5-1-2015

Bodies in Motion: A Bioarchaeological Analysis of Migration and Identity in Bronze Age Cyprus

Anna Jean Osterholtz
University of Nevada, Las Vegas

BODIES IN MOTION: A BIOARCHAEOLOGICAL ANALYSIS OF MIGRATION AND IDENTITY IN BRONZE AGE CYPRUS (2400-1100 BC)

by

Anna Jean Osterholtz

Bachelor of Arts in Anthropology
New Mexico State University
1999

Master of Science in Anthropology
University of New Mexico
2003

A dissertation submitted in partial fulfillment
of the requirements for the

Doctor of Philosophy - Anthropology

Department of Anthropology
College of Liberal Arts
The Graduate College

University of Nevada, Las Vegas
May 2015

We recommend the dissertation prepared under our supervision by

Anna Jean Osterholtz

entitled

Bodies in Motion: A Bioarcheological Analysis of Migration and Identity in Bronze Age Cyprus (2400-1100 BC)

is approved in partial fulfillment of the requirements for the degree of

Doctor of Philosophy - Anthropology

Department of Anthropology

Debra Martin, Ph.D., Committee Co-Chair

Alan Simmons, Ph.D., Committee Co-Chair

Liam Frink, Ph.D., Committee Member

John Curry, Ph.D., Graduate College Representative

Kathryn Hausbeck Korgan, Ph.D., Interim Dean of the Graduate College

May 2015

Abstract

Bodies in Motion: A bioarchaeological analysis of migration and identity in Bronze Age Cyprus (2400-1100 BC)

by

Anna Jean Osterholtz

Dr. Debra Martin, Examination Committee Co-chair
Lincy Professor of Anthropology
University of Nevada, Las Vegas

Dr. Alan Simmons, Examination Committee Co-chair
Distinguished Professor of Anthropology
University of Nevada, Las Vegas

The analysis of human remains from the Bronze Age on Cyprus offers insights into underlying issues of social change and identity formation. Data collected from human remains from six sites throughout the southern half of Cyprus dating to the PreBA through the ProBA (2400—1100 BC) provide insight into social cohesion and group identity during this time of constant social change. Human remains were used to provide demographic data (such as number of individuals interred together, age at death and sex), health profiles (such as incidence of childhood stress, pathologies, and trauma), and robusitícty. Specifically, these data were gathered to provide an additional line of evidence regarding social identity on Cyprus during the Bronze Age and to address the issues of identity formation and change through time. Biocultural bioarchaeology is poised to address such issues through the combined examination of skeletal data in conjunction with archaeological data (such as tomb type, location, settlement pattern,

subsistence pattern). In using a biocultural model, bioarchaeological data can help to examine social interaction and cultural buffering mechanisms.

An additional goal of this research was the examination of bioarchaeological data to provide an additional line of evidence for issues of migration versus colonization and integration of external peoples at two pivotal times in the Bronze Age (the PreBA 1 and the ProBA 1 periods). These two time periods have been seen as moments in time where population influx occurred, usually explained by colonization or migration. This work supports the migration and hybridization model by showing a consistent lack of indicators expected to be present during times of social upheaval.

Acknowledgements

I would like to thank Dr. Debra Martin for her support and guidance throughout the PhD program and this dissertation process. Her guidance and support have been immensely important to me, she has been a true mentor. Dr. Alan Simmons, who helped introduce me to Cyprus, guided my research and helped me along every step of the way has also been instrumental. I thank him for his patience and support. Dr. Liam Frink and Dr. John Curry, my committee members, have provided feedback and thought provoking questions for which I am grateful.

On the Island of Cyprus, I have been fortunate to meet and learn from a tremendous community of scholars. Thanks are owed to Dr. Despo Pilides and Dr. Marina Solomidou-Ieronymidou, acting directors of the Department of Antiquities (DOA) for permission to analyze collections housed in the Museum of Cyprus (in Nicosia), the Larnaca District Museum (in Larnaca), and the Kourion Museum (in Episkopi). Collections staff and museum directors in all of these museums were very helpful in locating collections and providing laboratory space for me on multiple occasions. The Cyprus American Archaeological Research Insitute (CAARI) has provided me with a second home while on Cyprus and for that I am very grateful. Thanks specifically to Andrew McCarthy and Vathoulla Moustoukki for their many kindnesses over the years. This research would not have been completed without the assistance and permission of Dr. Alison South and Dr. Ian Todd, who allowed access to the Vasilikos Valley materials, and Dr. Stewart Swiny, who allowed access to the Episkopi *Phaneromeni* and Sotira *Kaminhoudia* remains. My heartfelt thanks go to Frank Garrod for his company, trips to the Malcolm cat sanctuary, and knowledge; Xenia-Paul

Kyriakou for providing a wonderful introduction to bioarchaeology on Cyprus and helping me find my way; and Bill Weir for the frappes and company at the Episkopi museum.

I have been received funding through the UNLV Foundation Presidential fellowship, without which this dissertation would not have been completed in the way it has been. I was also awarded the Anita Cecil O'Donovan Fellowship from CAARI, which allowed me to work and stay at CAARI for a month in 2013. The Graduate and Professional Student Association and International Programs at UNLV also provided grants that made it possible for me to travel to Cyprus on multiple occasions.

On a personal level, thank you to my mother, father, brother, and sister-in-law. My family has been there through the rough spots and celebrated the high points. I will always be grateful for your love and support. Finally, thanks are owed to the ladies of the Perpetual Porch, my best friends in the world. Sometimes in life there are no suitable words for the impact my friends and family have had. The best thing I can say is, from the bottom of heart, thank you.

Dedication

This is dedicated to my mother and the memory of my father.

Contents

Tables

Figures

Chapter 1. Introduction and Theoretical Background

Introduction

This dissertation is the culmination of the examination of several thousand human bone fragments from over 100 individuals from the eastern Mediterranean island of Cyprus spanning over 1000 years of human habitation. These data are gathered primarily from fragmentary and commingled bone assemblages from sites throughout the island. During that time, political, economic, and cultural change defined Cyprus. From the early PreBA (Prehistoric Bronze Age) through the late ProBA (Protohistoric Bronze Age), periods of agricultural intensification, the rise of copper production, and the increasing prominence of Cyprus within the larger regional trading sphere created challenges for the population. Groups migrated to Cyprus in both the PreBA and ProBA, increasing the population size and increasing the need to mitigate social tensions, termed scalar stress (Friesen, 1999). This research examines how health and other biological indicators of stress resulted from these cultural changes. Issues of colonization, migration, agricultural intensification, and response to external influences such as trade are explored through biological and archaeological data.

Central to discussions of cultural change and complexity is the Vasilikos Valley, a central valley with access to both copper resources in the Troodos Mountains and coastal access for trade. This valley was chosen as it had representative skeletal samples from the PreBA through the ProBA and access to important agricultural land and commodities (primarily copper). The skeletal assemblages from three sites within the valley were well excavated and present a longitudinal record of biological responses to social change.

These sites are compared with three other sites from around the Island to look for regional variation. Though preservation of the materials is sometimes marginal, data gathered from multiple lines of evidence tell a story of continuous adaptation and change through time.

One major question at the heart of this research is the nature of population movement onto the island in the Early PreBA and ProBA. Various scholars have hypothesized that colonization occurred during this time frame to explain the introduction of new cultural elements (see Chapter 2 for detailed discussion). The nature of these new cultural innovations would impact health and robusticity of the island, depending on whether the action was colonization versus migration. Did the local Cypriot population integrate with newcomers or were they culturally dominated by the newcomers? Health profiles of indigenous groups who have undergone a colonizing event (i.e., the arrival of a new group with enforced cultural change) show definite signs of poorer childhood nutrition as well as increased rates of violence. This analysis looked at the frequency and timing of childhood stress indicators as well as the incidence of cranial depression trauma as indicators of the use of violence and social control as indicators of enforced social change.

Chapter 1 provides an introduction to the study as well as presenting theoretical models that are important for the study. Theoretical models are heavily influenced by the Biocultural model of Bioarchaeology (discussed in Chapter 3); this in itself is a heuristic model for the organization of data that can then be examined through various theoretical lenses. Chapter 2 situates Cyprus within the larger regional sphere, explores complementary changes occurring on Crete, and explores the culture history of Cyprus through the PreBA and ProBA. Chapter 3 details the methods and materials used for analysis as well as discussing the biocultural model employed in this analysis. Chapter 4 presents results from these analyses. These results are discussed first by site and then a comparison of regional and temporal trends. In Chapter 5, these results are placed within a larger context and conclusions regarding biological responses to cultural change are discussed.

Bodies in Motion: Landscape theory applied to Biocultural change

Social theory is used here to amplify the interpretations that result from analysis of data. Data, by themselves, are not useful in explaining social change. They must be placed within a larger framework. Archaeologically, landscape theory is prominent in modern archaeological research on Cyprus; specifically, landscape as applied to constructed space. Fisher (2007, 2009a, 2009b) used the concepts of restrictive space to argue for the creation of social space and negotiation of social hierarchy. This use of landscape theory postulates that the built landscape is integral in socialization and memory making (Ashmore, 2004). Specifically, Ashmore (2004, p. 264) sees the movement of individuals across the landscape as important, stating "… monuments and movement can channel access to spectacles of sound or light, manifestations of the sacred..." My use of similar landscape theory examines the ideas of placement of the body within the social landscape as a mechanism for identity formation. Given the relative consistency of trauma rates throughout periods of social change (the Early PreBA and the ProBA), some mechanisms appear to have been in place that prohibited increased rates of violence, contrary to what is seen in post-colonial populations around the world (see Chapter 5). One such mechanism may have been the increased importance of communal ritual revolving around the burial and interment.

The movement of burials into the living spaces and their association with places of political and economic importance (e.g. Building X at Kalavasos *Ayios Dhimitrios*) brings legitimacy (i.e., the right to control) to those enterprises through an association with ancestral groups. Ashmore (2004, p. 265) describes this process as the power of landscape to "create memories about the proper manner of articulating the living and the dead." This combines elements of ancestor veneration (e.g., Antonaccio, 1995), politicization of the dead (Pérez, 2006), landscape and restricted space (Fisher, 2007, 2009a, 2009b), identity theory (Joyce, 2005), materiality (Sofaer, 2006), and aspects of violence theory (Derriennic, 1972; Parsons, 2007). In combining these theoretical frameworks, the physical body can remain central to the discussion. It must be examined synergistically, as both a physical and cultural object, and cannot be separated into the physical and social without losing some of the meaning (Sofaer, 2006). For example, the body is the focus of power, the manipulation and negotiation of social space, and the creation of permanent hierarchy.

The nature of the body is constantly changing. Borić and Robb (2008, p. 4) see this as processuality of bodily configurations. They see the body as shifting and unstable. Embodiment, as discussed by Borić and Robb includes aspects of gender and performative theory. It essentially means that the physical body takes on a life of its own and means something other than as an identity for the deceased individual. This is particularly true of commingled and fragmentary remains. Duncan and Scwarz (2014) examined bodies in terms of fragmentation. While fragmentation may occur through a variety of methods, it can be useful to interpretation of the assemblages. They argue that in fragmentary and commingled assemblages, it is the conglomerated whole that becomes analytically and culturally important. It is not possible to examine the individual, but it is possible to examine the social processes that make the assemblage important.

Thomas and Tilley (1993, p. 270), in examining commingled assemblages from Brittany look at the artistic representation of collective burials as the “social whole, the body of the social collectivity, into which individual egos have merged.” They see the use of human body parts in collective burial as similar to art, conveying social meaning, particularly illustrating liminality (an in-between period of transformation). Archaeologically, the body is a signifier of social processes. What is buried with the body says a great deal about the relationship between the living and the dead. As Sofaer (2006, p. xv) says, “[t]he materiality of the body forms a common axis between the body and objects, placing the body within the sphere of archaeological investigation.”

The majority of the human skeletal remains used in this work are from commingled contexts. These are identified as collective burials (containing more than one individual), indicating long term usage of a tomb sometimes over multiple generations (Osterholtz, Baustian, & Martin, 2014a). Collective burials serve several social functions. One such function is that of social currency (Baustian, Osterholtz, & Cook, 2014). Sofaer (2006, p. 20) notes that the body can be “flagged as a highly visible social resource that could be appropriated to act as a focus for the communication of intended meanings related to social perception of the deceased by others.” Multiple or collective burials act as a way of solidifying group identity, particularly in agricultural communities (Cauwe, 2001). Keswani (2004) ties collective tombs on Cyprus to the maintenance of tradition during economic change. The relationship with the dead and the houses of the dead (tombs) and the living form a basis for community, and can be used to cement social ties or assert economic rights over specific resources or land (Keswani, 2004; Saxe, 1970).

Reuse of the tomb space by later groups or the construction of new tombs on top of previous cemetery space can be seen as a co-optation of the location by a new group or lineage. These bodies take on social importance and can be seen as relational bodies. Relational bodies are those bodies that are defined by their relationships with other people and objects (Duncan & Schwarz, 2014). Taking this further, Fowler (2008) looks at bodies as fractal, indicating that the bodies are integral, somewhere between separate individuals and the larger community. They can be seen as a culmination of the contributions from the ancestors, both male and female. The body of the deceased embodies the process of becoming an ancestor.

The decisions regarding the location and composition of tombs as well as the reuse of tomb and cemetery space and the inclusion of grave goods included in the assemblages is essentially used as a mechanism for the creation of social hierarchy. Social hierarchy implies the maintenance of social control. Fisher (2007) examined the use of space as a mechanism for social interaction through the use of restricted space in the ProBA. This is also a mechanism for the negotiation of social control. Social control must be maintained in order to organize labor. Architecture, tomb construction, and the reuse of tomb spaces may be seen as mechanisms of social control. Another mechanism for the negotiation and maintenance of social control is violent interaction.

The use of violence as social control has been thoroughly explored both archaeologically (e.g., Ames, 2001; Harrod, 2013; Martin, 1997; Osterholtz, 2012) and theoretically (e.g., Derriennic, 1972; Galtung & Höivik, 1971; Parsons, 2007). Central to this idea is that violence is a form of non-verbal communication used in the formation and negotiation of social identity and group cohesion. Violence (either structural or physical) acts as a way of identifying *the other* (see case studies in Schmidt & Schröder, 2001). Violence is performative as well, with an audience necessary for the social control function. Violent interaction has three actors: aggressors, victims, and witnesses (Krohn-Hansen, 1994). In terms of creating and maintaining social control over the all victims, the witness category is the focus of attention. While direct violence is perpetrated upon the victim group, the witnesses (presumably a larger number of individuals) would see what was occurring, possibly to their family members. The threat of violence is as (if not more) powerful as direct violence (Ferguson, 2008; Parsons, 2007), and so social control is created and maintained for all members of the witness group through the actions perpetrated upon a few of their number, who become the victim group.

In examining violence rates during colonization (the arrival of a group with enforced culture change upon an indigenous group), Rothschild notes that rates of trauma spike at and slightly after contact is made and the local population is placed under colonial control (2008). This argues for the use of physical violence as a mechanism for social control, with violent interactions visible for the larger population.

Hybridization, migration, and the diffusion of innovation

Hybridization and migration as theoretical frameworks for archaeology grew out of postcolonial theory. Postcolonial theory is an umbrella concept that grew out of a response to colonialism and seeks to examine interaction from the perspective of both the colonized and the colonizers. Using this theoretical lens, it is possible to do away with the dichotomous colonized/colonizer approach, and instead examine social interactions (Voskos & Knapp, 2008). This model allows for fluidity in the concept of identity, particularly important when examining the very intricately involved eastern Mediterranean. Voskos and Knapp note that archaeologically, hybridization of cultural traits can be identified, particularly for ProBA Cyprus.

Postcolonial theory has always been contentious, and carries with it some identified criticisms. These include the tendency to subjectivize political struggle by reduction of these struggles to psychic tensions, the avoidance of political economic models, an avoidance of the binarism of colonialism itself (the colonized and the colonizers), a commonwealth-centered approach neglecting non-european colonial interaction, and a failure to take ecological and climate change into account (Stam & Shohat, 2012, pp. 371-372).

The hybridization of populations containing both newcomers and existing groups requires there to be significant previous contact for a smooth transition to a new, conglomerated society. Stevens and colleagues (2014, p. 1738), in an examination of modern Greek and Turkish Cypriot interactions note that “national identifications and the constructed physical and cultural boundaries change according to social context.”

Identification of the *other* is accomplished based on the following characteristics: 1) their ideological content (fixed ideologies regarding supremacy); 2) the relational orientation (either self-assessment or comparative); and 3) the importance of national and/or ethnic identity for the individual (Stevens et al., 2014, p. 1739). The concept of the *other* allows for identification of *us* versus *them*, and it allows for the creation of group identity by exclusion (Rappa, 1999; case studies in Schmidt & Schröder, 2001). What, then, occurs when there is no clear distinction of *us* and *them*?

It is possible that social remittances are at play in integration and hybridization. Typically, migration theory is more concerned with economics than with social interaction. As Levitt and Lamba-Nieves (2010, p. 2) note, “Migrants carry ideas, practices and narratives which enable mobility and different forms of membership and belonging.” Migrants bring their skill sets from their place of origin to a new location. If they stay in contact with their places of origin, they also transmit cultural information in a backward manner. In this way, cultural exchange occurs in a continual feedback loop. For individuals residing in trading communities, sending messages and ideas throughout the Mediterranean would have been accomplished along with the dissemination of goods such as olive oil and copper beginning in the PreBA. As with the study of identity discussed above, migration studies are varied and should be examined within a defined cultural construct. As Mains and colleagues (2013, p. 138) note:

> Instead of thinking of movements as arrows across maps, lines are deemed intellectually, historically, and archaeologically more appropriate. Lines do not determine boundedness of the communities from which folks came; or those to which folks are moving. Instead lines acknowledge the circulation, movement and cultural transfer have been integral to human populations, their cultures and society.

Again, the interconnectedness of both the place of origin and new home are linked through contact and communication in a reciprocal network (see also Vertovec, 2001). Migrants may “link their cross-cutting belongingness with complex attachments and multiple allegiances to issues, peoples, places and traditions beyond the boundaries of their resident nation-states” (Çaglar, 2001, p. 610). As Cyprus continued to be a trading partner to the rest of the eastern Mediterranean and Anatolian and Levantine mainland, it is likely that cultural contact was extensive, facilitated by migrants acting in a hybridized Cypriot society. In discussing mobility studies, identity can be seen as a product of social interaction rather than fixed relationships to territory (Glick Schiller & Salazar, 2012)

According to Levitt and Lamba-Nieves (2010), studies of gender, class stratification, religion, and political impacts all vary depending on the groups studied. Lutz (2010) examined the role of gender in migration studies and found that gendered labor requires a different level of analysis based on the type of research questions asked. On one level (their macro-level), migrants are typically found in gender-specific professions. On a meso-level, these professions may make different demands on workers. Agricultural workers are seasonal, whereas domestic work is year-round, for example. A meso-level of analysis also looks at gendered models of care and family organization as well as networks and the ability for social mobility. On a micro-level, individuals and positions are at play. This level of analysis looks at the individual worker and the balance between the place of origin and a new home land. Archaeologically, we tend to operate on meso- and macro- levels of analysis. Gendered work patterns can therefore be examined in light of migration as well. On Cyprus, there is a general tendency to assume gendered work in the production of ceramics and textiles (e.g., Crewe, 2012).

Castles (2010) presents a new model for the analysis of migration. He argues that a general theory of migration, as an outgrowth of modern industrial society, is not possible. Part of the reason behind this is that migration has complex and diverse underpinnings. People may migrate for issues relating to livelihood, political, economic, or social factors (Collinson, 2009). Instead, theoretical growth can be found in linking migration to issues of social change and transformation. Social transformation occurs through migration studies, often resulting in relationships of power and inequality (Castles, 2010). Castles (2010, p. 1576) defines this as “a fundamental shift in the way society is organised that goes beyond the continual process of incremental social change that are always at work.” In essence, this provides a punctuation to the constant rate of social change that is expected to occur. Migration is integral to discussions of social change and transformation and needs to be viewed within specific cultural contexts. As noted by Van Hear (2010, p. 1532), migration and transformation examine the relations “between time and space, between dynamics or processes and outcomes, and between structure and agency. Mediating agents and transitions need also to be accounted for, as do intersections among class, gender, generations, ethnicity and other social cleavages.”

Mains et al. (2013, p. 132) argue that postcolonial theory and migration theory should be examined in concert, since the “bodies of those postcolonial migrants continue to provide a daily reminder of the spaces and practices of colonial pasts and the necessity for a critical understanding of the postcolonial present (and future).” Postcolonial theory challenges the dichotomy of *here* and *there*, instead “points to the political possibility of recognizing a shared postcolonial terrain” (p. 133). This allows for the identification of hybridity within modern constructs. There is no reason that the concept of hybridity cannot be extended into the past (e.g., Voskos & Knapp, 2008).

Any discussion of hybridization or blending of multiple cultures into a new coherent one must provide a mechanism for change to occur. One such method is the diffusion of innovations theory. Rogers (1995, p. 11) defines diffusion as the "process by which an innovation is communicated through certain channels over time amongst members of a social system." Innovations can be either material (such as the increased use of the potter's wheel or the redesign of a plough) to ideas or practices (such as the introduction of new religious practices or mortuary rituals). The introduction of innovative technology or practices occurs through a staged process. This begins with the diffusion of knowledge of technologies or practices and a cost-benefit analysis to adopting the innovation. Modification of the new technology or practice may occur through this process to make it satisfactory to the social system as a whole. The cost-benefit analysis weighs potential benefits of adoption versus those of the current practice.

Adoption may be tempered by various cultural factors, including social structure. Henrich (2001) notes that in prestige-biased transmission of cultural traits, high status individuals adopt innovations and are followed by lower status individuals within society. (Baustian & Falvey, 2013) also argue that individuals or households in situational hierarchies may have a similar effect, suggesting that the hierarchy need not be a permanent state. In this way, social status may be gained in a temporary fashion that may help lead to permanent hierarchy. On Cyprus, improved smelting or farming activities that may have evolved through a situational hierarchy may have become institutionalized when these individuals gained significant wealth or prestige through innovation.

Urbanization

Anwar (2014, p. 26) notes that postcolonial analyses of urban spaces should be acknowledged. “The city is a place where politics of identity restructure urban processes in distinct ways.” Anwar notes that the concepts of identity and difference are important to the analysis of urban environments through a postcolonial lens. Anwar’s focus is on modern constructions in southeast Asia, but her research can shed light on the rise of urbanization at the end of the LBA on Cyprus as well. “The politics of place and the politics of identity and difference are co-constitutive, a terrain on which claims of ‘origin’ and strategies of fixing identities becomes important for marginalized groups (Jacobs, 1996)” (Anwar, 2014, pp. 25-26). Entrepreneurship is an important element to these new constructions. Economic opportunities exist for both the previous and new inhabitants of a city. In a place like Cyprus, where urban centers were developing at the same time as groups were migrating to the island, this co-occurrence could have allowed for the construction of both new urban spaces and new urbanized identities without the culture shock usually accompanying migratory events.

Chapter 2. Culture History

Interconnectedness in the Bronze Age

Cyprus has always held a strategic position within the Mediterranean. Janes (2010, p. 144) describes the island as a "stepping stone," forming a stopping point for trade routes going east from Southwest Asia, north from Egypt, and west from Greece and Crete as early as the Middle Cypriot period.

It is impossible to discuss any one part of the Mediterranean without respect to interaction with other parts of the Mediterranean and without respect to trade. (e.g., Knapp, 1990a; Muhley, Madden, & Stech, 1988; S. Sherratt & Sherratt, 1993). Discussions of political complexity also center on access to trade goods as well. Knapp (1990a, p. 128) details how various researchers discuss interconnections from various view points, and notes that any direct association between trade and urbanism is overly simplistic.

The geography of the Mediterranean basin allowed for great interconnectivity from the Paleolithic onward. The Mediterranean itself is known for having very little tidal activity, allowing for currents to provide significant navigational aids. As DiBenedetto and Simmons (in Simmons, 2014, p. 49) note, deep-sea currents flow counterclockwise, "following the North African coast eastward rom Gibralter, turning north by the Levantine coast and going around Cyprus up the Turkish coast, and counterclockwise around the Black Sea." This would have put Cyprus directly in the path of any navigation and trade route relying on currents.

Part of the issue with discussing trade in the Mediterranean during the Bronze Age is due to simple geography and culture differences. Trade within this region involves the interaction of multiple culture groups, from Egypt to Sardinia, from the Levant to Crete. These are very different cultures; it is quite possible that, for some of these cultures, access to external trade routes was very important for the maintenance of hierarchy such as the trade relationship between elites that held control over trade routes (e.g., Kelder, 2009).

This may not have been the case for all culture groups involved. Bietti Sestieri (1988), examining Italian-Mycenaean connections, argues that these were local processes in Italy, unrelated to events in the Aegean. In some cases, commercial wealth attained through trade may have promoted internal developments that enabled elites to convert food, resources, and goods produced by specialists into refined goods in demand elsewhere in the Mediterranean (Knapp, 1990a). Market demand has a tendency to generate development more than coercive threat (Cowgill, 1975), so the cycle of demand and economic development could have created an unstable political and economic system.

Broodbank (2013) argues that Cyprus was buffered from larger cultural breakdown at the beginning of the PreBA by its relative isolation in the eastern Mediterannean. As discussed above, copper provided an entrance into the larger trading network for Cyprus. Broodbank (2013, p. 373) describes the eastern Mediterranean of the 3rd millennium BC as "a theatre of interaction." Goods and skilled craftspeople likely moved between islands for a multitude of reasons. A constant in trade was the long distance exchange of metals and metal goods. Textiles were likely also important, but leave few archaeological traces. Evidence of dye workshops and mollosks known to produce purple dye have been found throughout the Aegean (Broodbank, 2013) and at Hala Sultan Tekke (Karageorghis, 1976).

Knapp (1990a, p. 149) argues that participation in a larger regional trade network may have led to the development of "competitive, status oriented social system" on Sardinia in the LBA. The bulk exchange of metals, including the typical copper oxide ingot, was confined to the Late Bronze Age (Knapp, 1990a). Muhly (1988) argues for a general increase in trade between Cyprus and the greater Aegean world based on archaeological evidence of increased copper production on Cyprus and the increasing prominence of Mycenaean elements on Cyprus at the end of the LC IIC period. This trade did not stop at the Aegean, however, but extended to Sicily and eventually Sardinia as well (Knapp, 1990a).

Knapp (1990a, pp. 143-144) sums up the relationship of Cyprus with respect to the rest of the Mediterranean by noting the following patterns and events:

> 1) Metal was being produced locally on both Cyprus and Sardinia during the Late Bronze Age;
>
> 2) Cypriot trade with the Aegean expanded in the 13th century BC, and trade contacts between both of these eastern Mediterranean areas and the central Mediterranean intensified during the 13-12th centuries BC;
>
> 3) Most major state polities in the eastern Mediterranean suffered an economic 'collapse,' of differing intensity, between 1250—1150 BC;
>
> 4) By the end of the 12th century BC, iron technology on Cyprus assumed prominence within the eastern Mediterranean;
>
> 5) Although the widespread use of iron in the eastern Mediterranean did not supplant that of bronze until ca. 1000 BC, which means tin was still readily available at least until that

time, the ‘Bronze Age’ lasted longer in the central and western Mediterranean than it did in the east.

The Mediterranean in the Bronze Age

Figure 1 provides a comparison of time frames between the eastern Mediterranean (specifically Crete) and Cyprus. By comparing the chronologies between Cyprus and the rest of the eastern Mediterranean, it is clear that the culture change, developments and breakdown in the Eastern Mediterranean impacted cultural change and development on Cyprus.

Crete in the Bronze Age

The most comparable island to Cyprus is Crete, both in terms of relative size and the strategic geographic importance for a regional trading network. Crete measures approximately 250 × 60 km. McEnroe (2010) describes the geography of Crete (with a mountain range separating the north from the south of the island) as promoting the construction of distinctive regional cultural identities, particularly before roads were constructed between settlements.

Arthur Evans (1921-1935) attributed major cultural changes leading to the palatial system to the arrival of new groups onto the island, a parallel that will be seen in the identification of cultural change with newcomers on Cyprus (see below). McEnroe (2010) was interested in the interplay between architecture and identity (seen as a process that is constant and changing), tying the concept of identity somewhat to Frankel’s (2000) use of *habitus* to identify local group affiliations on Cyprus.

