. It seems that many of these bundles may have been from individuals who were of high status due to the presence of metal and *spondylus* shells in the mummy bundles. These elite-status items appear most often in mummies from the Huallamarca site and least often in mummies from Rinconada La Molina. This pattern suggests that the former is a population of high-status individuals, with those from Pedreros slightly lower, and those from Rinconada La Molina in the lowest position. Wood artifacts tend to be found with large quantities of metal in Huallamarca and could be an indicator of highest status burials; however, mummies from this site tend to be found with shells or metal, but not both. If wooden artifacts indicate an individual's social standing in all 3 sites, then it would seem that weaving and textile manufacture were of extreme importance in all 3 groups because nearly all of the wooden artifacts in the bundles were associated with these trades. It should be noted that whereas the wooden objects may reflect status, few of the bundles with wood had atherosclerosis. Atherosclerosis appears to be associated with shells and metal in Huallamarca, but not in any of the others. If metals and shells indicate the most elite-status people, then it would seem that individuals of higher status also are more likely to have atherosclerosis. The archeological sites of Pedreros and Rinconada La Molina do not show this association; thus, if the association were accurate, the lack of its appearance at these sites may be due to the small sample sizes or to differences between class groups being less distinct at these 2 sites.

ACKNOWLEDGMENT

We thank our numerous collaborators around the globe for their inspiration and ideas. In Peru, we would specifically like to thank the directors of the hospitals who graciously allowed us to use the CT scanners to image the ancient Peruvians: Dr. Yrma Quispe Zapana, Director of the Instituto Nacional de Ciencias Neurológicas, and Dr. Manuel Vílchez Zaldívar of the Hospital de Emergencias José Casimiro Ulloa.

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