Several scholars (e.g., Branigan, 1970; Renfrew, 2011; Warren, 2002) see the rise of the palatial system as a response to local social and economic processes that began in

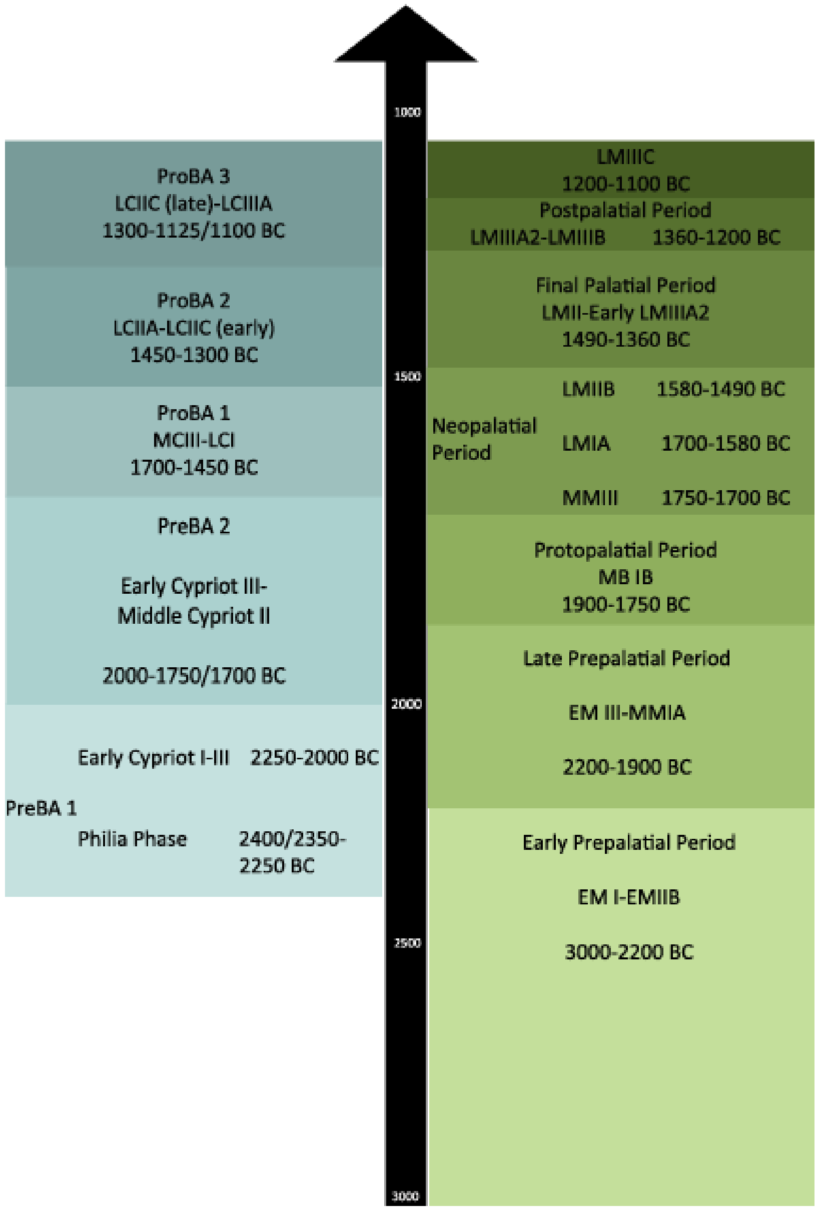


Figure 1. Comparison of Time periods between Cyprus and the eastern Mediterranean.

the pre-palatial periods. McEnroe attributes the rise of these complex, multi-use structures to the increased need for writing and record keeping by an emergent elite to examples from the Near East and Egypt. These arose, contrary to Cherry's (1983, 2009) model, from numerous social processes as opposed to single catastrophic events. In general, there is a new consensus that the transition to the palatial system was far more complex than previously considered.

Early palaces were dominant on the landscape, which would have further reinforced their socially important economic and ritual roles. They should best be considered as multi-use structures central to society (Schoep, 2002). There are a few characteristics that are used to identify these spaces: monumental scale; rooms set aside for specific uses (including residential quarters and storage magazines) arranged around a central court, and the presence of constructed elements such as ashlar masonry (McEnroe, 2010, p. 54).

The construction of these structures would have necessitated more labor than previously required for the construction of houses or other buildings; those who could expend political and social capital to commission them would have been seen as elite. Interior floors were also elaborate, in some cases paved with limestone or gypsum (McEnroe, 2010). The creation of these new social spaces was integral to the development of finer ceramics as well as the introduction of luxury and prestige goods. Driessen (1997) describes a Palace as a *constructed landscape*. Landscape, in this scheme, echoes Fisher's (Fisher, 2009a, 2009b) use of landscape in describing the negotiation of social hierarchy and place within society on Bronze Age Cyprus. Whether this organization of labor was the catalyst for the development of social complexity or a result of it is open for debate (see discussion in McEnroe, 2010).

The Protopalatial period saw an explosion of monumental architecture, including Palaces, theaters, and courts. Structures were connected via paved roads which would have created a communal space and facilitated interaction between people on a scale not seen before. The construction of large theaters at this time would also have had an identity-building function of sharing stories and myths. Myths and theatrical presentations can define a group through providing a shared history as well as transmitting cultural values. Agoras were also common elements of these larger settlements; these agoras exposed the populace to the variety of goods now available through trading networks. Exposure to goods that not all individuals could afford also reinforced a social order predicated on hierarchy. Defensive structures would also be important for the creation of this identity, with the populace reliant upon those with the power and control over those forced for security (both from within and without the community). Large storage facilities in association with palatial structures showed that palaces formed a key point in the distribution of surplus goods (Halstead, 1981).

Ritual has always been important for group identity as well as the formation of hierarchy. These rituals occurred at both palatial sites and rural sanctuary sites (that may have been involved with island-wide signaling) (see below). One such ritual site is that of Anemospilia. Excavations exposed three rooms, arranged like storage rooms. In the eastern room, pots were found along the walls and a raised platform was found at the end of the room. The central room had more pots and the feet of a large cult statue. The western room contained the skeletal remains of a single individual on a central platform. Two more skeletons were located on the floor of the room and a fourth was found in the northern corridor. Interpretations of this assemblage vary, from ritual human sacrifice

(Sakellarakis & Sapouna-Sakellaraki, 1997) to casualties of an earthquake (McEnroe, 2010). This assemblage also highlights the role that archaeologists ascribe to spaces that might contain ritual objects. The association with a platform and human remains automatically conjures images of human sacrifice, while the presence of storage jars and associated earthquake damage provides a more parsimonious explanation for the assemblage, particularly if the central platforms within the rooms were used as counting tables or to conduct trade.

The examination of social space often neglects the areas between buildings. Interconnectedness between the buildings is indicated by paved streets, courts, and public gathering places such as theaters or ritual venues. This interconnectedness within the sites is seen as integral to the creation of a uniquely Minoan identity (McEnroe, 2010).

The neopalatial period is defined by these palaces as well as interconnectedness both within the sites and between them. Knossos is probably the best known of these sites. The streets around the site all feed into the large West Court, which provides a direct view of the Palace. McEnroe (2010, p. 69) describes the western façade as irregular. “The Palace did not appear as a single, unified entity” but was arranged in “a series of projecting and recessing facades… No single linear boundary defined the building in any direction… As a result, the visitor cannot take the entire building in from any single viewpoint, as one can a classical temple or a Renaissance villa. To see the building, one must move around it, and with every movement the appearance changes.” Visitors to the site (even in antiquity) would have had to journey around the structure to see it, and it would have presented a different appearance from each approach to the structure.

The palace at Knossos is large and impressive, containing all of the aspects discussed above. These developed over approximately six centuries. It was subject to destruction via earthquakes followed by rebuilding episodes. One of these episodes was the explosion of the Theran volcano around 1628 BC. Known as the Second Palace, the rebuilt palace showed a marked change in building techniques. Not only had construction techniques changed, but the functions of some rooms appear to have been altered. There were now larger open spaces (allowed due to improvements in the construction of load-bearing walls. To a certain extent, interpretations of this structure (and the entire period) have been influenced by Arthur Evan's reconstruction during the 1920s and 1930s (McEnroe, 2010).

There is evidence for island-wide interconnectedness during this period. Barber (2010) examined a series of sanctuary sites located on hilltops and was able to establish sight lines between the viewing areas at these sites. This would have allowed for very quick communication between outposts. Barber believes that information sent along these signal lines covered a variety of topics, from emergency or invading enemies to communal ritual, political intrigue, and/or astral events. The linking of all the sites within a common network precludes collusion between just one part of the island against another, arguing for at least increased regional identity formation if not an island-wide polity.

It is important to view the Palace as a structure that creates social space as well as providing ritual, economic, and administrative functions for society. Storage magazines would have allowed control over surplus agricultural goods as well as serving as granaries for the inhabitants of the city in which the Palace was located. The Palace is identifiable due to the architectural indications discussed above, but these should be considered synergistically. The social aspect of combining these various functions creates a general social space that indicates an individual's place in society and therefore the universe. The relative importance of the various roles may have been highlighted in some areas over others. For instance, the role of storage may have been increased in regions specializing in agricultural production. So, residents of the Neopalatial cities were not likely to experience the palace equally, but instead through a complicated, multilevel involvement that may have been sometimes contentious (McEnroe, 2010).

During the Neopalatial period, regional control was likely prominent, following Cherry's (1983) model. Administrative control was distributed amongst numerous sites (as opposed to the Final Palatial period which saw these functions centered at Knossos), with various degrees of prominence exchanged through time between the centers. Palatialization is described by McEnroe as both island-wide and regional within Crete (2010). Architectural similarities on the island of Santorini also argue for significant connection between the smaller islands and Crete as well.

The Santorini explosion occurred somewhere between the 17th and 15th centuries (depending on the methodology used to estimate the actual age of the eruption) (Buckland, 1997). The current consensus argues for a date of around 1628. This explosion is visible as far away as Greenland in ice core samples. The resulting tsunami created a layer of sediment that is linked throughout the central western Mediterranean. (Cita, Camerlenghi, Kastens, & McCoy, 1984). This tsunami would have severely damaged many of the coastal centers on islands such as Crete and Cyprus; this destruction would have had the power to disrupt access to trading routes, and thereby undermine the social control of the elites. Driessen (1997) argues that the island of Crete never fully recovered from this destruction, with some villages completely abandoned.

The Final Palace at Knossos was destroyed at the end of the LMIIIB period, after which only a part of the palace was reoccupied. Found at Knosses were numerous Linear B tablets dating to the LMIIIB, illuminating the relationship between Knossos and the rest of the island after this occurred. These tablets detailed the economic ties, including records of grain and livestock raised for the production of wool. The large amounts indicate exportation of these goods. This would have created tremendous wealth for those in control of these commodities. Based on these data, it is possible that Knossos rose to fill the economic and administrative void caused by environmental disaster. That these tablets are written in Linear B indicates the presence of Mycenaeans on the island at this time; this also indicates that these Mycenaeans were in positions of administrative power. The presence of Mycenaean pottery types is also an indication of their presence.

This transition from Minoan to Mycenaean identity has been used as a launching point for the discussion of ethnicity and identity on the island. Steel sees this as a prime example of hybridization (Steel, 2013). Preston (1999) examined the process by which those living in Knossos at the time chose to employ some Mycenaean and some Minoan elements in mortuary ritual. This can be seen as a mechanism for linking political legitimacy through mortuary ritual and the ancestors. McEnroe took this same approach to an examination of the architecture at Knossos dating to the Final Palace. He was able to show a rebuilding of the palace at Knossos by Mycenaeans following Minoan lines, arguing that the Mycenaeans were presenting themselves as the legitimate heirs of Minoan tradition (McEnroe, 2010). This can also be seen at the settlement of Ayia

Triada, which was established as a regional center under Mycenaean administration during the LM $IIIA_2$ period (Steel, 2013). She sees the Mycenaean administrative and economic world as a two-way process of interactions between Minoans and Mycenaeans, with both groups as active agents in the creation of social order. Blending of cultural traditions is also visible in mortuary architecture. Steel (2013) sees a blending of Minoan and Mycenaean cultural traditions in the location and design of tombs as well as in their grave goods. While the new tombs follow a typically mainland style of architecture, the human remains themselves are treated along Minoan lines, for example.

The palatial system was powerful, but structurally subject to breakdown. Large scale fires mark the destruction of much of Knossos in the early $LMIIIA_2$ period. Administrative functions appear to have ceased after these fires. During the LM IIIB period, the Palace was a shadow of its former self. The role had also changed, with a focus on daily upkeep. Instead of highly decorated and structurally intricate walls, Post-palatial Knossos was constructed with rubble walls put up throughout the site. Outside of the Palace, local houses changed to squatter occupations, reusing some building materials from existing structures while many structures were in ruins around them.

Monumental construction does occur at other locations on Crete, including Mesara. This site is located in an agricultural region. Building P at Kommos was also constructed during this time. This structure may have been involved in either storage for transportation or the production of pottery. Cultic practices change throughout Crete during this time as well. Rituals once occurring at the Palaces and in peak sanctuaries shifted to village spaces. What once had been centralized became regionalized and village-based with the loss of the large administrative centers of the Neo- and Final Palatial periods (McEnroe, 2010).

Elite control over trade and the sea allowed for the accumulation of massive wealth and exotic good exchange during the Palatial periods, but also opened these same elites up for a drastic change of circumstance if their access to the sea or trade routes were to falter. One such dramatic environmental change was the volcanic explosion on Santorini. Prior to this change, Minoans had held administrative and ritual control. After this event, Mycenaeans held higher position and attempted to control access to trade as well, but with less success than the Minoans.

Cyprus

Figure 1 shows the sites included in this analysis. Additional sites are discussed throughout the rest of this chapter, but the sites indicated in this figure have all been instrumental in the analysis of cultural development and change on the island from the PreBA through ProBA periods.

Geography and Geology

The island of Cyprus is located in the eastern Mediterranean within view of high land in Syria and Turkey on a clear day. Measuring approximately 222 × 95 km, there are approximately 782 km of coastline, the island is the third largest island in the Mediterranean. Two mountain ranges are present on Cyprus, the Kyrenias in the north and the Troodos in the south. The Troodos, in particular, is rich in copper. Separating the two mountain ranges is the Mesaoria plain, the primary agricultural zone of the island. The presence of these high mountain ranges creates small local environments leading to a

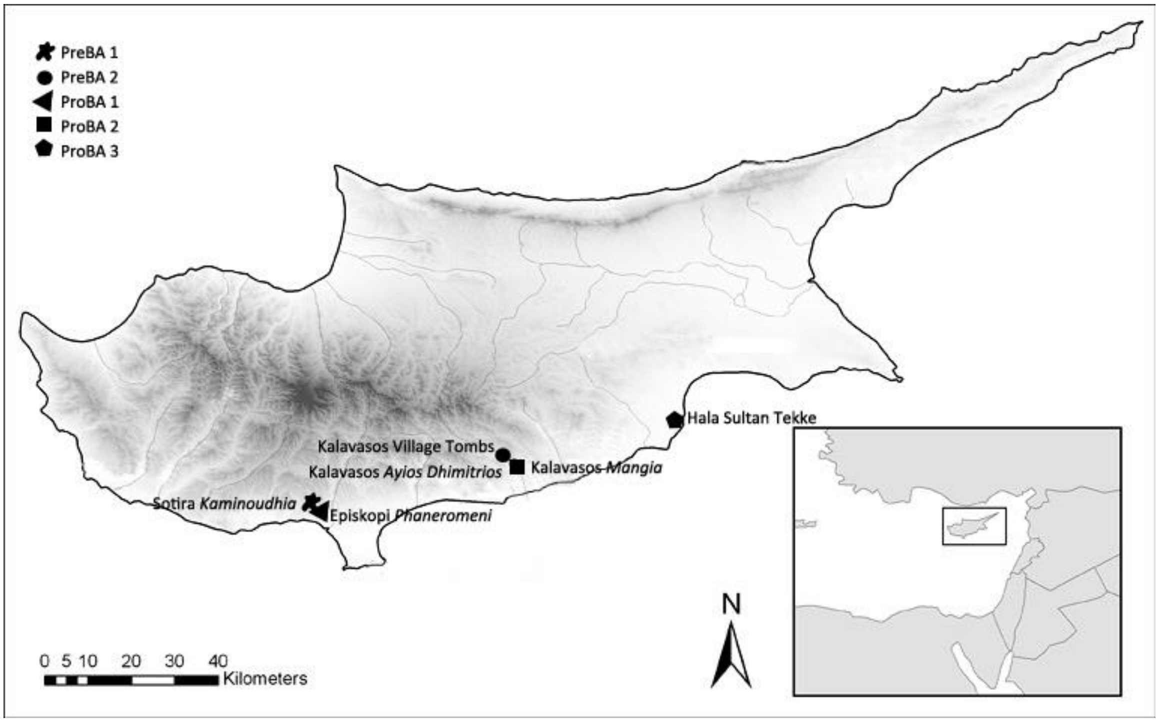


Figure 2. Sites included in analysis along with their temporal affiliations.

great amount of variation in both temperature and rainfall in different parts of the island. The climate is relatively mild, but temperatures can range to -5.5˚C in the winter and as high as 44.5˚C in the summer (Robertson, 1990).

Geologically, Cyprus is incredibly well studied (Knapp, 2013; Swiny, 1982). There is a large quantity of igneous rock. Oceanic crust exposed on the land is known as ophiolite. No natural obsidian deposits are present, but chert deposits were abundant. Grinding stones were produced from local basalt. Masonry structures were constructed of local limestone blocks with importation of marble in later Roman periods at major sites such as Kourion. The large amounts of limestone on the island, including the bedrock into which tombs are cut, has a poor effect on bone preservation.

<u>Cyprus Prior to the PreBA</u>

The earliest identified activity on Cyprus dates to the epipaleolithic. Prior to Simmons' (2014; 1999) excavations at Akrotiri *Atokremnos*, conventional wisdom held that the first occupations occurred during the late Aceramic Neolithic site of Khirikotia (beginning around 7000 cal. BC). By mainland standards, then, the occupation of Cyprus occurred late and appeared somewhat idiosyncratic (containing a completed Neolithic package deposited all at once). Simmons has been able show the interaction of humans and pygmy hippos at Akrotiri *Atokremnos*, possibly leading to their extinction on the island. Radiocarbon dates from this assemblage date to between 10,108 and 9877 Cal BC (A. Simmons & Mandel, 2007).

Additional excavations at Nissi Beach and Aspros, near Ayia Napa suggest that groups were present and engaged with fishing and marine exploitation (Ammerman et al., 2008). For example, Nissi Beach has been dated to 7592—7551 Cal BC based on a single shell-derived radiocarbon test which places this site in the Neolithic. Results from Nissi Beach should be viewed with caution due to the highly disturbed nature of the assemblage. As Knapp notes, the previous model of the Neolithic package (including farming and secondary products exploitation) arriving fully formed by the first visitors to Cyprus can now be discounted (Knapp, 2013). Coastal sites such as Akrotiri *Atokremnos* and Nissi Beach can be interpreted as seasonal exploitation of faunal and marine resources. Recent research, therefore, shows that the Neolithic on Cyprus is roughly contemporaneous to the mainland chronologies (Simmons, 2014).

During the Neolithic, inland sites were also likely visited in a seasonal manner. For example, the Prepottery Neolithic A site of Ayia Varvara *Asprokremmos* is located at the foot of the Troodos mountains. This site contains a lithic assemblage which has been interpreted as a Neolithic tradition but with core technology that appears different from the later Early Aceramic Neolithic tool kit (McCartney, Manning, Sewell, & Stewart, 2007). This site also contains a single chip of obsidian, extending the presence of this imported material back in time. This site has been interpreted as a semi-permanent settlement, indicating that visits to the island were becoming more common and that visitors were staying longer.

The Early Aceramic Neolithic brings the first settlers to the island. Throughout this period, we see a time of accelerated social change, changes in diet and husbandry of animals, and changes in lithic technology. Cultivation of plants and animals was occurring in conjunction with hunting of native species. Cultivation of cereals may have been domesticated locally on Cyprus (Willcox, 2002) or brought over as a completed package (Zohary, 1996).

According to Sherratt (2007), the Younger Dryas is responsible for exploration of Cyprus by Levantine foragers and hunters. The Younger Dryas is associated with drought, deterioration in woodlands and overall reduction in food sources (Bar-Yosef, 2001). This climatic degradation spurred social responses including mobility and adjustment to new plants and animals (Knapp, 2013). Settlers brought with them fauna such as pigs (at Ayia Vavara *Asprokremos*) and, later, cattle. Parreklishia *Shillourokambos* is an important site dating to this period. This site contains a rich faunal record, but lacks native fauna, seashells, fish or birds. Instead, deer, pig (imported to the island), sheep, goat, fox, dog, and one cat (Vigne, Carrère, & Guilaine, 2003; Vigne et al., 2000; Vigne, Debue, Haye, & Gérard, 2004). Sheep, goat, and pig remains are all those of domesticated animals. Of interest is the intentional burial of an entire cat, suggesting the presence of grain storage. Cats are commensal animals, attracted to grain storage areas for grain and the attendant rodents that are present with such storage. The cat burial was discovered approximately 40 cm from a human burial (Vigne et al., 2004). The presence of the cat on Cyprus indicates it was brought over with the settlers.

The site of Kalavasos *Tenta* is also relevant to this discussion. This site is located within the Vasilikos Valley, within sight of Kalavasos *Ayios Dhimitrios* and Kalavasos *Mangia*. McCartney and Todd (2005) interpret the assemblage as indicating a group of foragers present on the island, experiementing with cultivation of wild grains and husbandry of animal species.

Kritou Marottou *Ais Giorkis* is located approximately 20 km inland from the coast at the base of the Troodos mountains. The site has been intensively excavated over nine seasons under the direction of Alan Simmons (2005; 2014). Found at this site are numerous platforms and carved limestone figurines. Also present are several raised platforms consisting of rubble and undressed stones. Groundstone artifacts are typical for a settlement site, including handstones, pestles, and vessels. The faunal assemblage contains cattle bones; cattle would have been brought to the island in a domesticated state, and are seen as a signpost of the Early Aceramic Neolithic period (Knapp, 2013). Simmons (1998) and Croft (2003b) argue that cattle were exploited at the site for at least 1,000 years. Simmons (2009) argues that cattle held ritual implications both on Cyprus and on the mainland.

With the Neolithic, we see settled farming villages for the first time on Cyprus. Settlements were typically located in naturally protected locations. This time frame has always been typified by the site of Khirokitia. Some of the structures at Khirokitia may have had a defensive purpose, including large walls and ditches such as that seen at Kalavasos *Tenta* (Todd, 2001). The settlements were densely packed with circular buildings. Burials were typically single interments within structures. There is a common material culture throughout the island, based on analysis of the chipped stone and bone toolkits identified at various sites. Ground stone vessels were made from local volcanic rock. Vessels were also carved from stone, continuing a tradition visible in the Aceramic Neolithic (Steel, 2004).

The Ceramic Neolithic begins around 5000 BC. This is typified by the use of ceramic technology. Steel (2004) argues that ceramic technology appears on the island fully formed, suggesting migration of new inhabitants to the island bringing the technology. Settlement patterns are consistent with the Aceramic Neolithic, with sites concentrated around coastal areas; inland sites are also inhabited as well. Mountainous regions of the Troodos are still unoccupied during this period. The lack of open public spaces, larger structures, or differences in material culture throughout the sites are used by Steel to suggest a lack of social hierarchy. The material culture is relatively uniform throughout the island, with no evidence of craft specialization. Local clays were used for ceramic production. Subsistence was based on herding and hunting, exploitation of marine resources as well as agriculture.

The Chalcolithic Period dates to roughly 4000—2700 Cal BC. The beginning of the Chalcolithic is described by Peltenberg (1993) as a rapid transition typified by settlement abandonment, dislocation and fissioning of settlements. Typical are continued development of regional pottery types, changes in groundstone technology, consistency in chipped stone technology, increased use of picrolite (a relatively soft green stone used in the manufacture of figurines and other ornaments) and a decline in the importance of deer for subsistence (Knapp, 2013). There is also an increase in the production of picrolite figurines, beads, and pendants, often depicting gendered individuals; these figurines may be indicative of increasing social complexity towards the middle of the Chalcolithic.

Settlement expanded during the Chalcolithic to at least 125 known sites. Sites were located not only in coastal areas, but also in heavily wooded areas. Buildings were curvilinear, consistent with earlier time periods. Material culture is consistent amongst sites, suggesting a common culture. Peltenburg and colleagues (1998) note the development of domestic space during this time; internal space was divided into work, storage, cooking, and living areas. Special purpose areas are also evident. Deer continued to be important for subsistence, and deer antlers are sometimes included in grave goods during this time. In addition to deer, pig and ovicaprids were also exploited but in a more limited fashion. Mortuary practices are relatively well known. Burial most commonly involved pit burials. Early Chalcolithic burials also included trash and other refuse, but by the Middle of the Chalcolithic, burials are more formalized with differential mortuary practices visible. Multiple tomb types were used along with differential grave goods possibly denoting social hierarchy.

Cyprus in the PreBA

Subsistence

Intensive farming and the maintenance of orchards are recorded for this period all throughout the island. At Politiko *Troullia*, evidence of olive, grape, and fig orchards have been recovered (Falconer, Monahan, & Fall, 2014; Fall et al., 2012). Knapp (2013) summarizes the entire island as relying on these crops as well as various cereals and pulses.

Beginning in the early PreBA, around 2400 Cal BC, protein use shifts from a reliance on deer to a return to the use of cattle (discussed below), and the utilization of more pig and goat (caprine species) in the diet. At the sites of Marki *Lonia and* Sotira *Kaminoudhia*, caprines begin to make up the majority of the faunal assemblages, followed by cattle (up to 33% of the assemblage at Sotira *Kaminoudhia*), deer, and pig (Croft, 2003a, 2006; Reese, 1996). Based on artifact and faunal remains, Rapp and Swiny (2003) believe economy of the site was based on cattle exploitation as well as the utilization of ovicaprids, pigs, and fallow deer. During the main occupation phases at Kaminoudhia, cattle make up 33% of the overall assemblage, primarily belonging to adult animals. This suggests that milk production was important at the site (Swiny, 1989a). By comparison, fallow deer tend to be young females. Croft (2003a) attributes the relatively high percentage of cattle, sheep and goat to the production of secondary products, primarily milk.

The "Positive Feedback Loop": Cattle, the Plow, Copper, and Social Organization

While cattle are known to have been on Cyprus during the early Neolithic (A. Simmons, 1998), their role is unclear. The dates from *Ais Yorkis*, including a direct date from a *Bos* metapodial, indicate that *Bos* was present as a food source in the Prepottery Neolithic. A small number of *Bos primigenius* remains were identified at the Aceramic Neolithic site of Parekklisha *Shillourokambos* (Swiny, 2008). Based on the presence of fragments identified from all portions of the animal (e.g., extremities and cranial fragments), Vigne concludes that the animals (which he terms “predomestic”) were killed and butchered on-site, indicating they were present on the island as food animals. He also speculates on the disappearance of *Bos* from the island during the late Neolithic and the attendant social changes (Vigne, 2001, p. 57):

> One may also question why the species disappeared only a few centuries after its first introduction to the island during the early Aceramic phase, and why it remained absent from Cyprus for four millennia during the remainder of the Neolithic and the information on this issue, since the disappearance of cattle during the Middle Phase is associated with significant changes both in lithic technology and animal husbandry. The origins of these changes are thus more likely to have been caused by cultural rather than natural factors.

In other words, a decision was made to stop keeping cattle for some reason. Davis (2003) argues that providing fodder would have been very difficult, while Horowitz, Tchernov, and Hongo (2004) argue that the inability to replenish stock from the mainland made maintenance of the original herd difficult.

There then appears to be a roughly four thousand year lack of evidence for their presence on the island (A. Simmons, 1998; Swiny, 2008) with reappearance in the Early Bronze Age. *Bos* remains have been identified at Marki Alonia, an Early-Middle Bronze Age settlement on Cyprus (Croft, 2006). At Sotira *Kaminoudhia*, an Early Bronze Age site, cattle over 1.5 years of age are common in similar numbers to Caprines, indicating their relative importance at the site. Croft concludes that as part of the innovations associated with the beginning of the Bronze Age on Cyprus, cattle were kept as domesticates, possibly for purposes of traction and milk production (2003a, pp. 446-447). As Swiny notes, "The reintroduction of cattle to the island after a hiatus of some four thousand years is arguably the most significant development of the prehistoric Bronze Age… Cattle provided the means for the islanders to increase the quantity of grown crops substantially from the same input of time and labor as plow agriculture replaced hoe cultivation" (2008, p. 43).

Knapp (1990b, p. 161) describes a sort of positive feedback loop regarding cattle and copper within Bronze Age Cyprus. He notes that copper mining and the development of an extensive copper toolkit may have been related to the need for tools with which to clear forested land for agriculture. He states:

> … the ecosystem was permanently altered by human interference, copper mining and metallurgy developed in the context of an increasingly stable subsistence base. Innovations in metal tools facilitated changes in the subsistence economy: the axe and plough made available larger tracts of cultivable land, and in turn cattle-plough cultivation expanded the role of livestock and promoted specialized animal husbandry. These capitol-intensive developments in the metallurgical and subsistence sectors thus combined in a positive feedback loop to promote and build an efficient agro-pastoral economy.

While this model assumes a stable subsistence base, which may not be a safe assumption (see Frankel's reply to Knapp 1990), it cannot be argued surplus was not created at this time, as shown through the large storage areas visible at numerous coastal and "inland sanctuary" sites (Keswani, 1993; Steel, 2004).

It should be noted that the number of identified sites increases in the Early Bronze Age, with numerous sites in more marginal areas and in areas where occupational specialization is suspected (e.g., established mining camps); this pattern is consistent with a redistribution model as proposed by Keswani (1993). Increased use of plow agriculture allowed groups to produce larger agricultural yields without an appreciable increase in labor expense (Knapp, 1990b; Swiny, 1989b) Population estimates also increase during this time period, probably as a direct result of increasing production yields, settlement dispersion (which may have lessened exposure to crowd diseases), and the redistribution system that may have ameliorated the effects of occasionally lean harvests.

Production of goods

Household level production is believed to have occurred during the PreBA, including the manufacture of spindle whorls (Crewe, 1998), stone artifacts (Swantek, 2006; Webb, 1998), and pottery (including terracotta models) (Frankel, 1974, 1988). Ceramics are a very commonly studied artifact class for this type of analysis. In particular, the production of White Painted wares seems to be limited to household level production. Frankel ties production of these ceramics to female potters, believing that patrilocality was also occurring. When a female potter married outside her village, she took her specific style with her, and so the blending and shifting of local materials with unique motifs may be the result of this relocation.

In addition to the production of ceramics, textile production likely occurred on a house-hold level. Crewe (1998) describes two clay model spindles from Bellapais *Vounos*. Spindle-whorls vary in size and shape, as well as materials used in their creation. In the PreBA, these tend to be decorated, but the decoration begins to become less prominent by the ProBA, which is used by Crew (1998) to argue for individual craftsmen at work. The type of design present may be indicative of familial association (Frankel &

Webb, 2006b), with designs repeated throughout generations. Frankel and Webb (2006b) argue that the recurrence of these motives throughout the island argue for the relocation of female spinners, likely through movement after marriage. Spindle-whorls tend to be found in tombs during the PreBA, but not in the metal-rich high status burials (Crewe, 1998, pp. 36-37; Steel, 2004).

Falconer and colleagues (2014) believe that the presence of spindle-whorls and plank figurines at Politiko *Troullia* argue for the presence of communal activities. In their view, these activities occurred on a small group level in central locations. Ambiguously gendered plank figurines and spindle-whorls are seen as a way to identify lineages or other small groups. These were found in non-mortuary contexts, and so are reflective of work areas and community identity.

Picrolite, chipped stone and groundstone manufacture is also prominent at most PreBA sites. At Sotira *Kaminoudhia* in particular, 178 pieces were found in all stages of manufacture; indicating that the production (and possibly distribution and exchange (Swantek, 2006) of picrolite figurines was an important aspect of life at the site (Swiny, 2003, 2008). These picrolite figures are found in both tomb and habitation contexts, indicating their every-day use.

Chipped and ground stone from this period are typically analyzed in terms of expedient and curated objects (Knapp, 2013). Expedient objects address immediate needs such as pounding, grinding, and hammering. Curated tools, on the other hand, are designed for specific tasks, formal shapes, and are retouched and maintained until they have worn out. The most common ground stone artifacts are rubbers and querns (manos and mutates in new world terminology), used in food processing. Cutting tools are things such as axes and adzes. Marki *Alonia* and Sotira *Kaminoudhia* are typically used as examples for discussions of groundstone artifacts. At Marki, there were over 1000 groundstone artifacts, including 676 curated and 223 expedient tools. Also present were gaming stones, ornaments, and architectural elements. These artifacts were found in the interior of structures. Querns were usually near mealing bins or on wall benches. These tended to be made from igneous rock. Calcarenite and chalk were also used (Frankel & Webb, 2006a). Most of the main groundstone materials were manufactured from sources either at or very close to the site. Gaming stones were present both at Marki *Alonia* and Sotira *Kaminoudhia*. These are agricultural settlements (based on the groundstone assemblage); there are also a large number of sickle blades among the chipped stone tools.

Groundstone is also used in the household manufacture and production of goods such as olive oil and wine. At Politiko *Trullia*, household level production is indicated not only by the presence of smaller storage containers for oil and wine but also by small processing centers used for the crushing of olives with a mortar and pestle or in a shall rectangular groundstone trough (Fall et al., 2012). This view is supported by the work of Adjisavvas (1992), who notes that these elements are the most common form of archaeological evidence for household production of olive oil.

The composition of chipped stone assemblage is relatively equal for all PreBA sites (Knapp, 2013), suggesting that harvest activities were similar across the island and based on plough agriculture. When compared to chalcolithic assemblages, this prominence of sickle blades is a clear change. Chalcolithic assemblages have more burins, retouched tools, and denticulates; these tool types are virtually absent in the PreBA assemblages.

Social Structure

Migration versus hybridization

There are two competing theories for the increase in population size as well as the increase in site number and social complexity at the beginning of the PreBA. The first argues for a primarily Anatolian colonization who brought new technologies and farming techniques with them from the mainland, as well as differences in everyday behavior and material culture (Frankel, 2000). Frankel sees the influence of a new group from Anatolia in new ceramic forms, changes from round to rectilinear houses, possible changes in textile manufacture (as evidenced by a new design of spindle-whorls), and the use of draft animals for agriculture.

Frankel sees these pieces of material culture as evidence of *habitus*, the combined aspects of material cultural and beliefs that make up an individual's social identity (or ethnicity, in his verbiage). If social identity is indeed indicated by the goods left behind, then differences in the material culture found during this period indicate a change in social identity. Frankel believes this change in social identity stems from the arrival on the island of Anatolians, based on similarities between the new material culture and that found on the mainland at about the same time. He sees this as a long-term process with cultural contact extending from the Chalcolithic. Chalcolithic Anatolians were exploring Cyprus and ultimately by the PreBA, were comfortable enough to settle in relatively large numbers. This settlement phase is visible, in this model, as the Philia Phase of the PreBA. In some areas on the island, this phase overlaps with the Chalcolithic. For Frankel, this indicates the presence of two distinct groups on the island. By the end of the Philia phase, the newcomers had integrated into the larger society, and the *habitus* that they brought with them became the dominant cultural model (Frankel, 2000).

The second model argues for a hybridization between migrants (as opposed to colonizers) and local Cypriots to form a new social identity. Colonization is a process where social change is mandated by an arriving group upon the local inhabitants, but migration is a blending experience. Migrants tend to adapt their cultural practices to incorporate large aspects of the local population that they have joined while still maintaining a link to where they came from. This model sees both the migrants and the indigenous population as active agents who may view the interaction with a variety or reactions, including acceptance, ambiguity, or hostility (Steel, 2013). This still results in a new social identity, based on a blending of what was 'home' and what is new (Papastergiadis, 2005).

Knapp (2013) favors this explanation. Hybridization as an archaeological model is an outgrowth of post-colonial theory (Voskos & Knapp, 2008), and one that seeks to explain mortuary tradition as an "amalgamation" of "materialities".(Knapp, 2012, p. 32); in other words, a blending of material cultures that is strictly neither. By using a hybridization model, "any group engaged in transcultural entanglements contributes to the shaping of a hybridized culture. Such encounters typically result in new social and material realities—the emergence of 'third-space phenomena—forged by different customs, objects, values and traditions"(Knapp, 2012, p. 33).

First, a discussion of the nature of social (cultural) identity and ethnicity is necessary, since these concepts form the foundation of hybridization. Generally, those who see hybridization processes would agree with van Dommelen (2005, p. 116) when he argues against a dichotomy of us versus them in cultural exchange:

> By ignoring the much more nuanced and complicated social and economic divisions at the grassroots level, in which criteria such as gender, age, and class intersect with the colonial-indigenous distinction, dualist representations not only assert the dominant position of the colonizers, but they also overlook much of the social dynamics of a colonial situation. It is, in fact, the contrast between the black-and-white opposition of people's dualist representations and the many shades of gray evident in people's actions, that offers intriguing insights into colonial communities and their strategies for making sense of their own colonial context.

Essentially, it is the intersections that cause the creation of unique social identities. I argue that the term ethnicity is inappropriate to archaeology or should at least be explicitly defined whenever used. This concept is simply too ill-defined to be used responsibly at this point (Curta, 2007). Curta (2007, p. 166) has defined ethnicity as the "'politicization of culture.' Ethnicity may not be innate, but individuals are born with it; it may not be biological reproduced, but individuals are linked to it through cultural constructions of biology; it is certainly not just cultural constructions of biology; it is certainly not just cultural difference, but ethnicity cannot be sustained without reference to an inventory of cultural traits." But Nystrom (2006, p. 334) argues that there is no "trait-list that will unequivocally delimit one group from another, one identity from another."

Material manifestations typically used for ethnic or social identity identifications are marks of group distinction, but they fail to paint the entire picture. "… Studies that purport to assign ethnic affiliation solely through biological data fail to account for the situational and dynamic nature of identity. Group identity is not dictated, nor sufficiently captured, by examining trait or gene frequencies or the characterization of cranial morphology" (Nystrom, 2006, p. 334). This statement from a bioarchaeologist exposes the fundamental understanding that we, as archaeologists, have about the concept of ethnicity. We tend to believe that ethnicity is at least partially genetically determined. That belief is not restricted to bioarchaeologists, however.

Social identity, on the other hand, is not believed to be genetically dictated, and can be best thought of as *lived experience*. As an example, take the social identity versus ethnicity of adopted children. A Chinese girl adopted by American parents will generally be seen as socially American but ethnically Chinese. Hall (1997, p. 30) has defined social identity as “the knowledge, value and significance attached to membership in a social group.”

As applied archaeologically to Cyprus, Voskos and Knapp (2008) believe that a blending of local and non-local (foreign) cultural attributes are combined to form a uniquely post-colonial Iron Age Cypriot identity. In other words, Bronze Age Eteocypriots, Mycenaeans, and Anatolians were all placed in a large cultural blender from which poured the Iron Age Cyprus social identity. Knapp (2008b, 2013) sees signs of hybridization in the archaeological record include the mixture or blending of iconography and vessel form. Also important for the identification of hybridization are the find-spots of these mixed forms. Contextually, mixed forms from Late Bronze and Early Iron Age sites tend to be found in every-day contexts, indicating that they were not signs of increased status. Daily contact with foreign groups would have been a normal aspect of life, as navigability within the Mediterranean was relatively easy (Boardman, 2001). This generally high level of contact would create conditions conducive to a condition that Sommer (2007, p. 100) has described as “pre-colonization.” In his work, Sommer does not draw a clear distinction between migration and colonization, and so this can be viewed as a belief that familiarity with other groups will increase the susceptibility of one group to new ideas or immigrants from another.

Site Locations

With the advent of plough agriculture, sites could and were located in more marginal areas on the island; this is particularly true of the plains and closer to the coasts (Frankel, 2000; Knapp, 2013). Sites used for specialized purposes also became more common, such as those in the Troodos situated close to mineral, clay, and timber sources.

Based on evidence from Sotira *Kaminouhdia*, sites appear to have been sparsely furnished. Numerous rooms show signs of earthquake destruction (Swiny, 1989a), including the inclusion of human remains in the rubble, indicating that the rooms were not cleaned out after destruction by earthquake. This lack of site clearing creates a capsulated assemblage that allows for a more firm interpretation that the rooms were sparsely furnished during occupation. Of interest is that all individuals found within these rooms exhibiting earthquake damage were either female or juvenile (my analysis). This gives a window into the social structure, indicating that only females and children were indoors at the time of the earthquake, possibly indicating a division of labor in the society.

There is a general pattern of settlement being clustered on the northern aspect of the island beginning in the early PreBA. By the end of the PreBA, settlement size and locations had begun to change throughout the island. There is a general homogeneity visible archaeologically, with similar rituals evident as well as increase in the amount of copper being traded throughout the island. This indicates communication between regions, and the transition to a more island-wide focus (Knapp, 2013).

Central to our understanding of these changes is the settlement pattern within the Vasilikos valley. Beginning in the late PreBA 2 period, a series of sites begin to be used. These include Kalavasos *Mitsingites*, Kalavasos *Lourca*, Kalavasos *Arkhangelos*, and Kalavasos *Khorapheri*/*Vounaritashi*. Opposite Kalavasos *Lourca* and Kalavasos *Arkhangelos*, on the eastern side of the valley, are a string of distinct Middle Bronze Age sites. North of the modern Kalavasos village lies the site of Tokhni *Oriti*, which yielded groundstone elements and a single piece of copper slag during extensive survey. This complex is large, extending 10-11 hectares (Todd, 2004). These sites have not yet been excavated, and so their role in the future development of the large regional center at Kalavasos *Ayios Dhimitrios* is unclear at this time.

Mortuary Processes

The PreBA brought with it a new suite of mortuary practices as well. Rock-cut chamber tombs were the most common forms of burial throughout the PreBA. Most of these were extramural; the Kalavasos Village tombs are an excellent example of this. These tombs were associated with nearby settlements but were an extramural cemetery. Chamber tombs consist of three basic elements: the dromos, or entrance passage; the stomion, a narrow passage opening off the dromos and giving access to the burial chamber; and the burial chamber itself. Burial chambers may be simple or complex, and may include benches and niches.

The cemetery at Bellapais *Vounos* has been used by numerous authors to discuss tomb morphology and change through time (e.g., Knapp, 2013). This cemetery is located on a hill in the northern foothills of the Kyrenia mountains, near the modern village of Kyrenia (E. Stewart & Stewart, 1950). Some trends in the size and shape of the tombs are evident. Typically, as one nears the ProBA 1 period, the size and depth of dromos increased and more burial chambers were added from the same dromos. Several tomb chambers contained the bones of whole animals (not simply butchered elements), sometimes placed at the feet of the interment. Webb and Frankel (2010) used these occurrences to argue for animal sacrifice and consumption as part of the mortuary ritual. The human bones from these sites were not available for analysis.

At Lapithos *Vrysi tou Barba*, tombs excavated between 1913 and 1931, pit and chamber tombs were also present. Dromoi opened onto between one and four burial chambers, some with steps, recesses, and niches. Grave goods included ceramics (including Cretan jars), metal objects, gold and silver ornaments, spindle whorls, figurings, groundstone, and the bones of large mammals including cow and horse. Single burials were again the norm, but there is at least one example of multiple individuals interred in the same burial chamber (Tomb 806A) (Swiny, 1989b). Keswani (2004, pp. 67-71) notes that 9 chambers held approximately 65% of all the metal artifacts, suggesting wealth differentials in the burials themselves. These chambers holding the greater quantity of metal artifacts also tended to be larger than those without the grave goods, prompting Keswani to argue for the emergence of a hierarchy at the site during this time. Human skeletal remains from this site were also not available for study.

Burials tended to be laid in a flexed position on one side, where the position can be determined at the time of excavation. Looting in antiquity tends to obscure the position of many burials, but enough exist to give an idea that this is the typical posture. At Sotira-Kaminhoudia, both rock-cut and pit tombs were present. Most held a single individual that was interred with grave goods. Typically, these consisted of ceramics, spindle-whorls, jewelry, and metal implements (Swiny & Herscher, 2003). When compared with their chalcolithic antecedents, PreBA burials have more domestic ceramic vessels that show signs of use (Frankel, 2000), suggesting personal possessions of either the dead or of those that interred the individual.

The use of ceramics within the burial chambers also changes with time. Moving toward the ProBA period, there is an increase in the number of small, plain bowls and a decrease in the use of jugs. Some ceramics, specifically drinking cups and ceremonial wares, are typically associated with feasting activities (Knapp, 2013) that may have accompanied the funerary rituals. These vessels tend to decrease in number with time.

Though the above examples give the impression of well-ordered burial deposits, the presence of numerous fragmentary pottery vessels as well as disarticulated human remains and chronologically mixed ceramics within a single burial chamber is used by Keswani (2004) to argue for a multi-stage burial program for at least some individuals. She believes that burials may have taken place in shallow pits or other features with collection of the bones and grave goods with secondary deposition within the burial chamber. Alternatively Webb and colleagues (2009) believe that primary burial took place within the chamber itself, followed by removal of the bones and grave goods for redeposition elsewhere.

These two views would present different osteological signatures of small bone representation (Osterholtz, Baustian, & Martin, 2014a). The current analysis shows that the PreBA interments from the Kalavasos Village tombs are those of primary burials, with no visible discrepancy in the number of small hand and foot bones present for the MNI within the tombs. This argues against the burial chambers being a secondary location and a processing chamber (as would be the case if Webb's model were correct for these tombs). It is unclear, given the variability in mortuary program during this period, if these results should be considered typical for the island as a whole (given the regional nature of settlements), but for those using the Kalavasos village tombs, it does seem to be the case.

Knapp (2013) argues that for at least some PreBA cemeteries, burials became the focal point for competitive display. Based on evidence from Lapithos *Vrysi tou Barba*, he also argues that social inequality was also present. It is through the use of mortuary ritual, therefore, that social identities were negotiated. Keswani (2005) links the use of mortuary ritual to lineage-based land use claims, again drawing back to the feedback loop between copper and cattle. Knapp (2013, p. 321) notes that costly mortuary display and luxury imports may have attracted the attention of foreign traders or visitors, "thus broadening the exposure Cypriot culture and its rich copper resources to the wider eastern Mediterranean world." In this way, costly mortuary ritual can be seen as a type of advertising for the rest of the Mediterranean world. This assumes, however, that mortuary ritual was a public performance. As the burials are extramural, for the most part, this may indeed have been the case.

Regardless of their impact to foreign visitors, the role of mortuary ritual would have been a community building experience. As Parker Pearson (1999, p. 3) notes, "The dead do not bury themselves." Mortuary ritual tends to be organized and formulaic. Mortuary ritual helps establish and negotiate the relationship between the living and the dead, and in doing this, serves as a mechanism for the formation and renegotiation of social identity both for the individual and society at large. Performance plays a large role in this, through the reinforcement of accepted social acts. Mortuary ritual, particularly when differing amounts and quality of grave goods are used in a conspicuous manner, reinforced social hierarchies as well. These performances shape how an individual participating or witnessing the event sees his or her place within society. His or her role is known in that context, and the performance of the role accepted by the individual reinforces the hierarchy as well.

Cyprus in the ProBA Period

Subsistence

Given the larger populations on Cyprus during the ProBA, there was an increased need for exploitation of crops as well as intensification of animal usage for foodstuff as well as to provide trade goods. Domesticated plant usage revolved around cereals, pulses, nuts and fruits. Orchards of grape, fig, and Olives are inferred from the archaeological remains as well. At Kalavasos *Ayios Dhimitrios*, the presence of large pithoi (ceramic containers) indicate the specialized and intensified collection of olives to produce olive oil. The containers would have had a storage capacity of at least 35,000 liters, well beyond that needed for family or community use (South, Unpublished Manuscript). Family level storage of smaller amounts is present as well, but these pithoi are small, short necked vessels (Webb & Frankel, 1994) rather than the large pithoi seen at Kalavasos *Ayios Dhimitrios*.

Excavations at the later periods of Episkopi *Phaneromeni* demonstrate that cattle were being kept. Many sites show a preference for ovicaprids. Pigs are less common in this period in general. The exception to the general trend of the ProBA is Maa Palaeokastro (Croft, 1988). This site presents relatively higher amounts of pig bone as well as higher than normal frequency of fallow deer. It may be that the deer represent an elite dietary preferences (e.g., Halstead, 1977). The strange frequencies of fauna, however, may simply be reflective of a more wooded environment than other parts of Cyprus. They may simply been exploiting the available fauna. Demographic profiles of the cattle indicate the use of these animals as secondary product producers (Knapp, 2013).

Production, Specialization and Exchange

Steel (2010), notes that there are some changes to the production of ceramics on the island during this time period. During the ProBA 1 period, there is a pattern of increasing specialization in the production of ceramics. In some instances, there is a village-based specialization of ceramic production based on nearby local resources (see below for settlement locations discussion). During the ProBA 2 period, there is a decentralized dissemination of ceramic styles throughout the island. Sherratt (1991) argues that pottery production is standardized during the 13th through the early 12th centuries BC by the use of the potter's wheel and the decline of handmade fine wares. This need not indicate centralized production (Crewe, 2007), but may indicate the usage of new technology (i.e., the potter's wheel) in different regional settings.

In her study of intra-island exchange, Keswani accepts the idea of regional polities centered upon coastal sites that may have controlled production of products from inland sites (1993). Of particular import is the location of the earliest metallurgical installations at Enkomi, which were located in what appears to have been an official building complex; Keswani uses this location to argue for the presence of politically-organized exchange systems that were administered by coastal groups. Raw copper ore may have been collected and removed from managed mining camps to more centrally located centers for refining. She also notes the large number of storage containers found at multiple sites both along the coast and at 'inland sanctuary' sites, which she interprets as a redistribution center where specialized producers could exchange goods produced for goods needed (1993). Notably, copper and ceramics were produced on Cyprus and spread throughout the island and region.

Studies of specialization and exchange in the Late Bronze Age in the Mediterranean have been extensive. These include studies of pottery, utilitarian metals, exotic items, and even textiles. Cyprus also appears to have played an important "middle-man" role. Hirschfeld's analysis of pottery marks showed that Mycenaean ceramics distributed through the region were distributed by Cypriots, not Mycenaeans (1992, 2000). Drawing on visibility information and reconstructions of trading routes within the Mediterranean by Manning and Hulin (2005), Cyprus would have been a prime location to stop during trading voyages between the Aegean islands and Egypt.

Noting that maritime knowledge is cumulative, ancient Mariners could essentially stay within site of the coast if they followed the coast of Anatolia around the northern portion of Cyprus. Supporting this is that earliest evidence of long-distance trade (seen in the presence of non-local goods in Cypriot assemblages) appears on the northern end of the island (2005). Of course, the trade goods could have come into Cyprus through other middlemen—nonlocal goods should not be assumed to indicate direct contact with the producers of those products.

Goods were traded from Corsica and Sardinia in the West and Egypt and Mesopotamia in the East. In addition to ceramics, copper oxide ingots and glass products were also commonly traded goods. Ceramics were known to hold agricultural products, such as olive oil or wine (e.g., Knapp, 1991). Cyprus was also a provider of wood. Knapp (2013) draws a distinction between the political systems at play in the larger Mediterranean and that on Cyprus. While in the Aegean and eastern Mediterranean, elites were firmly controlling access to trade goods on a large scale; on Cyprus, the development of a looser political system with local elites controlled their own access to trade goods and were able to distribute them to those under their direct control. These smaller political units on Cyprus may have acted as a buffering system to a certain extent. These smaller political units may have been more flexible with their responses to the loss of a trade route. They may have turned eastward instead of westward during the fall of the Palatial system and vice versa when the Hittite empire collapsed. They also may have been seen as apolitical during times of economic and social change in Mesopotamia, providing a safe harbor for trade to opposing sides during conflicts.

Occupational specializations such as trading could not have become possible without the secondary productions revolution, which as Knapp points out, "made possible the increased agricultural yields necessary for a surplus, as well as the means to transport that surplus"(2008a, p. 79). Manning (1993) notes that the secondary products revolution would result in formalized and hierarchical relationships between those owning the livestock, those actually using the livestock, and those managing the workers—i.e., the solidification of social structure. This could form the basis for structural violence in the form of differential access and different social treatment of these different social groups.

From a biological perspective (employing a biocultural model), this could lead to decreased general health in those without good access to high-quality foods and increased rates of opportunistic infection (Goodman, Thomas, Swedlund, & Armelagos, 1988). As part of the biocultural model employed in this study, this differential access based on social class, age, or gender is a hallmark feature of structural violence (Parsons, 2007).

Late Bronze Age Social Structure

By the ProBA, the expansion of secondary products usage (Greenfield, 2010; A. Sherratt, 1981) is believed to have created an agricultural surplus as well as pressing the need for occupational specialization throughout the Mediterranean area. Keswani argues that specialized site forms were present in the ProBA, and proposed that a type of site known as a sanctuary could easily serve as a redistribution center for surplus (1993).

Trading relationships could flourish with the exchange of surplus for prestige goods. It is through the exchange of these goods that the local polities were able to solidify their hold over subaltern groups (i.e., those actually doing the farming, actually smelting the ore, and so on) as well as compete amongst themselves (Keswani, 1993, 2004). Iacovou (2007) argues that Keswani’s site sizes are overestimated, and that the settlements of the Late Bronze do not meet models of urbanization, though she agrees that by the Iron Age, there are what are described as city-kingdoms (p. 18).

Social Structure: Models for population influx

Three distinct models have been identified to account for the social changes that occurred around the collapse of the Palatial system in the West and the Hittite empire in the East around 1200 BC. These are the colonization model, the internal development model, and the hybridization model. They will be discussed individually below. All of these models seek to understand how identity was negotiated between incoming populations and local inhabitants, as seen through the material record. Primarily, ceramics are used, especially those that are created using Myceneans designs with local materials. Tomb type and location are also used, as is the distribution of artifacts within an assemblage.

Marauding Mediterraneans and Anatolians-the Colonization Model

The colonization model (Leriou, 2002) argues that Mycenaean refugees (or colonists) came to Cyprus after the fall of the Palatial System in the west (Karageorghis, 1982). They came to Cyprus because it was a place they were familiar with due to trading relationships, but this colonization (or more likely a migration) would have been more invisible archaeologically as it did not involve a language shift and the migrating individuals are argued to have integrated into the extant political and cultural system (Iacovou, 2008). Migration is the simple movement of people. Colonization, on the contrary, can be seen here as asymmetrical migration where a group migrates and the incoming group changes the cultural landscape to fit their own needs. In this schema, the second wave of colonization came during the LCIIIB (also known as the Protogeometric period) (Janes, 2010). During this migration, proponents of this model argue that Aegean material culture becomes more apparent, including mortuary locations, tomb architecture, and Greek language (Karageorghis, 1982).

The principal evidence for this model has and probably will always be the presence of non-local ceramics that have been recovered from high-status contexts (Catling & Karageorghis, 1960; Karageorghis, 1976, 1982; Knapp, 1997b; Manning & Hulin, 2005). Additionally, Karageorghis (1982) sees the introduction of chamber tombs with long dromoi and small rectangular chambers as being direct architectural descendants of Mycenaean tomb types (though Janes (2010) argues that this tomb type was present far before the proposed influx of Mycenaean populations). Iacovou, on the other hand, sees the introduction of the Greek language as the surest sign of significant Mycenaean contact and cultural exchange (1999, 2008).

The Continuity Model

Iacovou (2001, 2008) describes the transition from the Late Bronze Age to the Iron Age on Cyprus as the Protohistoric Interim. She, like Knapp (2013), Janes (2010), and Cannavò (2010) sees continuity between the Late Bronze to Early Iron Age. Each, to differing degrees, sees foreign elements, but they do not always agree about the nature or importance of those inclusions. Cannavò argues that Cypriot history should be viewed as a continuum without "artificial periodization originally conceived for different contexts" (2010, p. 41). Any arrivals of settlers fleeing political unrest to the west and east were episodic in her view and a "peaceful phenomenon (with some exceptions)"; essentially, this "was a process of Hellenization rather than colonization" (2010, p. 41, italics original).

Researchers generally agree that the Greek language was the dominant language on Cyprus by the beginning of the Iron Age, but the relationship of language, ethnicity, and cultural identity is a convoluted one. Cannavò would argue that ethnicity is not dependent solely on language, but that language makes up one aspect of identity. Iacovou, on the other hand, sees language as fundamental to identity formation (ethnicity in her lexicon) (1999, 2007). She ascribes a fundamentally Greek face on the external influences due to this focus on language, so much so that she tends to underplay the influences from Anatolia and the Levant. These areas did not contribute linguistically, and so are discounted to a large extent.

Settlement locations and patterning

By the ProBA, Cyprus was no longer egalitarian, isolated, or village oriented. Instead, it was outwardly focused, competitive, socially stratified and town-centered. Central to our understanding of the site location and interconnectedness is the patterning seen in the Vasilikos valley. The large complex of PreBA sites in the northern end of the valley was discussed above. Their relationship to the later ProBA sites in the more southern end of the valley is not entirely clear, but they may have been instrumental in the accumulation of wealth displayed at the later sites, particularly Kalavasos *Ayios Dhimitrios*. In addition to Kalavasos *Ayios Dhimitrios*, a large industrial site (Sanidha *Moutti tou Ayiou Serkou*) involved in the production of White Slip pottery is also present.

Throughout the ProBA there is a general expansion of a settlements and an increase in overall site size, co-occuring with an increase in overall estimated population. The majority of large, well-known sites are scattered throughout the southeast of the island. Some sites from the PreBA continued, including Kourion *Bamboula*, but new sites were founded. These include the sites of Enkomi, Hala Sultan Tekke and Kition (Knapp, 2013). The concentration of sites along the coast took advantage of new and intense trading relationships. Hala Sultan Tekke is a coastal site dating to the late Cypriot period. Karagheorghis (1982) attributes the rise of the site to the expulsion of the Hyksos from Egypt and the establishment of the 18th Dynasty in that country, leading to growth of the urban trading centers on the eastern and southern coasts of Cyprus. For Kargheorhis and those that favor outward facing models (colonization/migration model) for social change in the Mediterranean, trade goods coming from Cyprus (primarily copper from the Troodos) created an environment where external forces were more and more interested in developing trading partners and ultimately colonies on Cyprus itself.

Cyprus may be identified with the Bronze Age state of *Alashiya*, a prominent trading partner known from Hittite and Egytian sources. Cyprus has long been associated with *Alashiya*, based on geographic similarities to written description (see Holmes, 1971; Wachsmann, 1986). Recent petrographic analysis of Alashiyan tablets from Elamarna and Ugarit also support the identification of Cyprus as Alashiya (Goren, Bunimovitz, Finkelstein, & Na'Aman, 2003). If Cyprus is indeed the island of *Alashiya*, mentions of trade between Egypt and Cyprus begin in the 18th and 17th centuries BCE but become more frequent in the 14th century BCE. Hittite tables begin to appear in the 14th century as well, indicating contact and possible military takeover of at least part of the island by the Hittites. Clearly, given the high frequency of exotic goods, trade with both the Near East and Egypt was a certainty.

Its location near a probable natural harbor (now a salt lake) is one reason that Knapp (1997a) identifies this site as a major coastal urban polity. In describing his fourtiered hierarchy of sites during the LC, he uses this site as a type-site. HST appears to have had preferential access to trade goods from the Aegean, the Near East, and Egypt; this increased prevalence of foreign objects has been seen as a marker of increased hierarchy between coastal settlements (Steel, 2004). The primary industry of this site was likely trade based—Knapp (1997c, p. 157) refers to HST as one of the “trade emporia”--because at the end of the LCIIIA period, when the harbor began to silt over after a large earthquake, the site was apparently abandoned for nearby sites such as Salamis or Kition (Karageorghis, 1982, 1990).

New coastal centers, such as Hala Sultan Tekke answered the demand for Cypriot copper and other goods while bringing products from the Near East and Aegean into Cyprus. Coastal centers played a large role in the development and maintenance of a social hierarchy. Elites were instrumental in their founding, and they controlled the flow of goods onto and out of Cyprus (Keswani, 1989). This control allowed them to conspicuously display new wealth.

Knapp (1997a, 2008b, 2013) argues for a four-tier site hierarchy during the ProBA. The First Tier sites, and those displaying the most conspicuous displays of wealth and social differentiation, are coastal centers along with Kalavasos *Ayios Dhimitrios*. These sites contain large amounts of prestige goods as well as ashlar masonry, signs of metallurgical production (such as those found at Kalavasos *Ayios Dhimitrios*), Cypro-Minoan inscriptions, seals and weights. This tier of sites is defined not only by size but also by location and proximity to trade routes and inland resources. They served multiple functions, including some control over production and transport of goods. They also served as administrative and transportation points along trade routes.

Second Tier sites consist of inland towns; these are the smaller administrative centers involved with production, transport and storage of goods. These sites are identified as second tier not only by their size but also by their strategic locations. They are located near areas of production or copper sources, where access to these goods (including agricultural and prestige goods) could be controlled.

Third Tier sites are the smaller inland sites, including ceremonial centers, that are also involved with production, transport and storage of goods. The primary difference between second and third tier sites is one based primarily on size. Sanctuaries are included with third tier sites because of their presumed control over ritual sites. Interpretation of the sanctuary sites is disputed. Keswani (1993) believes that at least some of these 'sanctuaries' may have been used as transfer points in the exchange of goods and had storage functions for that purpose. Alcock (1993) believes they played a role in demarcating regional territories.

Fourth Tier sites are those specialized sites focused mainly on production and transport of goods to the larger centers. These sites are smaller and more specialized. They are located near the resources they intensively exploit; sites exploiting copper resources are located in or near the Troodos foothills; sites producing large amounts of agricultural surplus were located in the Mesaoria plane. These include Aredhiou *Vouppes* and the later phases of Episkopi Phaneromeni. Pottery-producing sites were located near clay-producing soils, such as Sanidha *Moutti tou Ayio Sekou*.

There are two well-known sites that do not fit this hierarchy, Maa *Palaeokastro* and Pyla *Kokkinokremos*. Maa *Palaeokastro* is located on the north coast, and Pyla

Kokkinokremos is located near the coast. These have been interpreted as defensive structures (Karageorghis, 1998; Steel, 2004). Keswani, however, interprets these as outposts of Kouklia *Palaipaphos* and Kition. Smith (1994) argues whether they may have been centralized storage facilities. Caraher et al. (2005, pp. 246-248) identified a prehistoric harbor near Pyla *Kokkinokremos* on what may have been the coastline during the ProBA. This may indicate that the site served as a transfer point for coastal ports and the transfer of goods.

More than just the site size and function go into the formation of a unique Cypriot identity during this time frame. Monumental architecture is a hallmark of tier one sites. While this monumentality lacks distinct palaces such as those seen in the eastern and central Mediterranean (e.g., Crete), Fisher's (2007, 2009a, 2009b) analysis of monumentality provides a different way of analyzing the space and use of space at ProBA sites.

Examining Building X at Kalavasos *Ayios Dhimitrios* showed a combination of public and private space that defined social status and hierarchy by allowing access to some portions of the building while keeping others restricted. Builiding X is approximately 1000 m^2, and contains the Pithos Hall. This room held 50 large storage jars with a combined capacity to store at least 33,500 liters of olive oil. Other rooms within this structure contain equipment used in the manufacture of olive oil as well (South, Unpublished Manuscript). There is also a large entry hall where feasting events likely occurred (Fisher, 2009a). Concentrations of meat-bearing ovicaprid bones and pottery vessels were found in a corridor off this hall. This building also contains a concentration of seals and inscriptions.

As there are no monumental structures from this period on Cyprus containing strictly public or private or strictly secular or ceremonial functions (recall the debate over sanctuaries above), the use of space within multifunctional structures allowed for the display of social hierarchies that transcending those categories, drawing them all together to reinforce social identity (Fisher, 2007; Knapp, 2013). Added to the multifunctional spaces these large structures created were the presence of tombs nearby (in the case of Kalavasos *Ayios Dhimitrios*, tombs were located in the street directly adjacent to the structure). The co-occurrence of monumental structures and tombs has been interpreted by Keswani (2004, 2005) as control of the economic and ritual functions occurring at the monumental structures by the elites, reinforcing their control across generations.

Another example of such a monumental structure is a complex of structures at Maroni *Vournes*. The Ashlar Building measures 600 m^2, contained an olive press and a large storage area. In addition to the elements within the structure, the structure itself may have performed a function. It would have been visible from distances and created an imposing view. In association with the Ashlar Building is the West Building, which had large areas for storage and production including metal working, olive oil presses, weaving, and writing (Cadogan, 1996). The Basin Building at the southwestern end of the Ashlar Building contained debris relating to copper production. Manning (1998) has interpreted these structures as a legitimizing tool for elites. One element of this interpretation draws from the construction of the Basin and Ashlar Buildings over existing tombs. This could be seen as an example of fictive kin, where emerging elites desired to associate themselves with previous lineages by constructing monumental structures over their tombs, thereby claiming them as part of their lineage.

Yet another example of this use of monumentality as a mechanism for the solidification and negotiation of social hierarchy can be found at Enkomi *Ayios Iakovos*. The Ashlar Building and Batiment 18 are germane to this discussion. Both buildings have central entrance halls opening onto rooms on both sides. The Ashlar building was rebuilt in the late ProBA to be dressed with Ashlar masonary. Fisher (2006) argues that this structure housed both residential and administrative functions for elite groups. The central hall contained a large hearth likely used for public occasions, which would have allowed some access by the public to a very elite location, while baring access to the private spaces off the central hall. The southern part of the building housed a sanctuary to the Horned God, including a large pillared hall (room 45, 60 m^2). Public events would have occurred within the pillared hall with a smaller restricted access area for exclusive rituals (Fisher, 2009a). This structure combines residential, administrative, and ritual functions within the same structure.

Other sites used complexes of structures to perform individual functions. At Hala Sultan Tekke, domestic, industrial, and mercantile structures are located within complexes located close to each other and should probably be considered as a complex of structures as opposed to single-use structures (Knapp, 2013).

Mortuary Processes

Mortuary practices in the ProBA have been a prolific field of study. The complexity developing in the PreBA is visible archaeologically, specifically in mortuary patterns (Greenfield, 2010, p. 30). Differentiation in mortuary type begins to proliferate in the Late Bronze Age with the introduction of tomb types that have been identified with both Aegean and Anatolian cultural affinities. Increasing complexity led to the rise of centers along the coast (such as Kition, Episkope, Maa) and inland (Politiko, Athienou, Idalion).As is clear from the discussion regarding monumentality, the location of tombs in association with these large structures was important in the formation and negotiation of social hierarchies. There are some broad patterns that occur during the ProBA. Burials move from extramural locations to intramural locations. Grave goods also tend to become richer containing more prestige goods, including gold, ivory, glass, faince, ostrich egg containers and imported goods. By the end of the 13th century BC, more variation is present in the tomb assemblages themselves. Individual and multiple burials occur within everything from shaft graves to large elaborate tombs (Keswani, 2004). Knapp (2013) draws an association between mortuary practices on Cyprus and the collapse of the economic relationships throughout the Aegean and eastern Mediterranean regions. While the breakdown of these relationships caused social collapse in those regions, it may have created economic opportunities on Cyprus itself. Cyprus was, in a way, redefining itself as a stable island in an unstable sea. By the 11th century BC, extramural cemeteries were once again common. Modes of burial were variable, from shaft tombs to large elaborate chamber tombs. Cremation was also practiced during this later portion of the ProBA (Keswani, 2004).

Keswani argues that ProBA burial practices reflect new social realities, specifically the formalized hierarchy based on access to copper trade goods, and therefore power (2004). Supporting the idea that wealth and power were also being expressed in non-mortuary contexts is the increase in gold and prestige items in use in domestic settings at the same time that these objects decrease in tomb assemblages (Knapp, 2013).

The shift from extramural to intramural burials is discussed above with relation to monumentality. Intramural tombs at Kalavasos *Ayios Dhimitrios* were in association with large structures, particularly Building X. There may also be a segregation of sexes within tombs at this site. The high number of adults of indeterminate sex from this site make this assertion less than secure, based on current data gathered for this study. In-field identifications do indicate that only females were buried in Tomb 11 (Moyer, Unpublished Manuscript), for example, but due to lab taphonomy or different methodologies used to estimate sex and age at death, this may no longer be confirmable. If there are solely females within this tomb, these are some of the most richly adorned tombs at the site, including stamp seals, gold jewelry, and multiple sets of Mycenaean kraters (ceramics). The jewelry, in particular, showed signs of being worn, suggesting the interment of personal possessions of either the dead or those who buried them.

Knapp (2013, p. 382) argues that mortuary ostentation is not as important for the expression of status differences during this period. He argues instead for the use of monumental architecture, luxury goods, and seals and sealings to establish elite status and power. The variability seen in the tomb assemblages and the increasing use of monumentality are seen by Knapp and Keswani (2004)

The use of the body as a political object is well known and has been studied cross-culturally (e.g., Osterholtz, 2013; Pérez, 2006). In a Cypriot context, we can examine not only the use of the body as a mechanism for the display of conspicuous wealth, as Keswani does, but also through the manipulation of mortuary space. The movement of the tombs into city spaces can be seen as a mechanism for the creation of lineage-based control over economic resources. In addition to using the tombs as economic anchors, tying lineages to certain monumental structures, the destruction of earlier burial plots may be seen as superimposition of new elites or lineages over old elites or lineages. The destruction of plots such as those at *Vournes* and *Tsaroukkas* can also be interpreted as competition between groups for political legitimacy (Manning, 1998; Webb, 1999). In a similar vein, Keswani (2004) argues that these destructions were tied to the arrival of new settlers from mixed descent groups who were not as closely tied culturally to the remains. This could be seen as a mechanism of destroying a previous descent group's claims to the area, allowing them to redefine history through the destruction of the tombs themselves. In areas with continuous occupation, such as the Vasilikos valley, however, residents at the sites build tombs over the existing ones (Keswani, 2004). Earlier tombs were not destroyed, suggesting a continuity between those who constructed the new tombs and those who constructed the older tombs.

Chapter 3. Methods and Materials

Methods

Commingled and fragmentary assemblages present many challenges to researchers and so they tend to languish in skeletal repositories without ever being fully studied (e.g., Zejdlik, 2014).These assemblages provide useful data when combined with methods that are tailored for isolated bones and fragments. In areas such as Cyprus, where commingled burials are the most common form of interment for some time periods (e.g., the ProBA II and ProBA III) (Keswani, 2004), their underutilization in theories about diet, health, migration, settlement and patterns of labor means that only a part of the picture of human behavior is being seen.

Consistent with the biocultural model, numerous lines of evidence are used examine social conditions and the biological effects of social change during the Bronze Age. The biocultural model explicitly emphasizes interaction between humans and their larger social, cultural and physical environments (Armelagos, 2011). In recent years, it has become firmly grounded in a consideration of the effects of social relations, particularly power relations, on human biology (Martin, Harrod, & Pérez, 2013). This focus draws attention to the influences of both microenvironmental, proximate conditions as well as complex, ultimately political, social and economic realities on processes of biological and cultural adaptation. As juxtaposed with descriptive osteology, which places emphasis on questions about the presence, absence, or degree of a given pathology in a given temporal, geographical, or cultural context, a bioculturally-oriented modern bioarchaeology focuses on examining the patterns of a particular pathology in order to show the effects of social, ecological and political processes on health and violence within and between groups (or populations) (e.g., Glencross, 2011). Essentially, the biocultural model examines linkages between factors that can be reconstructed for a given environment, culture and biology. In this way, it can contribute to an understanding of how people both adapt to and adapt their environments to themselves. It can also help to explain underlying social constructs that may not be visible archaeologically (such as differential health between males and females).

Bioarchaeology employing a biocultural model has three distinct premises (Armelagos, 2011; Zuckerman & Armelagos, 2011). First, it includes the application of a population perspective. The health of individuals contributes to societal health, but it the population perspective that provides a view into differential access by groups and the health of society as a whole. Second, the biocultural model recognizes that culture is an adaptive force within human environments that is linked to biological adaptation. Culture can either inhibit or encourage disease. Third, methods for testing alternative hypotheses on the interaction between biological and cultural dimensions of the adaptive process exist. This linkage grants bioarchaeology its creative and interpretive power for answering significant questions on the adaptive experiences of past populations on regional and broader levels.

The biocultural model is well-suited for the study of biological effects of social change. For example, the transition to agriculture (as a form of economic intensification) is known to have had significant health consequences (e.g., Cohen & Armelagos, 1984; Cohen & Crane-Kramer, 2007; Goodman, Martin, Armelagos, & Clark, 1984), including increased fertility, lower interbirth interval, lower age of weaning, and new zoonotic and crowd-based disease vectors. Social changes that go along with this transition to agriculture included increased social stratification, changes in division of labor, and different work patterns; all of these changes can be examined from archaeological perspectives that add in multiple lines of evidence that when examined with the biological data provide a fuller picture of life during this social change.

The bioarchaeological model is useful in terms of organizing data that can then be examined through various cultural lenses, in this case landscape, identity and collective kin. The examination of cultural change on Cyprus using a biocultural model is used here to explain how human populations adapted to the social changes that occurred from the beginning of the PreBA I through the end of the ProBA III periods. Furthermore, the model helps integrate the fragmentary remains with other known aspects of mortuary and cultural context.

Specialized Techniques

The use of commingled assemblages

Typically, bioarchaeological analysis begins at the individual skeleton, with the estimation of age at death, sex, and a pathological analysis. After individual analysis is completed, these individuals are then grouped together to form populations, the basis of study when using the biocultural model (see above). These populations are then compared within and between sites and examined for changes in patterns through time. Commingled remains are unique in that the individual is unobservable. All analysis must take place at a population level. Overall health indicators can be examined, such as rates of cribra orbitalia (anemia) or the age of the first insult for LEHs (physiological disruptions that cause linear enamel hypoplasias in teeth). Linear Enamel Hypoplasias are described in greater detail below. While an individual's full health status cannot be determined based on a survey of the entire body, the assemblage as a whole can be analyzed as a population.

Levels of Analysis

The elements themselves form the simplest unit of analysis, and then trends in the number (MNI), demography (where identifiable), pathology, and robusticity of the elements are examined on a population level (Figure 3). Once the data for the individual fragments has been analyzed, these fragments are then aggregated into site-specific groups. These are then analyzed with respect to intrasite, temporal, and regional variation.

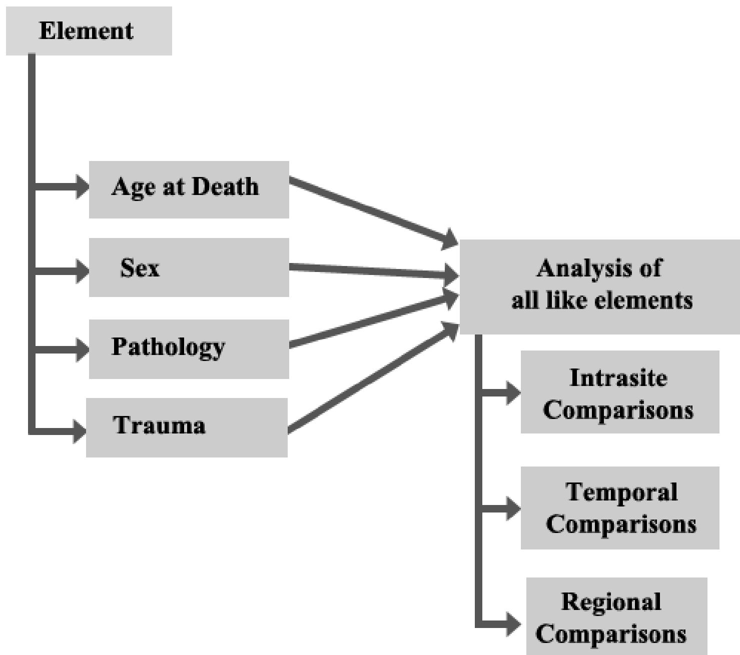


Figure 3. Flowchart of analysis.

Osteological Analyses

Table 1 gives an overview of the various methods used to develop demographic data as well as to analyze pathological change, childhood health indicators, and indicators of social change (e.g., changes in weaning age). The challenges of commingled and fragmentary remains require the use of diverse data sets, such as those presented in Table

1. A recent edited volume (Osterholtz, Baustian, & Martin, 2014b) provides a framework for the analysis of such assemblages and for their interpretation into larger analyses of social change. The method and theory presented in this volume of best practices influenced this analysis in important ways.

Table 1. Overview of Methodology, application of data and citations.

Data	How Data will be used	Citation
Age at Death and Sex Estimation	Demography, sex differences, population structure	Buikstra and Ubelaker (1994), Bass (1995); Scheuer and Black (2000, 2004); Ubelaker (1999)
Linear Enamel Hypoplasia	General childhood stress indicator, estimate age at weaning	Goodman and Rose (1990); Hillson (1996)
Tooth Wear	Change through time with respect to diet	Scott (1979); B. H. Smith (1984)
Paleopathology (general)	Nutrition, infectious diseases, social/class distinctions	Ortner (2003); Aufderheide and Rodriguez-Martin (1998)
General Stress Indicators	CO, PH, Periosteal Reaction, Dental Disease	Stuart-Macadam (1992); Ortner (2003); Martin et al. (1985)
Trauma	Interpersonal violence, social/class distinctions	Stodder et al. (2010); Osterholtz and Stodder (2010); Walker (1989, 1997); Brink et al. (1998)
Musculoskeletal Markers	General robusticity, division of labor, social/class distinctions	Mariotti (2007); Milella (2011)
Mortuary Context	Social/class distinctions, sex differences	Keswani (2004, 2005), others

Several issues are present when examining commingled and fragmentary remains, including:

- The estimation of age and sex can be less accurate and more difficult when the entire body is not present. Age and sex can, in some cases, be estimated for individual elements, but these methods introduce additional error based on metric standard error rates and the use of different reference samples.
- The distribution of a pathological process (such as a bone infection) within a single individual can rarely be analyzed, and so the unit of analysis becomes the element as opposed to the individual.
- This element-focus necessitates the use of population-level research questions (completely consistent with the use of the biocultural model).

This methodology listed in Table 1 is specifically tailored to this analysis in order to yield the strongest possible data set for determining the biological effects of change over time on Cyprus. Samples sizes for some lines of evidence (such as enthuses—muscle attachment sites) are small and skewed, and the multiple lines of evidence are needed to allow for a full interpretation. The addition of mortuary data is also important to situate the analysis. Mortuary data provides context on identity, status and other factors important to this study.

Sex and Age at Death Estimation

The estimation of adult age at death is based on general size of the element, completion of epiphyseal union, and sufficient robusticity. The estimation of age at death for adults is usually difficult to refine in commingled and fragmentary assemblages, but, with pelvic elements, both age at death and sex can be accurately estimated. The estimation of age at death in commingled remains (exclusive of the pelvis) is far more difficult and tends to be population specific. Typically, normal age related changes such as osteoarthritis would be used, but because osteoarthritis has multiple etiologies this methodology is not employed to estimate age at death even in general terms. This is particularly true when the rates and age of onset for osteoarthritic change may vary by sex, and where sex estimation is less secure, arthritis cannot be used.

For many of the long bones, particularly in areas with great degrees of sexual dimorphism, sex can be estimated. There is an understanding with these estimations that they are very population specific. Estimating sex based on general size is not possible for many areas, but the remains on Cyprus dating to the Bronze Age have a high degree of sexual dimorphism, and so sex estimations were made when possible. The majority of elements, however, do not provide such dimorphism and so there are still significant numbers of adults for whom sex can only be estimated as "indeterminate."

Standard osteological techniques, as presented by Buikstra and Ubelaker (1994) and Bass (1995) were often inadequate for the analysis. These are based on having access to more than a single element or fragment (e.g., using both the cranium and os coxa to estimate sex), and so take the whole body into consideration. While the Suchey-Brooks (Brooks & Suchey, 1990) and Lovejoy, Meindl, Pryzbeck, and Mensforth (1985) methods for estimating age at death in adults was often helpful, the number of fragments that could be subjected to this type of analysis was quite limited. In the analysis of the Tell Abraq assemblage (a large ossuary containing the commingled remains of 287 adults and over 100 sub-adults), numerous metric studies were conducted to estimate sex in the adults. Researchers used multiple metric methodologies, all with a published 70% accuracy rate. While this is not optimal, sex ratios of post-cranial elements were very consistent no matter which methodology or element was used (Osterholtz, Baustian, Martin, & Potts, 2014). The use of multiple methodologies brings with it attendant issues: the use of samples geographically and temporal different from the sample under analysis; lower accuracy rates; and how to interpret conflicting results. While these issues are present, the use of metric sex estimates in the Tell Abraq assemblage showed such consistency that it allowed for a greater understanding of the mortuary processing and demographic profile; it is therefore warranted in commingled analyses.

Despite the use of general size, standard and multiple metric analyses, age at death and sex were difficult to estimate for most elements. Many individuals were analyzed as being of indeterminate sex. This necessitated the dropping of sex from many analyses. For example, the analysis of dental wear was conducted on two levels. The first used dentition associated with cranial elements for which sex could be estimated. A second level of analysis used all dentition from a site to examine patterns of dental wear regardless of sex. This was done to boost sample sizes and only after a lack of statistically significant differences between males and females were identified.

Subadult age at death was estimated using epiphyseal closure rates (presented in Scheuer and Black (2000, 2004)), dental development (Gustafson & Koch, 1974; Saunders & Spence, 1986) and diaphyseal long bone lengths (Ubelaker, 1999). Subadult remains present even greater issues with respect for age at death estimation. While age at death is more exactly estimable for sub-adults, particularly based on epiphyseal union, the stages of epiphyseal union for individual elements may overlap with other elements.

For example, an individual between the ages of 2 and 6 will have varying degrees of element completion and fusion. Some of the vertebral neural arches will be fused, but others may not be. This creates overlapping refined age estimates, possibly conflating the number of individuals present. For this reason, age at death when there was the possibility of overlap was based on feature replication and not solely on an age at death estimate based on a single indicator. This was particularly important for the differences in development of a young child between the ages of 2 and 6 and an infant between the ages of 1 and 2 years. To achieve an MNI of 2 in this case, there would need to be a duplication of the same features between the two age groups. Non-adjacent age categories (e.g., an infant and an adolescent) could be scored as multiple individuals without the necessity of overlapping features as they would not be easily mistaken for each other based on size or morphology. For analyses, only general age categories were used (Table 2).

Table 2. Age categories.

Age Category	**Developmental Age**
Preterm	Fetal
Perinatal	Birth-2 Months
Infant	Birth-2 Years
Child	2-12 years
Adolescent	12-18 years
Adolescent+	12+ years
Subadult	<18 years
Young Adult	18-35 years
Middle Adult	35-50 years
Adult	18+ years

Present in Table 2 are three general categories that require additional explanation. These are the Adolescent+, Subadult, and Adult categories. The Adolescent+ category was used to indicate that robusticity was more developed than would be seen in a child or infant, but it is unclear if this individual may have been an older subadult or young adult. The subadult category was used to indicate that the individual element did not attain adult morphology or size by the time of death. The adult category indicated that the individual element had attained adult morphology or size at the time of death, but that a finer age at death estimate was not possible.

Dental Analysis

Complete dental analysis was completed whenever possible. This included identification of all available dentition, scoring for presence, degree of development (e.g., crown complete, root complete, etc.), wear, caries (cavities), and Linear Enamel Hypoplasias (LEH) (growth disruptions from an unspecified stressor). All dental observations were recorded along the guidelines presented in Buikstra and Ubelaker (1994). LEH observations and age at stress incident were collected using Goodman and Rose (1990). While age at death estimation of subadults using dentition is more precise, this is not the case with isolated dentition where the root is completed. The majority of dentition identified as “adolescent+” is identified thusly due to the presence of at least light wear indicating the tooth was used for some time prior to death.

Because the preservation tended to be poor, and the majority of dentition examined were isolated teeth, two observations became very important: LEHs and dental wear. These were systematically recorded wherever possible. Caries and antemortem tooth loss were also systematically examined wherever possible, along the guidelines presented in Buikstra and Ubelaker (1994). During tooth formation, enamel is laid in bands from the incisal (chewing) edge toward the root. The process of tooth formation is highly canalized, meaning that it is under heavy genetic control and less population-specific in terms of timing (Hillson, 1996). Rose, Condon, and Goodman (1985) postulate that elevated cortisone levels (as would be seen in a stress episode) inhibit protein synthesis and reduce the secretion of enamel matrix. The resulting line (the LEH) is a sign of reinitiated deposition of enamel matrix at the end of the stress episode. Essentially, the development of the tooth is halted, and when growth resumes, a discolored band or groove may result. This is similar to the identification of drought in tree-rings (typified by a thin or discolored band in the tree). Because the process of enamel formation is highly canalized, the age of formation of an LEH can be estimated using regression formulae (Goodman & Rose, 1990).

Recently, Ritzman, Baker, and Schwartz (2008) compared LEH ages of formation using multiple methods, including one developed by Goodman and Rose and microscopic methods. They found that visual recording methods may under-estimate the ages of formation by significant amounts. They also delved into exactly what effect population can have on tooth formation times. They found that overall tooth size and mean crown height may be population specific and effect the identification of the age of formation of LEHs. While there are analytical issues involved in the estimation of age of formation, it can be a useful tool, especially with sufficiently large sample sizes.

Linear enamel hypoplasias can be created during any stress episode, but are commonly associated by researchers with weaning and childhood stress (e.g., Lewis, 2007). Malley (2004) also examined the role of economic intensification in her master’s thesis, comparing two contemporaneous populations that specialized in different economic intensifications. She found that this specialization impacted the age of initial insult. This impact of specialization, however, may be more complex, impacting the age of weaning due to economic indicators in addition to different nutritional stresses that may be brought about by different economic strategies.

For this analysis, the Goodman and Rose (1990) regression formulae were used to estimate the age of insult or stress. The youngest age of stress was then compared with respect to sex, site, and time period to look for regional or temporal trends. Analysis of the youngest age of stress was compared in SPSS (version 22) without regard to tooth. The sample sizes were large enough to employ parametric tests.

Tooth wear was examined for all available dentition using the scoring system put forth in *Standards of Data Collection* (Buikstra & Ubelaker, 1994). For single rooted teeth, this follows B. H. Smith (1984) and for molars, following Scott (1979). Single rooted teeth are scored on a 1-8 scale, while the molars are scored based on quadrants in a 0-10 scale. The quadrants are then summed to provide an overall wear score for the tooth. The scoring of individual quadrants, though, allows for the comparison of wear on the various surfaces of the tooth. In Smith's (1984) article, this was used as a mechanism for discussing food texture in the transition from hunter-gatherers to agriculturalists. Hunter-gatherers tend to have more evenly distributed wear patterns across the quadrants, while agriculturalists tend to develop oblique wear patterns. Molar wear, therefore, provides evidence for overall subsistence patterns. In all instances where molar wear could be scored, asymmetrical wear is evident. This pattern is not surprising as the subsistence pattern of agriculture is not a debated topic for any time period examined. Comparisons were then made on a tooth-by-tooth basis in SPSS (version 22) to look for statistically significant differences in tooth wear by sex, site, or time period.

Indicators of General Stress and Health

Porotic hyperostosis (PH) and cribra orbitalia (CO) are characterized by the expansion of the diplöe through the outer table of the parietals and frontal, creating a porous appearance to the outer surface of the bone. Cribra orbitalia occurs on the superior surface of the orbit, while porotic hyperostosis occurs on the external vault of the skull. Both have been linked to iron-deficiency anemia with some asserting that this is the most common cause of these disorders worldwide (Stuart-Mcadam, 1992; Stuart-Mcadam & Kent, 1992). Martin et al. (1985), however, note that individuals with anemia are more susceptible to infections. Porotic hyperostosis and cribra orbitalia may in fact be the result of opportunistic infections associated with larger health issues. In the Mediterranean area, one such infectious agent would have been Malaria. Regardless of the actual etiology of these disorders, they are general indicators of stress, either as the primogenitors of the lesions or as a precursor to opportunistic infections creating the lesions. The following variables were examined for the analysis of porotic hyperostosis and cribra orbitalia:

- Abnormal bone loss: location and extent of involvement
- Number, location, and measurements of loci
- Bony response, any structural collapse

Angel performed differential diagnoses of remains from Late Bronze Age Cyprus sites, and found that thalassemia was not uncommon (1966, 1972a, 1972b, 1978).

Thalassemia is a recessive genetic anemia. Carriers of one copy of the defective gene gain some immunity from malaria. Individuals who inherit two copies of the defective gene develop thalassemia, which would have been life threatening before modern medical intervention, characterized by both cribra orbitalia and porotic hyperostosis (Waldron, 2009). These two indicators have been chosen for this study for several reasons. First, they are easily recognizable and scorable on a sliding scale of both presence and degree using the methodology set forth in Buikstra and Ubelaker (1994). Second, they can be recorded on fragmentary remains. Finally, given Angel's identification of thalassemia in well-preserved and conserved Late Bronze Age remains, the presence of its indicators must be explored thoroughly. Though some protection against malaria is conferred with one copy of the defective gene, it does lower the threshold for other forms of anemia, opening the possibility that these individuals will be more susceptible to various other anemias as well as other blood-borne illnesses.

Bones are covered by a thin membrane known as the periosteum housing blood vessels, nerve fibers, and other soft tissues. When systemic disorders occur, hemorrhage under the periosteum can occur, creating a bony response, termed "periosteal reaction."

Depending on the extent of the damage, and whether it is an isolated or chronic insult, bony response will be different. Chronic periosteal reaction can lead to the deposition of sheets of lamellar bone on the outer surface of the bone, creating a layered effect. If the chronic infection is active at the time of death, varying stages of healed, healing, and active deposition will be present as well, giving a glimpse into current health of the individual under study. The following variables were recorded for periosteal reactions:

- Abnormal bone formation: surface reaction
- Chronic versus episodic deposition
- Endosteal reaction
- Extent of involvement
- Specific structures involved
- Overall distribution (if this can be noted)

Traumatic Injury

Traumatic injury can be caused by numerous activities, including interpersonal violence, accident, and/or occupation (Guyomarc'h, Campagna-Vailancourt, Kremer, & Sauvageau, 2010; Kremer, Racette, Dionne, & Sauvageau, 2008). The patterning and location of injuries within individuals and groups can help to differentiate between accident or subsistence patterns (e.g., Murphy, McGuire, O'Malley, & Harrington, 2010) and interpersonal violence (e.g., Brink et al., 1998). Murphy and co-workers examined patterns of cow-related trauma amongst dairy farmers and found unique patterns. Brink and colleagues, on the other hand, examined the admissions to hospital of individuals who had been involved in interpersonal violence. They found that trauma via interpersonal violence was more likely to be in the form of cranial depression fractures and facial fracturing. Specific wounds can also be attributed to specific styles of fighting (e.g., the targeting of the limbs in remains from the Battle of Towton in 1461 due to the presence of body armor (Novak, 2007).

Through careful analysis of the prevalence and patterning of cranial depression fractures, Martin (1997) was able to identify a probable subclass of females within

Ancestral Puebloan society in the American Southwest. Her analysis also combined indicators of general health, robusticity, and trauma patterns in this work, showing the importance of a multi-component biocultural approach (Goodman et al., 1984) to describe prehistoric society. Limitations to the analysis of trauma in commingled assemblages are noted by Harrod, Osterholtz, and Martin (2013) in the analysis of the CDFs from Tell Abraq. For this analysis, the following criteria will be used:

- Fracture type, edge shape, location, secondary changes
- dislocation type and location (where applicable)
- identifiable soft tissue involvement (through the analysis of exostosis and associated physiological structures) activity

Entheses will be used as general indicators of activity, not specific indicators of occupation. As an individual uses and develops musculature, the insertions and origins of the muscles remodel to accommodate for increased activity. In this way, the use of the muscles themselves can be examined osteologically. Recent research (Foster, Buckley, & Tayles, 2012; M. Milella et al., 2011) has indicated that the development of muscle attachment sites is significantly correlated with age and sex but not with specific activities. The age correlation may be due to the necessarily cumulative action of enthesial development; robusticity increases with age. Though specific behaviors cannot be associated with distinct muscle markers, different patterns of robusticity can be used as an indicator of different activities performed by these different social and geographically located groups.

Entheses were recorded using methodology reported by Mariotti et al. (2007) for all elements where the marker was sufficiently preserved. Entheses from the shoulder (humerus), elbow (humerus, radius, and ulna), hip (femur), knee (tibia), and ankle (tibia) were scored wherever possible. The upper limb entheses are associated with use of the upper limb, while the lower limb entheses may be associated with locomotion. Specifically the type of terrain in which an individual lives may impact the development of the entheses; if an individual lives in a rocky and steep environment, muscle markers will likely develop differently than if an individual spent most of their life on relatively flat coastal plains.

Kruskal-Wallis tests were conducted on the upper and lower limb entheses to look for statistically significant differences based on site, sex, or time period. This test was chosen because it does not assume a normal distribution and allows for small and skewed samples.

Mortuary Context

Mortuary context has been published for all the sites included in this analysis. Site reports were examined for these data, as were synthetic work such as Keswani (2004) and Knapp (2013). For the identification of overarching comparisons and regional distinctions, the inclusion of specific observations, by necessity, vary based on the excavators' focus and research questions. These qualitative observations are discussed on site-level.

Determining MNI

Buikstra and Ubelaker (1994) provided one of the first systematic ways of looking at commingling. They advocated element identification with the estimation of element completeness (e.g., 25-50% complete, <25% complete). While a good first step, this method of cataloging loses a tremendous amount of data and may lead to an error in the estimation of the minimum number of individuals present. It also does fails to capture demographic complexities. Zooarchaeological methodology has provided better methodology for the estimation of MNI. Knüsel and Outram (2004) use a zone-based approach that targets key areas that are important for cultural reasons (e.g., muscle attachments that would be necessarily processed for meat) as well as portions of bones that dimorphic for age at death and sex. The analysis at Sacred Ridge, a massacre site in Colorado dating to around AD 800 for which fragmentation was severe, takes this one step further and applies this concept to human remains, with the identification of individual features on those bones (Stodder & Osterholtz, 2010). The analysis of Tell Abraq helped to refine this work using a visual recording system (Osterholtz, Baustian, & Martin, 2012).

This analysis uses a feature-based approach utilizing anatomical structures on individual bones in order to examine what is the most prevalent element within the assemblage. Sexually dimorphic elements and features can then be tabulated to determine the demographic breakdown of the adults.

The issue of subadult MNI in commingled assemblages is a difficult one. A feature-based approach was used for these individuals as well, but one that had relatively well-defined age ranges for specific fusion sites on the post-cranial elements (fusion times presented within Scheuer & Black, 2000; Scheuer & Black, 2004 were used for this analysis). For example, the metatarsals were often used to determine the overall MNI for a tomb as they tended to preserve well, even when other elements did not. Fusion of the head to the metatarsal shaft occurs at known times, and so if unfused, the element had to belong to an individual of less than the minimum age at which fusion occurs.

Dental MNIs were also tabulated based on tooth identification and degree of development. Dentition is the hardest substance in the human body and therefore tends to preserve better than bone. In juveniles, the dentition may be the only surviving remains of the individual. The osseous versus dental MNIs tend to differ for many of the assemblages studied. This may be due to several things: 1) the preservation of dental remains may be significantly greater than that of bone (i.e., the dental MNI represents the true MNI of the tomb); 2) higher numbers of teeth included in the tomb may be present as an artifact of incomplete tomb clearing activities preparatory to tomb reuse (i.e., not all the dentition was collected from the tomb's previous occupant); 3) lower than expected numbers of teeth may be indicative of antemortem tooth loss as individuals can lose teeth during life; or 4) in some instances, dentition may be included as grave goods in the burials. This pattern has never been inferred for collections on Cyprus, but no overarching analysis such as this one has been attempted for a large geographical area.

Osseous MNIs are preferred over dental MNIs (e.g., Osterholtz, 2013; Osterholtz et al., 2012; Osterholtz, Baustian, & Martin, 2014a; Osterholtz, Baustian, Martin, et al., 2014; Stodder & Osterholtz, 2010). This is primarily due to the feature based methods used which tend to focus on elements for the overall MNI that cannot be lost during life without causing death. Teeth can (and frequently are) lost during life, and so their use may skew the determination of MNI. In some cultures as well, teeth can be placed in the tomb as grave goods (though this pattern has never been identified for the Mediterranean). If tomb re-use is occurring, dentition (particularly single-rooted teeth) may not be completely cleared out of the tomb during clearing activities. These are easily lost from the skulls and may have been overlooked in cramped and dark tombs.

An analytical puzzle presents itself, therefore, when one examines a tomb such as Tomb 7 at Kalavasos-*Mangia*. The bone from this tomb was poorly preserved, with the majority of the elements being fragmentary. The overall postcranial MNI was determined based on the metatarsals. When fragmentation of the long bones is extreme, the hand and foot elements may be the best elements with which to estimate the MNI since they are smaller. The long bones for this tomb are completely unusable for MNI, but the bulky bases of the MTs are suitable. The osseous MNI for this tomb is 4 adults (1 of which is male, 1 ambiguous), and 3 subadults under the age of 13 (based on fusion of the metatarsal heads). The dental MNI is slightly different, with a minimum of 4 adults (all of indeterminate sex) and a minimum of 2 children (based on dental development). Estimation of age at death for dentition was hampered by broken roots and lab taphonomy. Of the 45 identified loose teeth from this tomb, 15 could not be scored for development. Given the dangers inherent with using elements such as teeth that can be lost during life without significant detriment, the author chooses to preference osseous MNIs for the formulation of baseline data.

Materials

This analysis focuses on health indicators from commingled and fragmentary remains from several sites on Cyprus dating from the PreBA I (2400/2350 cal BC) through the end of the ProBA III period (1125/1100 cal BC). Specifically, remains from Sotira *Kaminoudhia*, Episkopi *Phaneromeni*, Hala Sultan Tekke, the Kalavasos Village Tombs, Kalavasos *Ayios Dhimitrios*, and Kalavasos *Mangia* were examined (Table 3).

Preservation tended to be poor. Additionally, these remains were excavated between 15 and 40+ years ago, so there has been a significant amount of lab taphonomy that has occurred. Analysis was based on what was actually present in the boxes, and these data are preferenced over the published reports for demographic profiles.

Episkopi *Phaneromeni*

The site of Episkopi *Phaneromeni* is located east of the modern village of Episkopi, approximately 14 km west of Limassol. Kent State excavated at the site between 1975 and 1978. All remains included in this dissertation sample were gathered during this time under the direction of Dr. Stuart Swiny (1986). These remains are currently housed at the Kourion museum located in the modern village of Episkopi.

This site yielded a minimum of 22 individuals, including a minimum of 6 males, 6 females, 5 adults of indeterminate sex and 6 children (aged between 2 and 12 years). This MNI is based on postcranial elements of the upper and lower limb. These individuals came from a total of 15 tombs, most of which contained a single burial.

Sotira *Kaminoudhia*

Sotira *Kaminoudhia* is the earliest site to be included in this analysis. Spanning the PreBA I and PreBA II periods, this site was excavated by Swiny and colleagues. This site is unique in that some skeletal remains were recovered from habitation units. These individuals are believed to have been killed during earthquakes. (Swiny, Rapp, & Herscher, 2003). These remains are currently curated at the Kourion Museum located in the modern village of Episkopi.

Table 3. Skeletal samples used in analysis and their temporal affiliations.

Period	**Phase/Culture**	**Dates (Cal BC)**	**Associated Sites**	**Context**
PreBA I	Philia 'Phase'	2400/2350-2250	Sotira-*Kaminoudhia*	Tomb 15
	Early Cypriot I-II	2250-2000	Sotira-*Kaminoudhia*	Tomb 14, 17
			Kalavasos Village Tombs	Tomb 73, 74, 75
	Early Cypriot II-III		Kalavasos Village Tombs	Tombs 76,78
PreBA II	Early Cypriot III-Middle Cypriot I-II	2000-1750/1700	Sotira-*Kaminoudhia*	Tomb 11
			Kalavasos Village Tombs	Tomb 36, 37, 39, 40, 41, 43(?), 45, 46, 47, 48, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69, 70, 71, 72, 77, 79
Protohistoric Bronze Age (ProBA)	Middle Cypriot (MC) III-Late Cypriot (LC) IIIA	1750/1700-1050	Kalavasos Village Tombs	Tomb 38, 43(?)
ProBA I	MCIII-LCI	1700-1450	Episkopi-*Phaneromeni*	Tomb 105, 106
			Kalavasos Village Tombs	Tomb 51
ProBA II	LCIIA-LCIIC early	1450-1300	Kalavasos-*Ayios Dhimitrios*	Tomb 1, 4, 5, 7, 9, 11, 12, 13, 14, 16, 17, 18, 19, 21
			Kalavasos-*Mangia*	Tomb 5, 6, 7, 8
			Kalavasos Village Tombs	Tomb 46, 47, 57
ProBA III	LCIIC late-LCIIIA	1300-1125/1100	Kalavasos-*Ayios Dhimitrios*	Tomb 6, 10
			Hala Sultan Tekke	Toms 1, 2

This site contained a minimum of 11 individuals based on the femora. Of these, the majority are adult females. A total of 4 young adult females were recovered along with 5 females whose age could only be estimated as “adult.” Two adult males were recovered as well, along with three adults of indeterminate age. Remains were recovered from both tomb and residential contexts. The remains within residential contexts are believed to be those individuals unable to escape during an earthquake event. All of the remains from residential contexts are morphologically female.

Hala Sultan Tekke

The remains of two tombs were used in this analysis. These remains were recovered in the late 1960s by Dr. Vassos Karageorghis, other remains from this site were not relocated, and do not appear to have been retained by the excavators or museums. The remains from Tomb 1 and 2 are currently housed in the Museum of Cyprus in Nicosia.

Tomb 1 contains the remains of at least 18 individuals. These include 2 infants, 4 children, 1 adolescent, 4 adult females, 5 adult males, 1 young adult female, and 1 middle adult male (based on cranial elements). MNI was determined using duplication of features with elements where age and sex were diagnostic. The original MNI given by Astrom et al. indicates 11 individuals, but their methodology is never fully explained; this approach did not fully utilize the small elements and may not have taken age as a factor in the determination. Based on the number of loose teeth, as well as the relatively high number of small hand and foot bones (the proximal foot phalanges have an approximately 12% representation), it seems clear that this tomb is a primary long term collective burial (Osterholtz, Baustian, & Martin, 2014a), meaning that whole bodies were placed in the tomb and allowed to decompose.

Fragmentation and commingling is likely the result of the rooftop entry to the tomb, which would have caused disturbance of the burials each time the tomb was opened. The demographic breakdown of the tomb itself is consistent with a lineage-based tomb consistent with known mortuary practices, with both sexes and both adults and subadults represented. This tomb, therefore, likely represents a normal tomb population for the time, not an unusual burial program. Again, based on the presence of numerous small hand and foot bones as well as isolated teeth, this tomb was likely completely collected.

Vasilikos Valley Assemblages

The majority of the assemblages used for this analysis were collected from within the Vasilikos Valley. These were all excavated by Dr. Alison South and Dr. Ian Todd. There are several benefits to using these materials. First, excavation standards were high and there was usually a bioarchaeologist in the field during the excavations. In some cases, excavations of identified tombs were put on hold until a bioarchaeologist could be brought to the site (South, pers. comm.). This focus on maintaining the quality of excavation and the proficient excavation of human skeletal materials specifically means that the collection and retention of the remains is complete. Second, these assemblages were professionally excavated beginning in the 1970s using consistent methodology and staff. Consistency in excavation also aids in the complete collection and retention of the remains. Third, the remains provide a geographic record that spans the entire length of time examined in this research project. This allows for a study of change over time within a bounded geographic region. Finally, the dating (normally using ceramics) of the individual tombs allows for a fine-grained approach to examine cultural change through time. This valley can then be compared to the sites outside the valley for various time periods. The sites selected for this dissertation allow for both geographical and temporal comparisons in order to examine cultural change through time and based on location on the island. All materials from the Vasilikos Valley are currently housed in the Terra apotheke of the Larnaca district museum. Excavation of the Kalavasos Village Tombs

Kalavasos Village Tombs

The Kalavasos Village Tombs constitute the largest single site in this analysis and span the PreBA I through ProBA II periods. They also provide the largest skeletal sample. This analysis includes remains from Tombs 36-79, all excavated by South and Todd beginning in 1978. Excavation of the Kalavasos Village Tombs began as rescue excavations in the summer of 1978 and continued for several years. Prior to the work by South and Todd, Karageorghis had conducted limited excavations necessitated by construction (Karageorghis, 1940-1948). The remains from these earlier excavations have been lost or were never retained in the first place, a common occurrence for excavations of this time period.

All together a total of 63 individuals were examined from this site. These included a minimum of 17 adult females, 15 adult males, 3 adults of ambiguous sex, and 20 adults of indeterminate sex were recovered. Poor preservation is mostly responsible for the large number of adults for whom sex cannot be estimated. A minimum of 1 infant, 4 children, 2 adolescents, and 1 subadult (without finer age at death estimate) were recovered from this site.

Kalavasos Ayios Dhimitrios

Kalavasos *Ayios Dhimitrios* consists of remains from the ProBA II and ProBA III period (roughly the Late Bronze Age). These remains constitute the second largest skeletal sample, and are associated with a large administrative structure. The tombs were looted in antiquity, but collection and retention of all remains excavated was complete. All remains were recovered from within tomb contexts except for a single niche burial of an infant (context A50W). All together a minimum of 41 individuals were examined (based on cranial and post-cranial elements). These included a minimum of 4 adult females, 6 adult males, and 15 adults of indeterminate sex. Subadults are represented by at least 6 infants, 7 children, and 3 individuals of subadult age for whom finer age at death estimates were not possible.

Kalavasos Mangia

Kalavasos *Mangia* is a single period site dating to the ProBA. This relatively small assemblage consists of a minimum of 16 individuals, including 1 adult female, 1 adult male, 2 adults of indeterminate sex. Of interest, though, is the relatively high number of subadults represented in the assemblage. These include 1 preterm individual, 3 perinatal remains, 2 infants, 3 children, 2 adolescents, and one subadult for whom a finer age at death estimate was not possible.

Chapter 4. Results

This chapter presents the results of osteological analysis for all sites. After this, the results of comparisons for regional and temporal differences are presented.

Analysis of Individual Sites

Sotira *Kaminoudhia*

Overall summary

This site dates to the PreBA 1 period, between 2400 and 2000 cal BC. A total of 12 individuals from this site were included in the analysis. Most tombs contained single individuals, based on the current material available for study. LEHs were scored for all teeth, but only females were identified osteologically, so sex differences could not be examined. Caries were identified in two teeth. Antemortem tooth loss, dental wear, and the use of teeth as tools were also scored for this assemblage. Pathological changes such as cribra orbitalia, porotic hyperostosis, periosteal reactions, and indications of trauma were also scored for this assemblage. The minimal preservation precluded much analysis, as did the demographic skewing (only adult females were recorded).

MNI and Demography

A total of 12 individuals were identified from the various contexts at Sotira *Kaminoudhia*. As can be seen in Table 4, only one, Tomb 15, contained more than one individual. There were no subadult remains recovered from this site except for some child teeth found in Op H23D which may have been lost during life.

In addition to the individuals listed in the table below, numerous isolated teeth were found. In Tomb 11, the primary skull is that of a young adult female, but there were two other isolated teeth. One, an upper right canine is inconsistent in size with the young adult female, and the other is a lower left second incisor; this tooth is a duplicate of the one included in the mandible associated with the young adult female skull. The presence of these loose teeth may indicate tomb reuse with extensive cleaning of the tomb after use. Alternatively, there could be at least two or possibly three individuals within this tomb; all postcranial elements were not independently assigned sex, but there were no duplication of features, and so the overall MNI is still one. MNI was not computed based on the dentition because dentition can be lost during life.

Childhood Health Indicators: LEH

LEHs were scored for all available teeth, both from within identified burial contexts and isolated teeth (Table 5). A total of 159 teeth were examined for LEHs from this site, but only 14 stress incidents were identified where an estimated age at stress incident could be estimated. In some cases, this could not be accomplished because the tooth could not be conclusively identified (e.g., could only be identified as a lower left molar) or because standards are not extant in the tooth (e.g., M3). Twelve of these occurred on individuals of over 12 years of age (Adolescent+ category) and 2 on children (2-12 years at the time of death). At this site, the child teeth have a higher average age of onset for the stress incident than the adults, but this is likely due to asymmetric demographic profiles from the site with the sample heavily skewed towards adults. Only subadult dentition was recovered from the habitation area; they may have been lost during life by an individual who did survive past 12 years of age. Unfortunately, all identified individuals are female, and so sex comparisons could not be conducted.

Table 4. Sotira Kaminoudhia, *MNI by context, sex, age, and element.*

	Adult				Subadult						
Context	Female	Male	Amb.	Indet.	Preterm	Perinatal	Infant	Child	Adolescent	Subadult Gen	**Tomb Totals**
I16D				1							**1**
Op H23D/H24D	1										**1**
Rm 18	1										**1**
Rm 44	1										**1**
Rm 71	1										**1**
T6				1							**1**
T11	1 (YA)										**1**
T14	1										**1**
T15		1		1							**2**
T17				1							**1**
Looted TB2				1							**1**
Total	**5**	**1**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**12**

Table 5. Sotira Kaminoudhia, *Total numbers of LEH and age at stress incident, by Age at death Category.*

	Adolescent+		Child	
Tomb	Total N Insults	Mean Age of Insult	Total N Insults	Mean Age of Insult
O16D	1			
OH23D			2	4.47
T1	10	3.79		
T14	1	2.8		
Totals	12	3.33	2	4.47

Total N of insults 14

When all teeth are considered together, regardless of whether the tooth could be conclusively identified or not, a total of 14 teeth exhibited LEHs out of the 173 that were scored for presence or absence (an additional 54 could not be scored). This provides an overall frequency of 8% of all teeth exhibiting some form of growth disturbance. It should be kept in mind, however, that the preservation at this site was marginal and that it is unclear if this number represents all the teeth that were initially found at the site; this number only reflects those available for study at the current time.

Dental Analysis

Caries

Of the 141 teeth that were scored for caries, only two exhibited carious lesions. Both of these were classified as large, meaning that they had destroyed the majority of the crown of the tooth.

Antemortem tooth loss

There were several difficulties in recording antemortem tooth loss. First and foremost, the majority of teeth examined were isolated, and so the state of any antemortem tooth loss for those individuals was unscorable. For the mandibles and maxillae where antemortem tooth loss could be recorded, it was recorded by individual tooth as per Standards. One individual exhibited antemortem tooth loss, an adult female. The permanent upper right first molar and permanent upper right fourth premolar were both lost before death with the area completely remodeled. For both of these teeth, this presents an overall rate of antemortem tooth loss for each tooth of 25%. It should be remembered, however, that the remains from this site were relatively poorly preserved and this likely does not accurately reflect antemortem tooth loss for the site.

Dental Wear

Dental wear was recorded for all dentition where either the root was visibly complete or where wear was visible indicating it had been in use during life (Table 4). Teeth with an estimated sex are associated with cranial remains where sex can be estimated. Estimation of age was limited to adolescent+, indicating that the root was completed and/or wear was evident on the crown. No deciduous or partially formed dentition was recovered from this site. The general patterns were explored statistically, but there were no statistically significant differences in wear between males and females, likely due to the very small sample sizes for individuals where sex could be estimated. This site was included in inter-site comparisons, discussed below.

Dentition from this site tended to be poorly preserved, Figure 4 is an excellent example of typical dental preservation. Both the root and crown are heavily impacted by root scoring as well as limestone concretions that obscure and erode the surfaces of the tooth. Analysis of intrasite dental wear was limited by this preservation.

This site has examples of dental notching (Figure 4). Preservation at this site is poor, and all teeth with notching were isolated finds, so it is not possible to estimate sex to determine if this notching as an extramasticatory use of the dentition is a gendered activity.

An additional pattern of differential wear is present on remains from Op H23D/H24B one of the habitation rooms from which remains were recovered. These are the remains of a female. The right lateral and central incisor have increased wear on the

Table 6. Sotira Kaminoudhia*, summary table of dental wear by sex and number of teeth.*

	URM3		URM2		URM1		URP4		URP3		URC		URI2		URI1	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female					1	12.00	1	2.00	1	2.00	2	2.00			1	5.00
Male	1	4.00	1	4.00	1	17.00	1	5.00								
Indet.					1	6.00			1	1.00	1	2.00	1	7.00		
	ULI1		**ULI2**		**ULC**		**ULP3**		**ULP4**		**ULM1**		**ULM2**		**ULM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	5.00									1	5.00				
Male							1	1.00	1	2.00	1	6.00	1	10.00	1	4.00
Indet.	2	2.50	2	3.00											1	9.00
	LLM3		**LLM2**		**LLM1**		**LLP4**		**LLP3**		**LLC**		**LLI2**		**LLI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	3	8.33	3	12.00	2	15.00	2	4.00	3	4.33	2	4.00	3	4.00	3	4.00
Male	1	13.00	1	14.00			1	3.00								
Indet.	1	4.00	2	12.00	2	14.00	2	5.00	1	4.00	4	4.00	2	3.67	3	4.67
	LRI1		**LRI2**		**LRC**		**LRP3**		**LRP4**		**LRM1**		**LRM2**		**LRM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	2	4.00	3	3.33	3	3.33	3	3.67	3	3.33	2	16.00	4	12.00	2	11.50
Male							1	4.00	1	4.00	1	15.00	1	14.00	1	8.00
Indet.	3	5.00	4	3.50	5	2.80	2	2.00	2	2.00	3	11.33	2	11.50	1	12.00

URM3=upper right 3^{rd} molar. URM2=upper right 2^{nd} molar. URM1=upper right 1^{st} molar. URP4=upper right 4^{th} premolar.
URP3=upper right 3^{rd} premolar. URC=upper right canine. URI2=upper right 2^{nd} incisor. URI1=upper right 1^{st} incisor.
ULM3=upper left 3^{rd} molar. ULM2=upper left 2^{nd} molar. ULM1=upper left 1^{st} molar. ULP4=upper left 4^{th} premolar.
ULP3=upper left 3^{rd} premolar. ULC=upper left canine. ULI2=upper left 2^{nd} incisor. ULI1=upper left 1^{st} incisor.
LRM3=upper right 3^{rd} molar. LRM2=upper right 2^{nd} molar. LRM1=upper right 1^{st} molar. LRP4=upper right 4^{th} premolar.
LRP3=upper right 3^{rd} premolar. LRC=upper right canine. LRI2=upper right 2^{nd} incisor. LRI1=upper right 1^{st} incisor.
LLM3=upper left 3^{rd} molar. LLM2=upper left 2^{nd} molar. LLM1=upper left 1^{st} molar. LLP4=upper left 4^{th} premolar.
LLP3=upper left 3^{rd} premolar. LLC=upper left canine. LLI2=upper left 2^{nd} incisor. LLI1=upper left 1^{st} incisor.

Figure 4. Sotira Kaminoudhia*, Tomb 11; Notching visible on central incisor.*

distal aspect of the tooth (Figure 5). This is not present on the left incisors. This pattern is reflective of extramasticatory tooth use, but what that activity may have been is unclear.

Pathology

Cranial pathology

Cribra orbitalia

Preservation was marginal at this site, and so the identification of cribra orbitalia and porotic hyperostosis were hampered by a lack of visible cortex and small fragment size. Table 7 presents the results of the examination of cribra orbitalia. Only one individual was scorable on either side, on the right an adult female (Figure 6), and on the left a young adult female. These may be from the same person, but this is unclear. It should be noted that the figures in the table refer to numbers of fragments, not individuals.

Due to the small and skewed samples, there can be no comparisons by age or sex for this site.

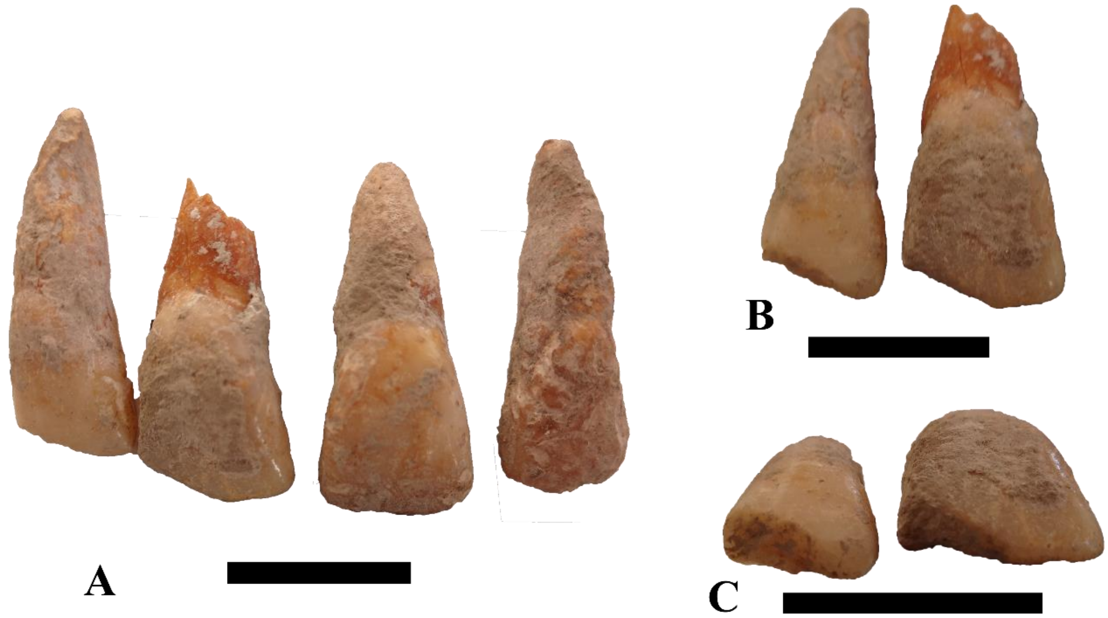


Figure 5. Sotira Kaminoudhia, *Op H23D/H24B, differential wear pattern on an adult female. A) labial view; B) focus on just the right incisors, lingual view; C) incisal view.*

Table 7. Sotira Kaminoudhia, *summary of cribra orbitalia (CO) by age, sex scoring, and degree of expression.*

		Left				Right			
				CO				CO	
		CO NS	No CO	Unhealed	Healed	CO NS	No CO	Unhealed	Healed
Adult	Female	3							1 Mi
	Male	1							
	Indeterminate	1							
Y. Adult	Female	1			1 Mo		1		

CO NS=cribra orbitalia not scorable
No CO=no cribra orbitalia was present
Mi=minimal expression
Mo=moderate expression

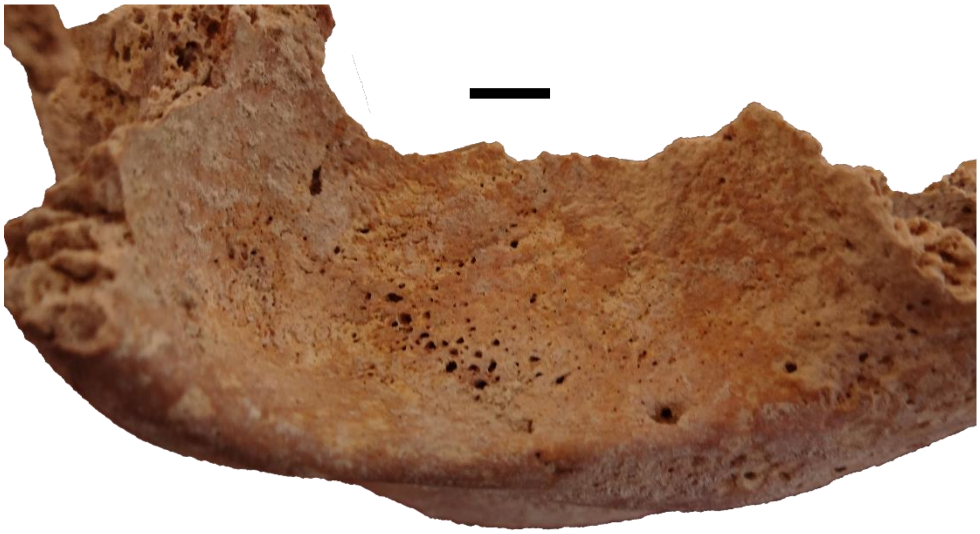


Figure 6. Sotira Kaminoudhia*, Tomb 11, Fragment T.11.S1, adult female showing minimal healed cribra orbitalia in the right orbit.*

Porotic hyperostosis

The majority of cranial fragments from this site were so poorly preserved that they could not be identified to element, and so were not included in the analysis. Those that could be submitted to analysis are included in Table 8. Only one fragment exhibited very mild healed porotic hyperostosis on the parietal.

Postcranial Pathological Changes

Little pathology could be recorded for Sotira *Kaminoudhia*. In addition to the data presented in Table 9, a great number of very small, nondiagnostic fragments were not submitted to analysis at all. Only those that could be identified to element were included; given the poor state of preservation this was a necessity but it also limited the analysis of pathology. It should also be noted that the numbers presented in Table 9 and Table 10 represent fragments, not individuals.

Table 8. Sotira Kaminoudhia*, summary of porotic hyperostosis (PH) by age, scoring, healing and expression.*

		PH NS	No PH	PH Unhealed	PH Healing	PH Healed
Adult	Female	3				1 Mi
	Male	1				
	Indeterminate	1				
Y. Adult	Female	1				

PH NS=porotic hyperostosis not scored
NO PH=no porotic hyperostosis is present
Mi=minimal expression

The only periosteal reactions visible were on adult remains. These were all healed at the time of death. Reaction expression is difficult to determine in fragmentary remains, but for these appear to be either minimally or moderately extensive to the element. This could indicate that the reactions are localized. This inference is tempered by the fragmentary nature of the remains, however.

Table 9. Sotira Kaminoudhia, *summary of the recording of pathology.*

Element	Age	Sex	N No path	N path NS	N path
Humerus	Adolescent	Female	1		
	Adult	Indeterminate	1		
	Y. Adult	Female			
Radius	Adolescent	Female	2		
	Y. Adult	Female	1		
Ulna	Adolescent	Female	1		
	Y. Adult	Female			1
Femur	Adolescent+	Indeterminate		1	
	Adult	Female		1	2
		Indeterminate		6	
	Y. Adult	Female		2	
	Adolescent+	Female		1	
Tibia	Adolescent+	Indeterminate		1	
	Adult	Indeterminate		3	
	Y. Adult	Female		1	
Tibia	Adult	Female			2
		Indeterminate			1
Fibula	Adult	Female			1

NS=Not scored

Table 10. Sotira Kaminoudhia, *summary table of postcranial periosteal reactions.*

Element	Age	Sex	Degree of Healing	Minimal	Moderate	Extensive
Ulna	Y. Adult	Female	Healed		1	
Femur	Adult	Female	Healed	2		
Tibia	Adult	Female	Healed	1	1	
Fibula	Adult	Indeterminate	Healed		1	

Entheses

Entheses for both the upper limb and lower limb were recorded wherever possible. Elements suitable for this analysis were not available for the lower limb entheses. Immediately obvious from examination of these data is that there are no identified males from this assemblage with remains complete enough to score enthesial changes. So comparison of males and females from within this assemblage is impossible.

Traumatic Injury

Traumatic injury to both the cranial and postcranial bones were analyzed.

Cranial Trauma

Two cranial depression fractures (CDFs) were identified on remains from SK. Both of these CDFs were identified on female skulls and both were recovered from non-tomb contexts. Figure 7 shows the overall location of all CDFs and their relative sizes.

The skull of a young adult female from Rm 44 has a large lozenge-shaped CDF on the frontal bone. Young adult age at death is based on associated os coxa scoring of the auricular surface. Sex is estimated due to gracile cranial indicators as well as a wide GSN. Despite being covered with limestone concretions, this is well defined and large, measuring approximately 14.61 × 4.78 × .83 mm. It is well healed and integrated into the surrounding bone.

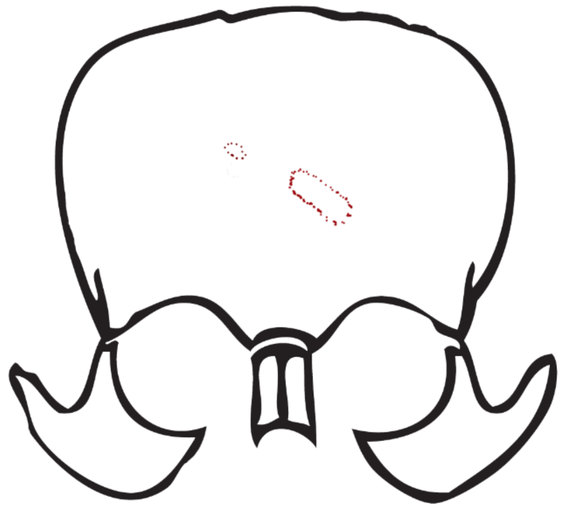


Figure 7. Sotira Kaminoudhia*, Diagram showing all CDFs*

The other CDF from Sotira *Kaminoudhia* occurred on remains also recovered from a non-tomb context, in Op H23D/H24D. This also occurs on the frontal of an adult female, but is much smaller, measuring 5.96 × 3.14 × .77 mm.

Figure 8. Sotira Kaminoudhia*, Rm 44, adult female with large CDF on frontal (noted by arrow on left, closeup of CDF on right).*

Figure 9. Sotira Kaminoudhia*, Op H23D/H24D, Small CDF on adult female frontal (noted by arrow).*

Postcranial trauma

Only one instance of postcranial trauma was identified at Sotira *Kaminoudhia*. A left tibia from Op H24A has signs of a healed fracture to the proximal tibia (Figure 10). This fragment is that of a proximal tibia inferior to the tibial tuberosity extending to roughly the nutrient foramen. It is very bladelike and has a relatively large healed callus that is well integrated into the surrounding bone. Thickening of the cortex is visible in the proximal cross section. There is no active periosteal bone deposition in this area, so the injury is old and well integrated. Based on the shape of the bone, though, the use of the limb was likely altered after the injury. The soleus attachment on the posterior surface is more vertical than diagonal, indicating reorganization of the musculature. Given the lack of reactive bone on the shaft, the injury occurred several years before death, possibly in childhood, allowing for the adaptation of the limb to the injured bone. Unfortunately, the rest of the bone shaft was not recovered. These remains appear to have been surface finds, and so their exact depositional context is unclear and not reconstructable.

Mortuary Context

This site contains largely single burials of adults within the tombs themselves. The cemetery, consisting of cist and shaft tombs, is located north-northeast of the settlement. Dikaios (1948) excavated some graves known as Cemetery A (some of these remains were available for study). The remains used in this study come from Cemetery A as well as from the habitation rooms. Most of the cist burials and shaft tombs were dug into the surrounding slopes, but others are known to have once been located in the valley floor. Two tombs (Tomb 11 and Tomb 20) were recovered from the valley floor after the roof collapsed after a winter of heavy rain in 1985. The form of the tombs follows what

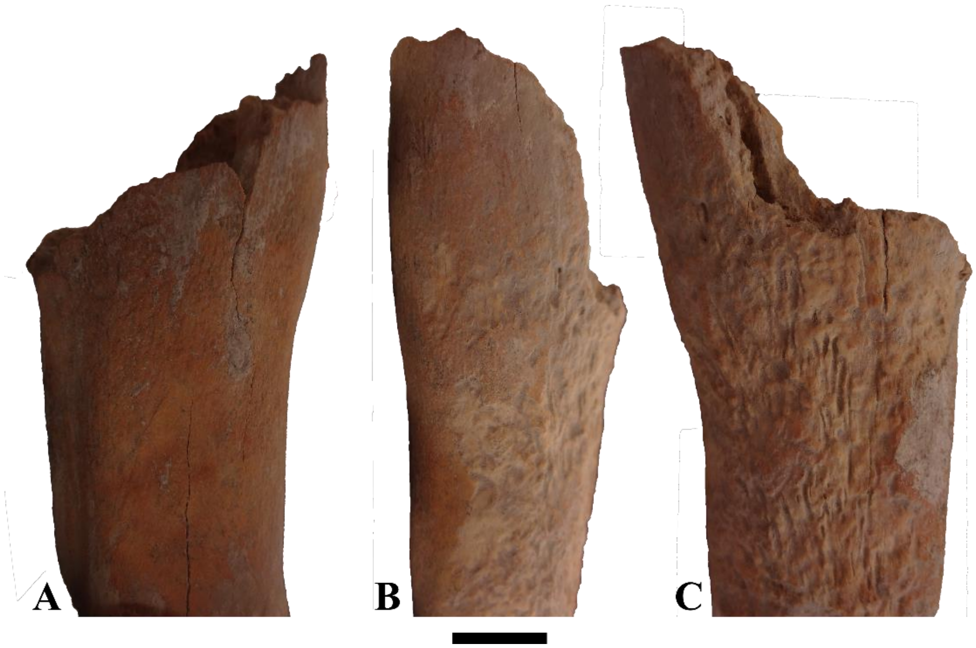


Figure 10. *Sotira* Kaminoudhia*, Op H24A, Fragment number O.H24A.1, left tibia. A) Lateral view, B) Anterior view, C) Medial view.*

Swiny and Herscher (2003, p. 104) refer to as "a generic tradition common to Cyprus from the Bronze Age to the Christian era." Tombs were cut from bedrock and usually consisted of a dromos, or entry chamber, with an opening on one side (the stomion) that allowed passage into the burial chamber. The stomion is usually blocked by a large capstone that could be removed to place individuals in the burial chamber. Burial chambers, according to Swiny and Herscher, are typically circular in shape. Dikaios notes that several of the tombs in Cemetery A, however, had far simpler forms consisting of cist graves. These cist graves lack the dromos and stomion, instead access to the burial is direct from the surface.

The tombs yielding material for this study are Tomb 6, Tomb 11, Tomb 14, Tomb 15, and Tomb 17. Tomb 6 is a cist burial lacking a dromos. Swiney and Herscher (2003) attribute the lack of a dromos to erosion of the bedrock in the area. The excavators believe that the tomb housed a single flexed individual laid out on its right side (this matches the MNI developed in this study). In addition to the human remains found in the tomb, there were several small red and white beads recovered around a cranium suggesting a necklace. Hair ornaments were found in a cluster by the foot bones. The possible remains of a dagger were also found, as were a pair of interlocked gold earrings. Ceramics recovered place the tomb in the Philia phase of the PreBA 1 period. There no signs of imported goods or ceramics in the tomb.

Tomb 11 shares a dromos with another tomb (Tomb 20, not included in this analysis). The tomb measures approximately 1.54 × 1.24 m in dimension and would have had a height in the burial chamber of at least 1.5 m. The tomb contained a single burial, flexed and deposited on its right side (a finding consistent with this analysis). This tomb was subject to numerous processes that effected preservation of both the skeletal remains and artifacts, including a roof collapse, repeated episodes of wash, and depositions of havara (local bedrock) throughout the tomb (Swiny & Herscher, 2003). Numerous bowls and jars were found with this individual, as was a skull and mandible of a goat kid, which Croft (2003a) interprets as a funerary offering. No metal or chert artifacts were found with this burial. This tomb dates to the PreBA 2 period based ceramic dates, slightly later than the other tombs included in this analysis.

Tomb 14 belonged to a cluster of tombs. Of the six (possibly 7) tombs making up this cluster (also including Tombs 15 and 17), Tomb 14 is the only tomb to have a well-preserved dromos. The burial chamber is roughly oval measuring 1.28 × .94 m with a height of 1.2 m. At some point after it fell out of use, the covering stones fell into the tomb. The excavators state that the skeleton was flexed on its right side with the skull to the South, consistent with Tomb 11 (MNI is also consistent with this analysis). Grave goods included ceramic, though no metal, beads or pendants were associated. A chert flake, possibly part of a sickle, was found in association with this burial (Swiny & Herscher, 2003).

Tomb 15 is located in a cluster that contains, amongst others, Tombs 14 and 17. It measured 1.24 × 1.06 m with a height of .68 m. Preservation in this tomb was poor; excavators had a difficult time differentiating between the collapsed roof and eroded limestone surrounding the skeletal remains and grave goods. In addition to the falling of the covering stones, T15 had been disturbed in antiquity. This tomb was the only one from SK to contain multiple burials; Swiny and Herscher (2003) attribute this disturbance to reuse of the tomb. The excavators identified three skulls, but only two individuals could be identified in this analysis based on replication of features. Finds could not be associated with individual burials. The tomb was relatively rich, with a copper awl, dagger, flat tang, fragment of quern, ceramics, one shell and 6 picrolite anthropomorphic figures, and at least one necklace recovered from the tomb. Tomb 15 is associated with the Philia Phase of the PreBA 1 period based on ceramic dates as well as the association of the picrolite figurines and Philia phase dagger.

Tomb 17 is adjacent to the west side of T15 and near T14. It is relatively circular and measures 1.08 × 1.2 m with a height of approximately 74 cm. The human remains and ceramics within the tomb were found in a scattered state, which Swiny and Herscher

(2003) attribute to the tomb being left open for a time after the deposition of the body. Grave goods included two bowls and two chert blades. The tomb dates to the PreBA 2 period, slightly later than the Philia phase tombs.

Of interest at this site are the remains of females that were found within occupational units. These are believed by the excavators to be victims of earthquakes that were not recovered after the destruction of the structure. This may give insight into division of labor, with females staying close to the residential areas, assuming that the earthquake responsible for their demise occurred during daylight hours or while males were engaged in work away from the settlement.

There are no identified juvenile remains from this site, based on either osseous or dental materials. This is likely an issue of excavation bias or preservation bias. It is unclear how much of these materials were from screened contexts; it is also unclear if laboratory analysis was conducted in conjunction with excavation (a situation wherein a trained bioarchaeologist working with a faunal analyst can spot juvenile remains and add them to the human remains). Based on experience with other projects, this real-time analysis has prevented the misidentification of juvenile (particularly infant) remains as faunal and added to the overall site picture markedly. Also, the preservation of materials from this site is relatively poor overall, and so juvenile remains which are less-well mineralized may simply not have survived the time between deposition and analysis.

Episkopi Phaneromeni

Overall Summary

Episkopi *Phaneromeni* dates to the ProBA 1 period. A total of 21 individuals were used in the analysis. Dental analysis included recording of LEHs, caries, dental wear, antemortem tooth loss, and the use of teeth as tools. Pathological indicators such as cribra orbitalia, porotic hyperostosis, and periosteal reactions were also recorded. Pathological indicators showed a clear dichotomy between the subadults and adults from the site, with subadults exhibiting only unhealed and healing pathological changes. This pattern was repeated in the analysis of postcranial pathology. Only one instance of cranial trauma was found. Rib fractures were also present. Tomb 25D contains the remains of an individual exhibiting numerous traumas, including trauma to the shoulder joint, left him and right hip.

MNI and Demography

Total MNI and demography is presented below in Table 11. Six of the 14 tombs contained multiple individuals, with the greatest Tomb 105C having the most individuals (n=3). The remaining 8 contexts contained single interments. Contexts J1, J9 and J14 are not tomb contexts, but instead habitation rooms. They should be considered separately. When only the tombs are considered, 5 of the 11 tombs have multiple individuals. Of the three tombs with child remains, 2 of them occur with adult individuals (the exception is Tomb 23B that only contains a single child).

Childhood Health Indicators-linear enamel hypoplasia (LEH)

A total of 18 LEHs were identified and scored for age at stress incident from Episkopi *Phaneromeni* (Table 12). Four teeth exhibited more than one LEH. The age categories were defined as Child (2-12 years) and Adolescent+ (12 years or more) based on development and root completion. Although the sample is too small to provide statistically robust results, the single LEH from a child's tooth demonstrates stress at a younger age than any of the individuals that survived to adolescence or beyond. As is

Table 11. Episkopi Phaneromeni, MNI and demography by context, age, and sex.

	Adult				Subadult						
Context	Female	Male	Amb.	Indet.	Preterm	Perinatal	Infant	Child	Adolescent	Subadult Gen	Tomb Totals
J 1				1							**1**
J 9								2			**2**
J 14	1										**1**
T105A		1									**1**
T105C	1	2									**3**
T22A		1						1			**2**
T23B								1			**1**
T23D	1										**1**
T23E				1				1			**2**
T24B		1									**1**
T24C	1										**1**
T25A	1	1									**2**
T25B	1	1									**2**
T25D				1							**1**
Total	**6**	**7**	**0**	**3**	**0**	**0**	**0**	**5**	**0**	**0**	**21**

discussed in the LEH section below, this may indicate a predisposition towards earlier death if an individual is exposed to sufficient stress to produce LEHs earlier in life.

Sex comparisons cannot be made for this site, since the only teeth associated with dimorphic cranial remains were those of males.

The total number of teeth exhibiting LEHs was 14 out of 22 that were scorable, for a total of 59% exhibiting at least one LEH. A total of 11 teeth were not scorable.

Table 12. Episkopi Phaneromeni, *Total number of LEHs and corresponding ages of insult, by Age at Death category.*

Tomb	Adolescent+ Total N Insults	Adolescent+ Mean Age of Insult	Child Total N Insults	Child Mean Age of Insult
T22A			1	2.99
T23D	4	5.79		
T25A	6	3.25		
T25D	4	4.53		
J 14	3	4.04		
Totals	17	4.40	1	2.99
		Total N of insults		18

The total number of teeth showing LEHs, regardless of how precisely the tooth could be identified, for this site 19. A total of 363 teeth had no LEHs, and an additional 117 could not be scored. Of the 140 total teeth that could be scored, 14% exhibited at least one LEH.

Dental Analysis

Caries

Despite the relatively large number of teeth scored for caries (n=74), there were no identified lesions in any age group.

Antemortem tooth loss

A single individual had antemortem tooth loss at this site. An adult of indeterminate sex exhibited antemortem tooth loss of the URM1, for an overall rate of loss of this tooth for the site of 25%.

Dental Wear

Dental wear was examined, when possible, for teeth where either the root was complete or there were signs of wear indicating the use of the tooth during life. Unfortunately, the sample sizes are very small and not evenly distributed across sexes. Or the majority of dentition, either males or females were identifiable in small numbers, but only in one case (a lower right permanent first molar) were the same tooth identified from both males and females. The samples were too small to allow for comparison of this tooth.

Some of the dentition from this site exhibits an interesting dental wear pattern. There is significant lingual wear on the anterior dentition. This was seen on multiple teeth in the assemblage (though frequency data with commingled and fragmentary data are somewhat useless). This site yielded the only teeth with this pattern that could be linked to a skull for which sex could be estimated (Figure 11). This individual is male. The other three instances all occur in loose dentition.

Pathology

Cranial pathology

Cribra orbitalia

Fragmentation of the frontal was significant at this site, and so very few could be scored for CO. Of those, the left were more well-preserved

Table 14). The child frontals scored presented with unhealed CO (Figure 12) while the adult was in a healed state at the time of death. This pattern is consistent across the sites regardless of time period.

Table 13. Episkopi Phaneromeni, *summary of dental wear in permanent dentition by sex and number of teeth.*

	URM3		**URM2**		**URM1**		**URP4**		**URP3**		**URC**		**URI2**		**URI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.			2	13.50	2	21.50	2	2.50	1	4.00	4	4.00	2	4.50	2	1.00
Male																
	ULI1		**ULI2**		**ULC**		**ULP3**		**ULP4**		**ULM1**		**ULM2**		**ULM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.	3	1.67	4	2.75			2	4.50	2	5.00	3	10.00	2	16.50		
Male	1	5.00	1	4.00			1	4.00	1	5.00	1	16.00				
	LLM3		**LLM2**		**LLM1**		**LLP4**		**LLP3**		**LLC**		**LLI2**		**LLI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	4.00	1	16.00	1	20.00										
Male			2	20.00	2	22	1	3	1	3	1	5	2	4.00	1	5.00
Indet.											2	3.50				
	LRI1		**LRI2**		**LRC**		**LRP3**		**LRP4**		**LRM1**		**LRM2**		**LRM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	3.00							1	3.00	1	20.00	1	16.00	1	7.00
Male	1	5	1	5.00			1	5	1	3	1	25	1	25.00		
Indet.			1	2.00	1	7.00					1	8.00				

URM3=upper right 3rd molar. URM2=upper right 2nd molar. URM1=upper right 1st molar. URP4=upper right 4th premolar.
URP3=upper right 3rd premolar. URC=upper right canine. URI2=upper right 2nd incisor. URI1=upper right 1st incisor.
ULM3=upper left 3rd molar. ULM2=upper left 2nd molar. ULM1=upper left 1st molar. ULP4=upper left 4th premolar.
ULP3=upper left 3rd premolar. ULC=upper left canine. ULI2=upper left 2nd incisor. ULI1=upper left 1st incisor.
LRM3=upper right 3rd molar. LRM2=upper right 2nd molar. LRM1=upper right 1st molar. LRP4=upper right 4th premolar.
LRP3=upper right 3rd premolar. LRC=upper right canine. LRI2=upper right 2nd incisor. LRI1=upper right 1st incisor.
LLM3=upper left 3rd molar. LLM2=upper left 2nd molar. LLM1=upper left 1st molar. LLP4=upper left 4th premolar.
LLP3=upper left 3rd premolar. LLC=upper left canine. LLI2=upper left 2nd incisor. LLI1=upper left 1st incisor.

Figure 11. *Lingual wear on maxillary dentition from Episkopi Phaneromeni Tomb 25A (male).*

Table 14. Episkopi Phaneromeni, *summary of cribra orbitalia by age, sex scoring, and degree of expression.*

		Left				Right			
		CO NS	No CO	CO Unhealed	CO Healed	CO NS	No CO	CO Unhealed	CO Healed
Child	NA	1	5	1 E				1 E	
	Female		1						
Adult	Male	1	3		1 Mi				
	Indeterminate		1						

CO NS=cribra orbitalia not scorable
No CO=cribra orbitalia not present
Mi=minimal expression
E=extensive expression

Figure 12. *Episkopi* Phaneromeni, *unhealed cribra orbitalia visible on the left orbit of a child.*

Porotic hyperostosis

Only fragments that could be identified to element were included in the analysis for porotic hyperostosis. These results are presented in Table 15. The child fragments exhibiting porotic hyperostosis were in the unhealed and healing stages, while all adult fragments that exhibited porotic hyperostosis were in a healed state. The adults in this assemblage had more extensive reactions, but this could be due to the fact that the adult skulls in question had been conserved at excavation and so were more complete. There was simply more surface area to examine. It is likely that the child remains would have exhibited more extensive reactions had they been more complete at the time of analysis.

Table 15. Episkopi Phaneromeni, *summary of PH by age, scoring, healing and expression.*

		PH NS	No PH	PH Present		
				Unhealed	Healing	Healed
Child	NA	4	2	1 Mi	1 Mo	
	Female	1				1 Mi
Adult	Male	1	2			1 E
	Indeterminate	1				1 E

PH NS=PH not scorable
No PH=no porotic hyperostosis is present
Mi=minimal expression
Mo=moderate expression
E=extensive expression

Postcranial pathological changes

As with Sotira *Kaminoudhia*, recording of pathological changes was hampered by the relatively poor preservation and fragmentary nature of the remains. Smaller fragments for whom pathology could not be recorded tended to be left out of the analysis all together, thus explaining the relative lack of data in the column titled "N Path NS" in Table 16.

For the pathological changes that could be scored, subadults exhibited either unhealed or healing reactions. This indicates that these individuals were actively fighting infectious processes at the time of their death. Adults exhibited both healing and healed reactions (Table 16). The healing reactions all indicate that they were actively fighting infectious processes, possibly suggested a suppressed or lower-functioning of the immune system. Healed processes indicate successful fighting of an infectious process. This does show that infectious agents, whether they be strap or strep (Martin et al., 1985) or some other agent, were endemic to the population. All levels of the population regardless of sex or age were exposed to infectious agents.

Table 16. Episkopi Phaneromeni*, summary of recording of pathology.*

Element	**Age**	**Sex**	**N No path**	**N path NS**	**N path**
Humerus	Child	NA	1		1
	Adult	Male			1
		Indeterminate	5		8
Radius	Child	NA	1		1
	Adult	Male	1		
		Indeterminate	7		3
Ulna	Child	NA	3		1
	Adult	Male	1		
		Indeterminate	1		4
Femur	Child	NA	3		4
	Adult	Female			1
		Male	1		1
		Indeterminate	7		6
Tibia	Infant	NA			1
	Child	NA	1		1
	Adult	Indeterminate	2	1	12
	Y. Adult	Male	2		
Fibula	Child	NA	1		4
	Adult	Indeterminate		1	

Entheses

Entheses were also scored where possible for future comparison with other sites. These data, given the small sample size and high number of individuals of indeterminate sex limit the interpretive power until viewed on a larger scale. Both males and females exhibited a wide range of enthesial development. Only one female was scorable for any of the entheses. These data are used in larger-scale analysis below.

Table 17. Episkopi Phaneromeni, *summary of pathological changes by element, age at death, sex, degree of healing and expression.*

Element	**Age**	**Sex**	**Degree of Healing**	**Minimal**	**Moderate**	**Extensive**
Humerus	Child	NA	Unhealed		1	
	Adult	Male	Healing	1		
		Indeterminate	Healed	2	5	
Radius	Child	NA	Healing		1	
	Adult	Indeterminate	Healed		2	1
Ulna	Child	NA	Unhealed			1
	Adult	Indeterminate	Healed	3	2	2
Femur	Child	NA	Unhealed			1
			Healing			2
			Healed	1		
	Adult	Female	Healed		1	
		Indeterminate	Healing			1
			Healed	2	2	
Tibia	Infant	NA	Unhealed			1
	Child	NA	Healed		1	
	Adult	Indeterminate	Unhealed			3
			Healing			2
			Healed	1	2	4

Traumatic Injury

Cranial Trauma

Only one CDF was found on remains from Episkopi *Phaneromeni*. This is present near the right parietal boss of an adult. Based on overall size, the sex is estimated to be male (Figure 13). This is a relatively small CDF, measuring approximately 6.63 × 2.35 × .72 mm. It is located above the hat brim line, indicating that it likely the result of interpersonal violence.

Figure 13. *Episkopi* Phaneromeni, *Cranial depression fracture on an adult male.*

Postcranial Trauma

Three rib fragments show evidence of healed rib fractures, two with callus formation on both internal and external surfaces (one of which is pictured in Figure 14), and one with a callus formation on the internal surface but with no callus formation on the external surface.

Figure 14. *Episkopi* Phaneromeni*, Fragment T.25B.17, healed rib fracture.*

Tomb 25D

Tomb 25D consists of the remains of an adult female, based on pelvic indicators. This individual exhibits two distinct traumas. The left humerus has a severe trauma to the proximal end with complete reorganization of the shoulder joint. Unfortunately, the clavicle and scapula were not present in any of the boxes to compare. The reorganization of the shoulder includes an accessory facet for the clavicle and the development of a large fossa on the anterior surface. It would appear to be a fracture of the neck of the humerus that was not properly set. The lipping on the humerus is only moderate, so this could indicate an early fracture that caused reorganization and revised use of the limb during life.

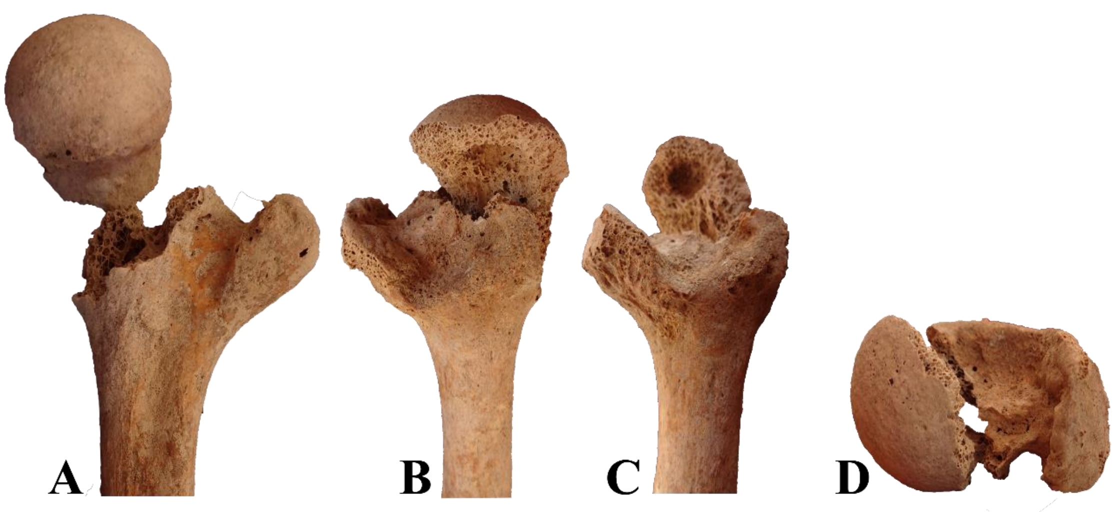


Figure 15. *Episkopi* Phaneromeni*, T25D, Left Humerus. A) Anterior view, B) lateral view, C) Posterior view, D) superior view.*

The second trauma is to the right hip joint. There is evidence of eburnation on both the acetabulum and the femoral head (Figure 16). This is a large area on both elements and the acetabulum shows a reorganization and extension of the bone on the superior surface (where the eburnation is located within the acetabulum, Figure 17). The articulation of the femur within the acetabulum is superior to the normal position, and the extensive nature of the eburnation indicates a long-standing condition. This would likely have caused an altered gait, leading to the slight amount of lipping on the left acetabulum and the slight osteophytic lipping on the anterior body of the thoracic vertebrae associated with this individual.

Mortuary Context

Episkopi Phaneromeni consists primarily of tomb assemblages with just a few scattered human remains found from within occupation units. From examination of the demographic breakdown from the tombs themselves, multiple burial or tomb re-use is definitely established by this time period (the Middle Cypriot or ProBA 1). Also common in this assemblage are burials containing adults of both sexes and children. Single burials are also present, but the shift towards multiple burials and tomb reuse is already in place by this time period.

Figure 16. *Episkopi* Phaneromeni, *T25D, right hip joint with eburnation and significant bone deposition around the acetabulum.*

Figure 17. *Episkopi* Phaneromeni*, T25D, right hip joint superior view showing significant bone deposition around acetabulum.*

Hala Sultan Tekke

Overall Summary

Remains included in this analysis from Hala Sultan Tekke are from the ProBA 3 period, dating to between 1300—1100 Cal BC. Only remains from Tombs 1 and 2 are included, resulting from excavations conducted by Dr. Vassos Karageorghis. Recovery of Tomb 1 appears to be complete, with multiple small bones and juvenile remains. Recovery of Tomb 2 is not complete, with only adult crania and some long bones preserved. Tomb 1 contains at least 18 individuals ranging from infant to middle adult. Dental analysis consisted of the identification of dental developmental defects (LEHs), antemortem tooth loss, caries, and dental wear. Pathological changes to the cranium and postcranial elements and enthesial development of the upper and lower limb were recorded. Traumatic injury and mortuary context were also recorded.

MNI and Demography

Tomb 1 contains the remains of at least 18 individuals (Table 18). These include 2 infants, 4 children, 1 adolescent, 4 adult females, 5 adult males, 1 young adult female, and 1 middle adult male (based on cranial elements). MNI was determined using duplication of features with elements where age and sex were diagnostic. The total for Tomb 2 is listed with an asterisk; the recovery or retention of those remains was very incomplete, and so it is not possible to accurately determine the MNI for Tomb 2 based on the assemblage available at the Cyprus Museum. Tomb 1 can be used to examine mortuary patterns, though. The tomb, with multiple age categories and both sexes, was most likely a lineage or family-based tomb.

Table 18. Hala Sultan Tekke, summary of MNI and demography by tomb, age at death, and sex.

	Adult				Subadult						
Context	Female	Male	Amb.	Indet.	Preterm	Perinatal	Infant	Child	Adolescent	Subadult Gen	**Tomb Totals**
T1	4 (1 YA)	5 (1 MA)	1	1			2	4		1	**18**
T2		2 (1 MA)									**2***
Total	**4**	**7**	**1**	**1**			**2**	**4**		**1**	**20**

* incomplete recovery and/or retention of the tomb

Childhood Stress Indicators: LEH

Analyses of incidences of childhood stress were limited to individuals who died over 12 years of age for this site. A total of 67 stress incidents were identified with an average of 4.08 years of age at onset. These data will be examined in conjunction with other sites and time periods below. Sex comparisons were not attempted for this site, since only one tooth associated with a male crania was identified. The rest belong to females or are isolated teeth.

When all teeth were compared, regardless of how precise the identification of the tooth was, a total of 57 teeth exhibited LEHs. There were no non-scorable teeth from this site. This site has the highest percentage of LEHs at 29%.

Dental Analysis

Caries

There were 76 teeth that were scorable for caries from this site. Of these, one individual aged adolescent+ and one adult exhibited distal interproximal caries.

Antemortem tooth loss

Two individuals had antemortem tooth loss at this site, both adult males. Both individuals lost the permanent lower left second molar long enough before death for the area to be completely remodeled. For this tooth there was an overall 50% antemortem loss of this tooth. This site is the only one to exhibit antemortem tooth loss in males.

Dental Wear

Summary data regarding the average wear per tooth by sex are presented in Table 19. The total numbers are too small to allow for statistical testing. In addition to the difficulties presented by the small sample sizes at Hala Sultan Tekke, there are several cases of extramasticatory tooth use. Identification of different types of extramasticatory tooth use indicate that mastication was not the only thing that was impacting tooth wear. Without a more complete skeletal sample, it is difficult to draw conclusions or comparisons with these data alone. The data from the site as a whole are included in both temporal and regional analyses below.

Table 19. Hala Sultan Tekke, summary of dental wear by sex and number of teeth.

	URM3		**URM2**		**URM1**		**URP4**		**URP3**		**URC**		**URI2**		**URI1**	
	N	**wear**	**N**	**wear**	**N**	**Wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.					1	26.00	1	5.00	1	5.00	2	3.50				
Male	1	18.00	1	16.00	1	22.00										
	ULI1		**ULI2**		**ULC**		**ULP3**		**ULP4**		**ULM1**		**ULM2**		**ULM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**Wear**
Indet.	3	4.33	1	2.00					1	4.00	2	8.00	2	14.00	1	14.00
Male																
	LLM3		**LLM2**		**LLM1**		**LLP4**		**LLP3**		**LLC**		**LLI2**		**LLI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**Wear**
Female	1	13.00	2	17.50	2	21.00	1	4.00								
Male	3	14.67	1	17.00	3	25	3	6	1	4	2	8	1	10.00	1	10.00
Indet.									1	2.00	4	2.50	1	4.00		
	LRI1		**LRI2**		**LRC**		**LRP3**		**LRP4**		**LRM1**		**LRM2**		**LRM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**Wear**
Female																
Male											2	20				
Indet.	1	2.00	3	3.00	4	2.75	1	2.00	1	2.00					1	21.00

URM3=upper right 3rd molar. URM2=upper right 2nd molar. URM1=upper right 1st molar. URP4=upper right 4th premolar.
URP3=upper right 3rd premolar. URC=upper right canine. URI2=upper right 2nd incisor. URI1=upper right 1st incisor.
ULM3=upper left 3rd molar. ULM2=upper left 2nd molar. ULM1=upper left 1st molar. ULP4=upper left 4th premolar.
ULP3=upper left 3rd premolar. ULC=upper left canine. ULI2=upper left 2nd incisor. ULI1=upper left 1st incisor.
LRM3=upper right 3rd molar. LRM2=upper right 2nd molar. LRM1=upper right 1st molar. LRP4=upper right 4th premolar.
LRP3=upper right 3rd premolar. LRC=upper right canine. LRI2=upper right 2nd incisor. LRI1=upper right 1st incisor.
LLM3=upper left 3rd molar. LLM2=upper left 2nd molar. LLM1=upper left 1st molar. LLP4=upper left 4th premolar.
LLP3=upper left 3rd premolar. LLC=upper left canine. LLI2=upper left 2nd incisor. LLI1=upper left 1st incisor.

There are some examples of unique dental wear at the site that have no other examples and likely represent extramasticatory tooth use unique to the site. Figure 18 shows one such example, with severe buccal wear and cupping occurring on the occlusal surface of a lower left permanent first molar and lower left permanent fourth premolar from an adult male mandible. This mandible is remarkably robust as well. Because these do not occur on more than one individual, it is likely occupation specific and does not represent a general trend throughout the site.

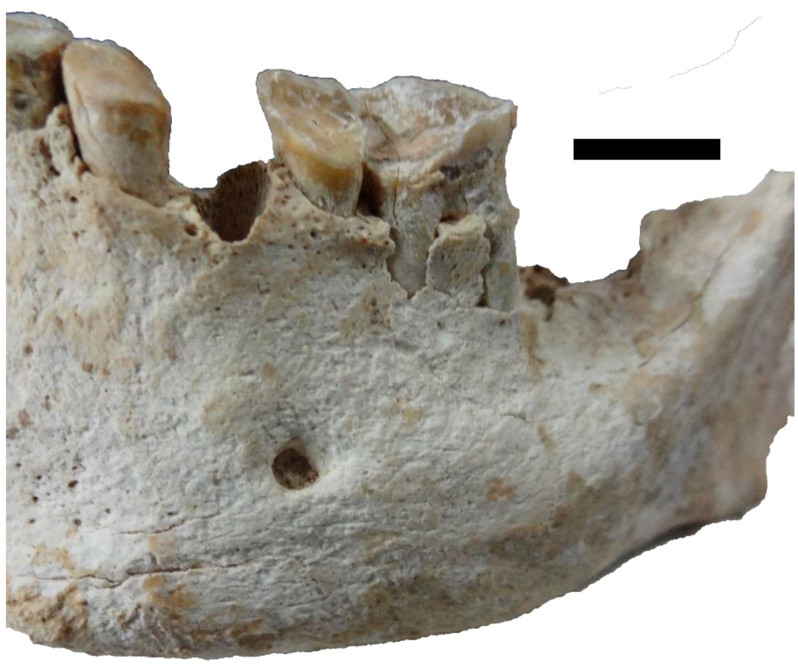


Figure 18. *Hala Sultan Tekke, T1, fragment ID 1.7.1, unique wear pattern.*

There is also an example of notching, though in this case it is located on the mesial aspect of the tooth. This is an isolated tooth, and so drawing conclusions based on the presence of this tooth is difficult. This does indicate extramastictory tooth use but, beyond this statement, little more can be said.

Figure 19. Hala Sultan Tekke, Tomb 1, Fragment 1.2.42; ULI1, mesial notching visible.

Pathology

Cribra orbitalia

The vast majority of fragments could not be scored for Hala Sultan Tekke. One older adolescent female exhibited cribra orbitalia in both orbits, and the rest of the observations came from adult males (Table 20). All of these instances were healed. What is of interest, however, is that when cribra orbitalia occurs, it occurs in both males and females, suggesting that both sexes experienced stresses leading to the development of cribra orbitalia.

Table 20. HST, summary of cribra orbitalia by age, sex scoring, and degree of expression.

		Left				Right			
		CO NS	No CO	CO Unhealed	CO Healed	CO NS	No CO	CO Unhealed	CO Healed
Subadult	NA	2				2			
Infant	NA		1			2			
Child	NA	5				5			
Adolescent	Indeterminate	1				1			
Adult	Female	17			1 Mi	17			1 E
	Ambiguous	1				1			
	Male	15			1 Mo, 1 E	16	1		1 E
	Indeterminate	31				31			
Y. Adult	Female	1				1			
	Indeterminate	1				1			
M. Adult	Male	1				1			

CO NS=cribra orbitalia not scorable
No CO=no cribra orbitalia is present

Porotic hyperostosis

Porotic hyperostosis was more scorable at this site. Porotic hyperostosis demonstrates the need for multiple indicators, particularly in analyses of commingled and fragmentary remains. While cribra orbitalia could only be scored on the adults in Tomb 1, porotic hyperostosis was scored on two infants (including one pictured in Figure 20), one child, and 4 adult fragments (Table 21). Normally, the areas of the skeleton where porotic hyperostosis will be visible on the cranium (parietals, occipital squama) contain no sexually dimorphic characteristics. Sex could not be estimated for any of the adults with visible porotic hyperostosis. Both infants exhibited healing porotic hyperostosis, the child exhibited active porotic hyperostosis, and the adults were all in a healed stage at the time of death.

Table 21. Hala Sultan Tekke, summary of porotic hyperostosis (PH) by age, scoring, healing and expression.

		PH NS	No PH	PH		
				Unhealed	Healing	Healed
Subadult	NA		2			
Infant	NA				2 Mo	
Child	NA	1	2	1 Mo		
Adolescent	Indeterminate		1			
Adult	Female	16				
	Ambiguous		1			
	Male	15	1			
	Indeterminate	7	19			1 Mi, 1 Mo, 1 E
Y. Adult	Female	1				
	Indeterminate	1				
M. Adult	Male	1				

PH NS=porotic hyperostosis not scored
No PH=porotic hyperostosis not present
Mi=minimal expression
Mo=moderate expression
E=extensive expression

Figure 20. *Hala Sultan Tekke, Tomb 1 (Cranium C); unhealed PH on external table of an infant cranium.*

Other cranial Pathology

The infant burial (Cranium C from Tomb 1, Figure 20) exhibits not only active porotic hyperostosis on the external table but also increased vascularization of the internal table (Figure 21). This type of vascularization has in the past been linked to scurvy (Brickley & Ives, 2006; Ortner & Ericksen, 1997; Osterholtz, Bethard, Gonciar, & Nyaradi, 2014), but without more of the cranium present to examine, any specific diagnosis is unwarranted.

In addition to the porotic hyperostosis and hypervascularization, a parietal fragment associated with this individual exhibited prolific bone deposition on the internal surface (Figure 22). Taken together, this indicates a serious systemic disorder that likely involved the meninges surrounding the brain (due to the vascularization and proliferative bone on the internal table of the parietal. The internal table of this fragment is maintained (as visible in the cross section in the lower image of Figure 22); this reaction is additive and may be related to hypervascularization of the meninges. The nature of this pathology is unclear, but it was active at the time of death.

Figure 21. Hala Sultan Tekke, Tomb 1 (Cranium C), internal table of the left frontal exhibiting hypervascularization.

Figure 22. *Hala Sultan Tekke, Tomb 1 (Cranium C); Significant periosteal bone deposition on the internal table of the parietal. Internal view above, cross sectional view below (internal cranial surface is up in lower image).*

One additional individual exhibited cranial pathology. An adult of indeterminate sex had nodule formation on the internal table of the frontal consistent with hyperostosis frontalis interna (HFI). The exact etiology of HFI is unknown, but tends to occur primarily on females of middle adult or older age (She & Szakacs, 2004).

Postcranial Pathology

Both upper and lower limbs were examined for pathological changes (Table 22). For this assemblage, the elements for which path could not be scored were not included. This was the first sample examined; after examination of this assemblage, it was decided to include a field for recording when taphonomy precluded analysis.

Table 22. Hala Sultan Tekke, summary of recording of path by element, age, and sex.

Element	Age	Sex	N No path	N path NS	N path
Humerus	Child	NA	2		2
	Adult	Female	3		
		Indeterminate	14		6
Radius	Adult	Indeterminate	6		1
Ulna	Child	NA	1		1
	Adult	Indeterminate	4		
Femur	Child	NA	1		1
	Adolescent	Indeterminate	1		
	Adult	Male	1		
		Indeterminate	32		10
Tibia	Child	NA			1
	Adult	Indeterminate	13		8
Fibula	Adult	Indeterminate	8		4

As with the other sites examined, subadults exhibited only unhealed pathological changes, indicating active infection at the time of death. Adult lower limb bones have either healed or healing reactions (Table 23). Most have minimal expression on the bones themselves. The tibia is especially useful as an indicator of systemic infection, and 9 of the tibiae exhibit periosteal development, most either moderate or minimal in expression. Periosteal bone development may have many etiologies, from systemic infection to localized infection to a secondary traumatic response, so assigning specific etiologies to the periosteal development seen at this site is problematic at best. On one hand, periosteal reaction indicates that the immune system is strong enough to combat infection, but the presence of chronic infection suggests a degree of low-level infection or exposure to infectious processes is constant in the population.

Table 23. Hala Sultan Tekke, Summary of postcranial periosteal reactions.

Element	Age	Sex	Degree of Healing	Minimal	Moderate	Extensive
Humerus	Child	NA	Unhealed			1
	Adult	Indeterminate	Healed	1	2	
Radius	Adult	Indeterminate	Healed		1	
Ulna	Child	NA	Unhealed		1	
Femur	Adult	Indeterminate	Healing	1		
			Healed	4	3	1
	Child	NA	Unhealed	1	1	
Tibia	Adult	Indeterminate	Healing		1	
			Healed	3	3	1
	Subadult	NA	Unhealed			1
Fibula	Adult	Indeterminate	Healed		2	3

Entheses

Enthesial changes were recorded wherever possible. Comparison of enthesial development by sex could not be conducted as only a single female was scorable. The lower limb produced sample sizes too small to compare once adults of indeterminate sex were removed. Enthesial scores are included in the larger regional and temporal analyses below.

Traumatic Injury

Both cranial and postcranial trauma were recorded.

Cranial Trauma

There were a few cases of traumatic injury found in the Hala Sultan Tekke materials. These occur on an adult male, an adult female, and an adult of indeterminate sex. Figure 23 shows the location and relative size of both CDFs from this site. It is difficult to draw conclusions based on these data as there are so few instances. Both occur above or at the hat brim, however, indicating that they are likely the result of interpersonal violence as opposed to traumatic injury (Guyomarc'h et al., 2010; Kremer et al., 2008).

Skull I from Tomb 1 exhibited a well-healed and integrated nasal fracture on the left nasal, but this is partially obscured by limestone encrustation (Figure 24). This skull belongs to an adult female based on sharp orbits, relatively gracile browridges and small mastoid processes.

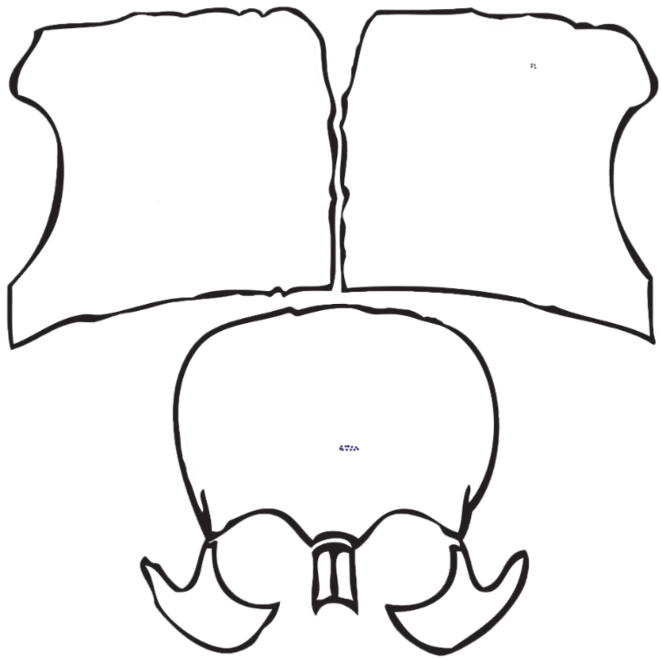


Figure 23. Hala Sultan Tekke, diagram showing all CDFs (Male visible in blue, indeterminate in gray).

Figure 24. Hala Sultan Tekke, T1 Skull I, healed nasal fracture.

The only other instance of trauma recorded at Hala Sultan Tekke was a healed cranial depression fracture on the left frontal of an adult male based on cranial markers. This measures 1.1 x .4 x .26 mm and is well healed and integrated into the surrounding bone (Figure 25). The location of this is slightly superior to the hat brim line and is therefore likely to be the result of interpersonal trauma (Kremer et al., 2008).

Figure 25. *Hala Sultan Tekke, T2, Skull 2A, healed CDF on left frontal superior to nasal bones.*

The final CDF identified is on the left parietal of an adult of indeterminate sex. This is a very small CDF, measuring 2.2 × 1.8 × .25 mm.

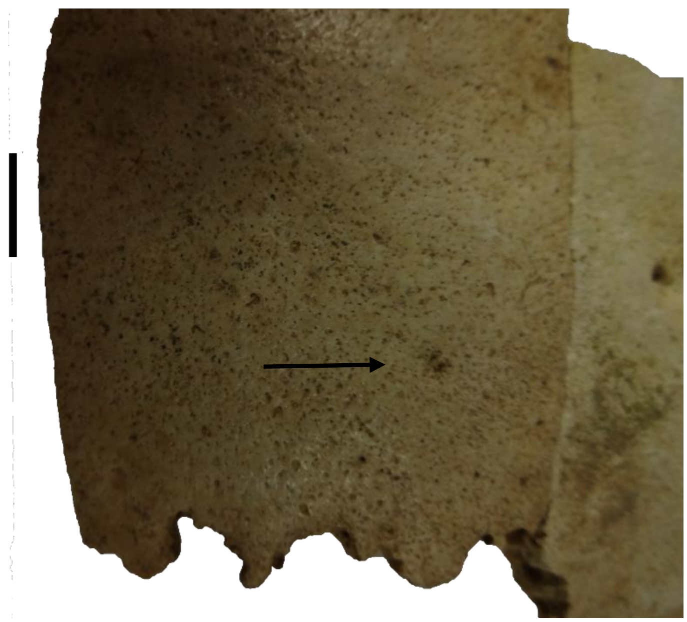


Figure 26. *Hala Sultan Tekke, T1, SKU-012, left parietal, small CDF (identified by arrow) superior to lambdoid suture.*

Postcranial Trauma

A left humerus (Fragment 1.6.17) has hard tissue changes that are likely the result of some soft tissue trauma (Figure 27). The olecranon fossa is mostly filled in with reactive bone. Slight lipping is visible eon the superior border of the trochlear articular surface. The radial fossa is also filled in with reactive bone and the trochlear fossa shows evidence of exostosis and chronic remodeling. The most likely cause for this sort of trauma is damage to the tendon and ligamentous attachments of the proximal ulna. The presence of osteoarthritic change and reactive bone in the fossae associated with the ulna indicates that the joint was significantly used after the injury was sustained.

In addition to the trauma to the left elbow, one left patella has a large osteochondral fracture, an injury associated with torsional trauma (Mason, Moore, Walker, & kathol, 1996; Milgram, 1943; Osterholtz, Harrod, & Martin, 2011; Triantafillopoulos, Papagelopoulos, Politi, & Nikiforidis, 2002).

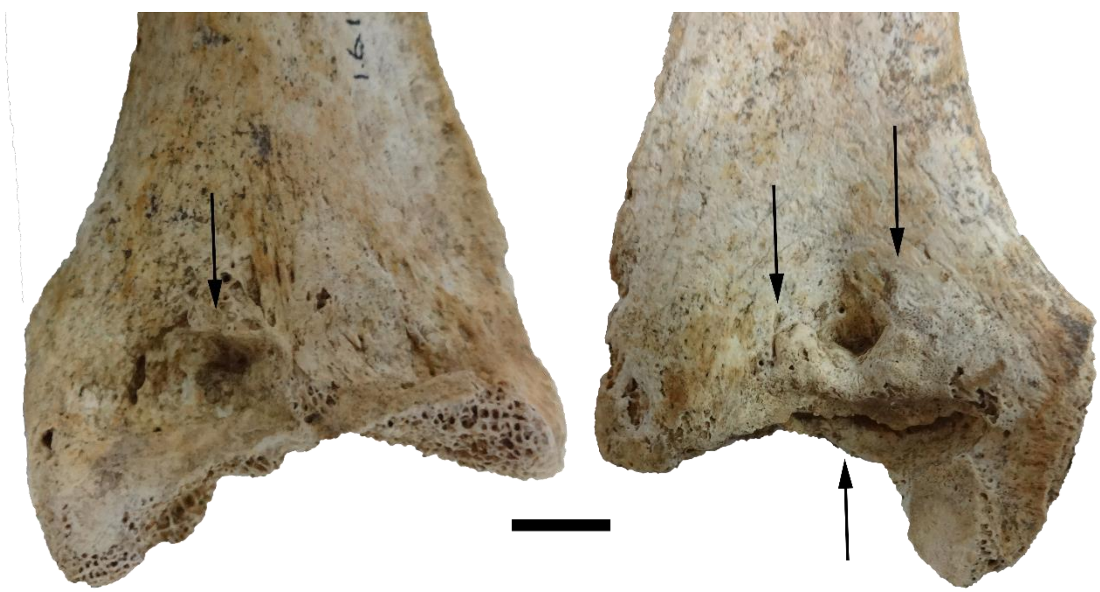


Figure 27. *Hala Sultan Tekke, Tomb 1, Fragment 1.6.17, traumatically induced bony changes to the distal left humerus.*

Mortuary Context

J. W. Crowfoot describes the average tomb at Hala Sultan Tekke to be cut into bedrock at a depth of up to 16 feet. Most contained a central dromos or entry chamber with tomb chambers extending from the dromos at right angles. These tomb chambers were typically capped with large stone slabs. Within the tomb chambers themselves, it was not uncommon to find a partial wall extending to the middle of the tomb as a celing support (Åström, Bailey, & Karageorghis, 1976). Human remains and ceramics were scattered throughout the spaces when excavated, likely due to ceiling collapse or very quick excavations that may have caused disturbances.

Tombs 1 and 2 differ from the typical tomb described by Crowfoot. These are roof entry shaft tombs. According to Åström (1976, p. 71):

> No dromos could be traced for either of the tombs; access to them was possible only from an opening in the middle of the roof. The natural rock here was soft clay and no proper chamber could be dug without the danger of having its roof collapsed in the process of the digging. Hence the nature of the rock dictated the form of the tomb: It had the form of a flattened bottle, roughly circular in plan, with a low roof and an opening more or less in the center, being the stomion… The obvious inconvenience in such tomb s was that instead of filling the dromos after the burial, they had to fill the chamber itself. If the tombs were used more than once, the thorough disturbance of the contents was inevitable.

Tombs 1 and 2 are important for numerous reasons: 1) they show important trade links through grave goods from the Anatolian region as well as Egypt; 2) there is a high percentage of Mycenean pottery, argued by Karageorghis to postulate a Minoan colony on the southern coast; and 3) the association of human remains with sacrificed horses (Karagheorghis in Åström et al., 1976, p. 89).

Based on the number of loose teeth, as well as the number of small hand and foot bones, it seems clear that this tomb is a primary long term collective burial (Osterholtz, Baustian, & Martin, 2014a), meaning that whole bodies were placed in the tomb and allowed to decompose. Fragmentation and commingling is likely the result of the rooftop entry to the tomb, which would have caused disturbance of the burials each time the tomb was opened. The demographic breakdown of the tomb itself is consistent with a lineage-based tomb consistent with known mortuary practices, with both sexes and both adults and subadults represented. This tomb, therefore, likely represents a normal tomb population for the time, not an unusual burial program. Again, based on the presence of numerous small hand and foot bones as well as isolated teeth, this tomb was likely completely collected.

<u>Vasilikos Valley: Kalavasos village tombs</u>

Overall Summary

Remains included in the analysis date to the PreBA 2 and ProBA 1 period. Remains representing at least 63 individuals were examined. Childhood stress indicators on the dentition were recorded, as were caries, antemortem tooth loss and dental wear. Cranial and postcranial pathology were also recorded. Entheseal changes were scored wherever possible. Traumatic injury was present on both the crania and postcranial remains as well.

MNI and Demography

Of the tombs containing subadults, most were interred with an adult of either sex. Half of the tombs (n=19) contained single interments, with the remaining 19 tombs containing between 2 and 6 individuals (Table 24). Tomb 53 contains the remains of two adolescents that were sufficiently old enough at death to estimate sex, these were the only subadults not buried with adults. Tombs 38, 43, and 51 are associated with the ProBA 1 period, all others are associated with the PreBA 2 period. There appears to be no difference in the demographic makeup of theses tombs based on time period (though the sample sizes are too skewed to compare statistically). All of the tombs associated with this later period, however, do contain multiple individuals, a pattern that becomes entrenched in the ProBA 2 period.

Table 24. Kalavasos village tombs, summary of demography by tomb and age.

	Adult				**Subadult**						
Tomb	**Female**	**Male**	**Ambig.**	**Indet.**	**Preterm**	**Perinatal**	**Infant**	**Child**	**Adoles-cent**	**Subadult Gen**	**Tomb Totals**
T36		4	1					1			**6**
T37				1							**1**
T38		1		1				1			**3**
T39				1							**1**
T40				2							**2**
T41				1				1			**2**
T42				1							**1**
T43		1								1	**2**
T44				1							**1**
T45				1							**1**
T46				1							**1**
T47				1							**1**
T48				1							**1**
T51				1							**1**
T52				1							**1**
T53									3 (1 M? 1 F?)		**3**
T55	1										**1**
T56				1							**1**
T57	1	1									**2**

Table 24. Kalavasos village tombs, summary of demography by tomb and age (cont).

Tomb	Adult				Subadult						Tomb Totals
	Female	Male	Ambig.	Indet.	Preterm	Perinatal	Infant	Child	Adoles-cent	Subadult Gen	
T58	1	1 (MA)	1	1							**4**
T59	2 (1 YA)	1									**3**
T60	2	1							1		**4**
T61									1 (F?)		**1**
T62			1								**1**
T63	2 (1 MA)										**2**
T65	2	2									**4**
T66	2						1				**3**
T67	3	1		1					1		**6**
T68	1	1									**2**
T69	1	1									**2**
T70	1			1							**2**
T71	1 (YA?)	1 (MA)									**2**
T72				1							**1**
T75	1							1			**2**
T76	1										**1**
T77	1 (MA)										**1**
T78		1									**1**
T79				1							**1**
Total	**17**	**15**	**3**	**20**	**0**	**0**	**1**	**4**	**2**	**1**	**63**

Childhood Stress Indicators: LEH

Given that the Kalavasos village tombs provide a large skeletal sample, the dental sample is actually quite small. This is likely a product of poor preservation and not due to intentional cultural action. A total of 9 insults were identified from this site, the majority coming from child teeth (Table 25). Of interest here is that the average age for Tomb 38 is 4.96, while Tomb 36 is 3.98 years. Tomb 38 dates to the ProBA I period, while T36 dates to the PreBA 2 period; though the sample size is too small for any meaningful intrasite statistical testing, this is a pattern that occurs when the sites are pooled by time period (discussed below).

Table 25. Kalavasos village tombs, Total number of LEH and age of stress incident, by Age at death category.

	Adolescent+		Child	
Tomb	Total N Insults	Mean Age of Insult	Total N Insults	Mean Age of Insult
T36	1	3.98		
T38	3	4.96		
T69			5	3.96
Totals	4	4.47	5	3.96
		Total N of insults		9

Sex could not be compared for this site, but both children and individuals of over 12 years of age were recovered. These were compared, and although there was no statically significant difference identified, the mean age of stress incident was lower for those who died under 12 years of age (Figure 28). This mimics the overall pattern seen when all time periods are combined (see below) and suggests that individuals who were exposed to stress sufficient to stop production of dentin tended to die younger than those who were exposed to such stresses slightly later in life.

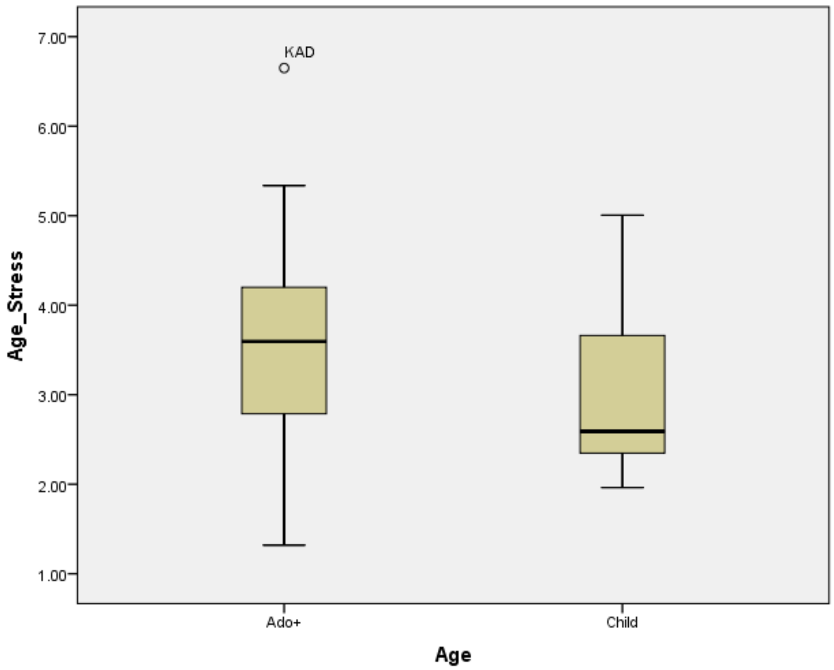


Figure 28. *Kalavasos village tombs, Age of stress incident by age.*

When all scorable teeth were combined (including those for which precise identification was not possible), a total of 10 teeth exhibited at least one LEH. A total of 363 teeth had no LEH, for a total frequency of 3%, the lowest of all the sites examined.

Dental Analysis

Caries

Carious lesions for this site were restricted to adults (Table 26). The sample from this site is skewed towards adults; the overall caries rate for adults is 4.2%.

Table 26. Kalavasos village tombs, Carious lesions by age and lesion location.

	Occlusal	Interproximal-Mesial	Interproximal-Distal	Smooth	Cervical	Large	No Lesion
Adolescent+							18
Adult	2	2	3	1		3	259
Child							13
Middle Adult							9
Subadult							8

Antemortem tooth loss

Two individuals had antemortem tooth loss, both females. One adult female from T66 exhibited antemortem tooth loss of the permanent lower right third molar (overall rate of loss at the site is 20%), permanent lower left first molar (overall rate of loss at the site is 14%) and permanent lower left second molar (overall rate of loss at this site is 25%). An adult female from Tomb 67 lost the permanent lower right first molar before death; the overall rate of loss of this tooth at the site is 10%.

Dental Wear

The sample sizes for the Kalavasos village tombs, despite representing males, females, and ambiguous individuals in addition to the indeterminates, is still too small for statistical comparisons to be conducted. The Kalavasos village tombs data were used below, however, in the discussion of regional and temporal variation.

Table 27. Kalavasos village tombs, summary of dental wear by tooth and number of teeth.

	URM3		URM2		URM1		URP4		URP3		URC		URI2		URI1	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	2	12.00	2	17.00	1	10.00	1	3.00	1	8.00					1	3.00
Male	2	12.00	2	7.00	4	14.50	3	4.00	3	3.67	4	4.00	1	6.00	5	5.60
Indet.					1	22.00	1	4.00	1	4.00	1	5.00	2	6.00	2	7.00
	ULI1		**ULI2**		**ULC**		**ULP3**		**ULP4**		**ULM1**		**ULM2**		**ULM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	3.00	2	3.00			3	1.33	2	1.50	2	7.50	2	9.00	2	10.00
Male	3	5.00	2	6.50			2	2.50	3	3.67	3	12.00	2	10.50	4	9.25
Indet.	5	2.60	1	4.00			4	2.00	3	2.33	2	7.00	1	10.00		
	LLM3		**LLM2**		**LLM1**		**LLP4**		**LLP3**		**LLC**		**LLI2**		**LLI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	3	11.00	6	13.16	5	13.20	6	2.50	8	2.88	6	4.00	5	5.20	5	5.60
Ambiguous	3	9.33	2	13.00	3	24.00	4	3.25	4	3.50	2	3.00	1	3.00	1	4.00
Male	1	19.00	3	15.33	2	19.00	3	4.00	4	3.75	6	4.33	6	5.00	4	6.25
Indet.			2	19.50	2	13.00	2	2.50	3	1.67	4	3.00	2	2.00	3	3.33
	LRI1		**LRI2**		**LRC**		**LRP3**		**LRP4**		**LRM1**		**LRM2**		**LRM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	5	5.20	4	4.50	8	3.63	3	2.67	5	2.80	5	15.40	5	16.80	2	4.50
Ambiguous	2	4.50	1	5.00	1	6.00	2	4.00	3	3.67	3	21.00	2	13.50	1	11.00
Male	3	6.00	4	6.00	3	5.00	4	4.00	3	3.67	3	25.33	6	16.17	3	12.67
Indet.	1	3.00	1	2.00	6	2.00	3	2.67	2	2.00	2	10.00	2	8.00		

URM3=upper right 3^{rd} molar. URM2=upper right 2^{nd} molar. URM1=upper right 1^{st} molar. URP4=upper right 4^{th} premolar.
URP3=upper right 3^{rd} premolar. URC=upper right canine. URI2=upper right 2^{nd} incisor. URI1=upper right 1^{st} incisor.
ULM3=upper left 3^{rd} molar. ULM2=upper left 2^{nd} molar. ULM1=upper left 1^{st} molar. ULP4=upper left 4^{th} premolar.
ULP3=upper left 3^{rd} premolar. ULC=upper left canine. ULI2=upper left 2^{nd} incisor. ULI1=upper left 1^{st} incisor.
LRM3=upper right 3^{rd} molar. LRM2=upper right 2^{nd} molar. LRM1=upper right 1^{st} molar. LRP4=upper right 4^{th} premolar.
LRP3=upper right 3^{rd} premolar. LRC=upper right canine. LRI2=upper right 2^{nd} incisor. LRI1=upper right 1^{st} incisor.
LLM3=upper left 3^{rd} molar. LLM2=upper left 2^{nd} molar. LLM1=upper left 1^{st} molar. LLP4=upper left 4^{th} premolar.
LLP3=upper left 3^{rd} premolar. LLC=upper left canine. LLI2=upper left 2^{nd} incisor. LLI1=upper left 1^{st} incisor.

This site contained examples of extramasticatory tooth use (Figure 29), the same pattern of significant lingual wear noted for Episkopi *Phaneromeni* (Figure 11). These teeth were all isolated, and so estimation of sex is not possible. Age can be estimated as adult based on the degree of wear, but as there are no available standards for fine estimation of age at death based on dental wear for this (or any related) population, estimation was not attempted.

Figure 29. Kalavasos village tombs, Lingual wear on anterior dentition, Kalavasos Village Tomb 65 (PreBA 2 Period)

An additional individual exhibited extreme labial wear on the anterior mandibular dentition (Figure 30). While this may be related to extramasticatory use of the teeth, it could also be the result of malocclusion of the mandible and maxilla. Specifically, this would indicate an overbite. The reason for malocclusion is unknown. Hillson notes that there may be a genetic component, but diet and tooth size may also play a role (1996).

Pathology

Cranial Pathology

Cribra orbitalia

As with all the other sites, these remains were very fragmentary, and so scoring of cribra orbitalia was minimal. All instances that could be scored were in adult orbits, and all instances were healed at the time of death.

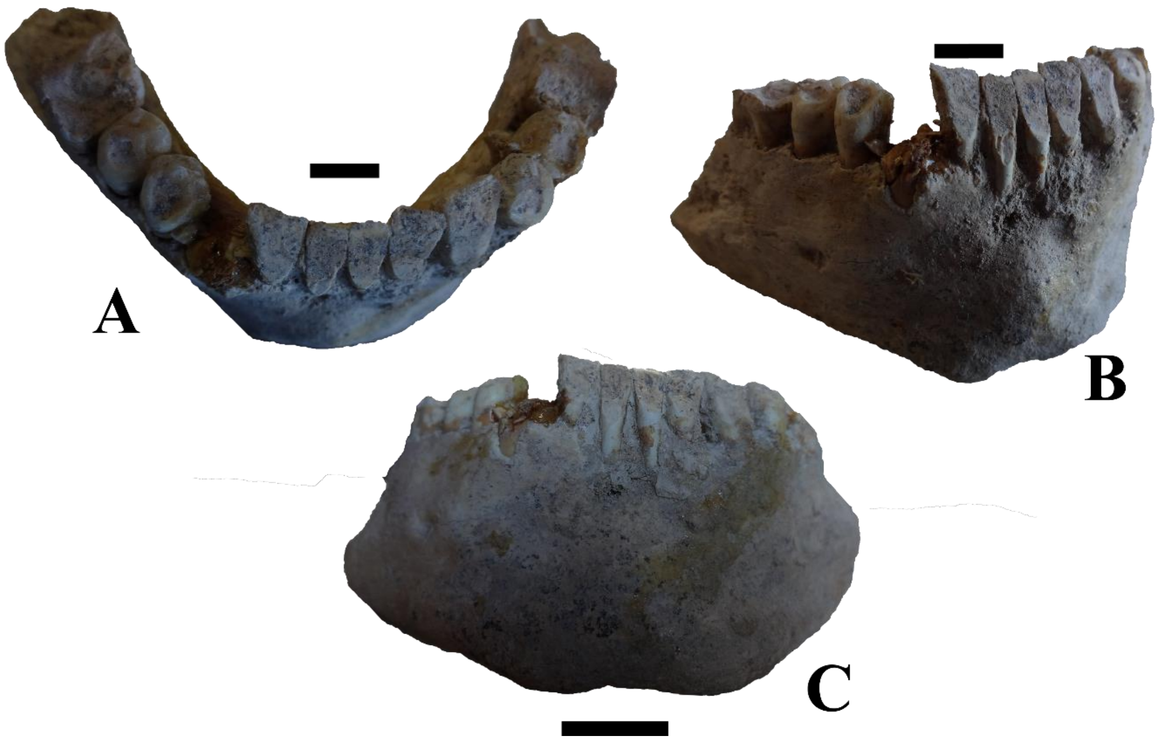


Figure 30. Kalavasos village tombs, Tomb 36, extreme labial wear on the anterior mandibular dentition of an adult female. A) occlusal view; B) anterolateral view; C) anterior view.

Table 28. Kalavasos village tombs, summary of cribra orbitalia by age, sex scoring, and degree of expression.

		Left				Right			
		CO NS	No CO	CO Unhealed	CO Healed	CO NS	No CO	CO Unhealed	CO Healed
Child	Indeterminate	2				1			
Adolescent+	Female	1							
	Indeterminate	1	1			1			
Adult	Female	6	13		2 Mi	7	6		
	Ambiguous	1	2			2	1		
	Male	6	7		1 Mi	3	9		
	Indeterminate	5				1			
Y. Adult	Male		1			1			
M. Adult	Male		1				1		

Porotic hyperostosis

Porotic hyperostosis was only scorable on adult remains. Of these, only one exhibited healing porotic hyperostosis. All other instances were healed. This pattern indicates that adults were exposed to stress as well as subadults, given that at least one individual had not fully recovered from the stress that caused the porotic hyperostosis to develop.

Table 29. Kalavasos village tombs, summary of PH by age, sex, scoring, stage of healing and expression.

		PH NS	No PH	PH Unhealed	Healing	Healed
Subadult	NA	1				
Child	NA	1	1			
Adolescent+	Female	1				
	Indeterminate	2	2			
Adult	Female	13	8			1 Mi, 1 Mo
	Ambiguous	2	1			1 Mo
	Male	9	4		1 E	2 Mo
	Indeterminate	5	1			1 (unclear)
Y. Adult	Male		1			
M. Adult	Male	1	1			

PH NS=porotic hyperostosis not scorable
No PH=no porotic hyperostosis is present
Mi=minimal expression
Mo=moderate expression
E=extensive expression

Other Cranial Pathology

Tomb 65 SK3 (an adult male) exhibits severe pathological changes to the left mandibular ascending ramus. This area is completely reorganized. Resportion of the outer cortex has been nearly complete with hypertrophic deposition in association. This is an uneven process, with islands of extreme hyperotrahy, suggesting quickly deposited bony changes. This suggests a cancerous process or a very fast moving infectious process (left side of Figure 31). If it is the latter, it is possible that the area of resportion on the ascending ramus is the area where infection was introduced. Resportion is localized to the ascending ramus, with the deposition present at the base of the lesion. This entire process is localized to the ascending ramus, with no bony changes visible on the body of the mandible. Only slight bony changes in the form of periosteal bone deposition are present on the internal surface of the mandible (right side of Figure 31). Given the extent of the reaction present, and the lack of hypertrophic bone anywhere else on the cranial bone associated with this individual, cancer is less likely than a very intense infectious process.

Postcranial Pathology

Both upper and lower limbs were examined for pathological changes (Tables 30 and 31).

Figure 31. Kalavasos village tombs, T65, S3, left mandible with active infectious process on external surface. External surface on left, internal on right.

Table 30. Kalavasos village tombs, summary table of upper limb pathology recording by element, age at death and sex.

Element	Age	Sex	N No path	N path NS	N path
Humerus	Adolescent	NA	1		
	Adolescent+	Indeterminate	3		
	Adult	Female	11	7	1
		Ambiguous	3		
		Male	7		
		Indeterminate	25	11	4
	M. Adult	Female		2	
		Male	3		1
	Indeterminate	Indeterminate	1	1	
Radius	Subadult	NA	1		
	Adolescent	Male		1	
		Indeterminate	1		
	Adolescent+	1			
	Adult	Female	9	2	1
		Ambiguous	1		
		Male	2	1	
		Indeterminate	20	5	4
	Y. Adult	Male	1		
	M. Adult	Female		2	
		Male	3		1
	Indeterminate	Indeterminate	1		
Ulna	Adolescent	NA	1		
	Adolescent+	Indeterminate			1
	Adult	Female	8	1	1
		Male	11		1
		Indeterminate	14	5	4
	M. Adult	Female		2	
		Male	2		2
	Indeterminate	Indeterminate	2		

Table 31. Kalavasos village tombs, summary of lower limb recording of pathology by element, age at death, and sex.

Element	Age	Sex	N No path	N path NS	N path
Femur	Subadult	NA	2		
	Infant	NA			1
	Adolescent+	Indeterminate	1		1
	Adolescent+	Male		1	
	Adult	Female	10	7	2
		Ambiguous		1	1
		Male	3	4	5
		Indeterminate	17	13	5
	M. Adult	Female		1	
		Male		1	1
Tibia	Subadult	NA		1	
	Infant	NA			
	Adolescent+	Indeterminate		1	
	Adult	Female	6	3	
		Male	1	2	
		Indeterminate	10	18	
	M. Adult	Female		2	
		Male			
	Indeterminate	Indeterminate	1		
Fibula	Adolescent+	Indeterminate	3		
	Adult	Female	7		
		Male			1
		Indeterminate	7	6	14
	Y. Adult	Male	1		
	M. Adult	Male	1		3

The overall distribution of healed and healing versus unhealed periosteal reaction at the Kalavasos village tombs is similar to that seen at the other sites (Table 32).

Table 32. Kalavasos village tombs, summary of post-cranial pathology by element, sex, degree of healing and expression.

Element	Age	Sex	Degree of Healing	Minimal	Moderate	Extensive
Humerus	Adult	Female	Healed	2	3	
		Indeterminate	Healed	2	2	
	M. Adult	Male	Healing	1		
Radius	Adult	Female	Healed	1		
		Indeterminate	Healed	3	1	
	M. Adult	Male	Healed	1		
Ulna	Adolescent+	Indeterminate	Healed	1		
	Adult	Female	Healed		1	
		Male	Healed		1	
		Indeterminate	Healed	3		1
	M. Adult	Male	Healed	1		
Femur	Infant	NA	Unhealed		1	
	Adolescent+	Indeterminate	Healed		1	
	Adult	Female	Healed		2	
		Ambiguous	Healed	1		
		Male	Healed	1	4	
		Indeterminate	Healed	1		
Tibia	Infant	NA	Unhealed		1	
	Adolescent+	Indeterminate	Healed	1		
	Adult	Female	Healing			1
			Healed	1	1	
		Ambiguous	Healed		2	
		Male	Healing	1		2
			Healed		3	
		Indeterminate	Healed	3	5	
Fibula	Adult	Male	Healing			1
		Indeterminate	Unhealed		1	
			Healing			2
			Healed	2	9	
	M. Adult	Male	Healed	2	1	

Entheses

The Kalavasos village tombs contributed the largest sample for this analysis. All upper limb enthesial scores were compared for sex differences, but only the Brachialis enthesis was statistically different for males and females, with a p value of .034. Males had significantly greater brachailis development than females (Figure 32). There were no significant differences by side (left versus right).

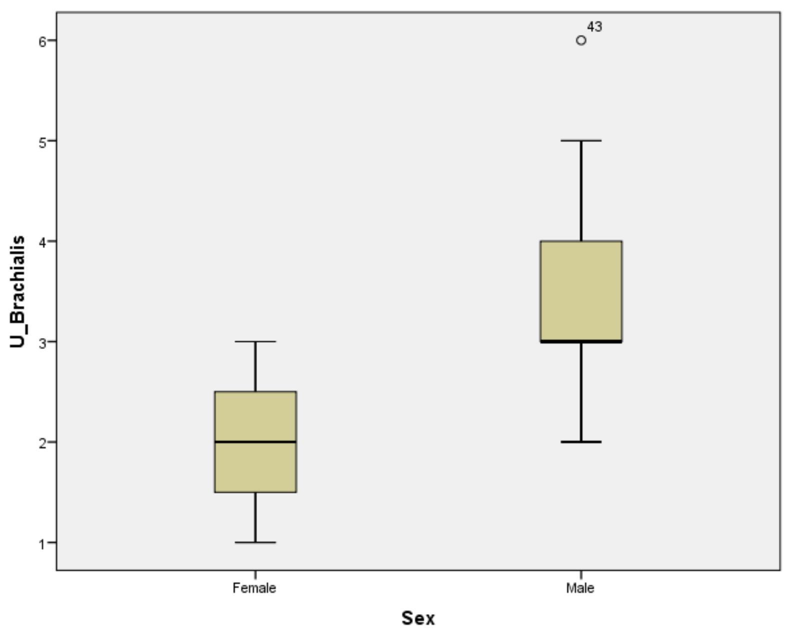


Figure 32. *Kalavasos village tombs, Brachiais development by sex.*

When adults of indeterminate sex were considered, there is a significant difference in right versus left development of the brachioradialis at Kalavasos village tombs as well. Sexes were combined for this analysis as they showed no significant differences in development. The right side are significantly more developed than the left (Figure 33).

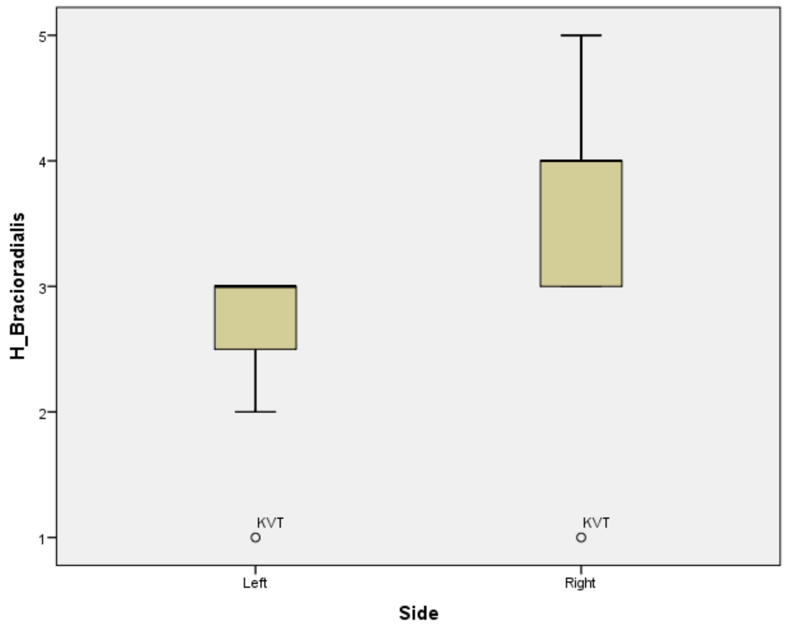


Figure 33. Kalavasos village tombs, development of right versus left Brachioradials (sexes combined)

The gluteus maximus, iliopsoas, posterior cervical imprint, quadriceps tendon development, and the presence/absence of squatting facets were comparable for sex at Kalavasos village tombs, but none produced statistically significant differences.

Traumatic Injury

Cranial Trauma

A total of 9 individuals from this site exhibited CDFs. Figure 34 shows the overall distribution of all CDFs. In the diagram, males are shown in blue, females in red, and adults of indeterminate sex are shown in gray. Of the individuals of estimable sex, the larger CDFs occur in males and on the above the hat brim on the frontal bone, suggesting interpersonal trauma(Guyomarc'h et al., 2010; Kremer et al., 2008). All of the CDFs on female skulls occur on the superior portion of the cranium. This suggests that, for this site, patterns of interpersonal trauma are different for males and females.

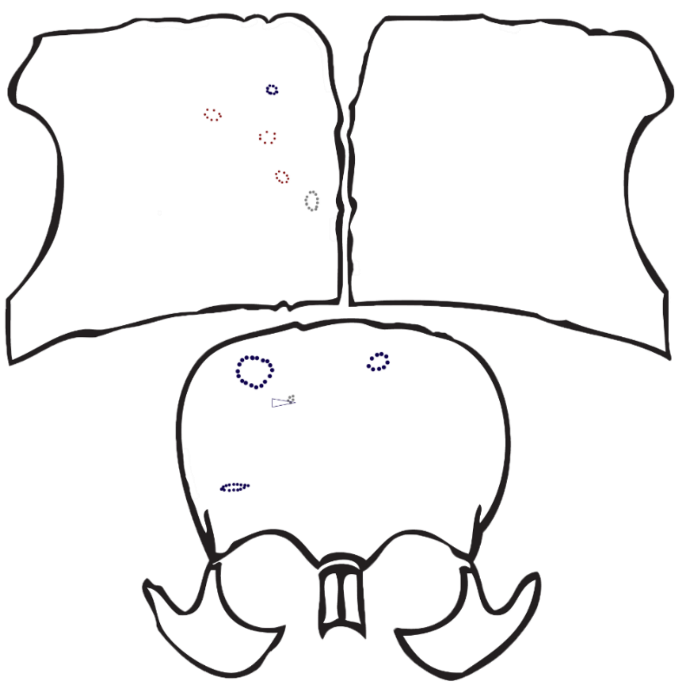


Figure 34. *Kalavasos village tombs, diagram showing location and relative size of all CDFs. Males are shown in blue, females in red, indeterminate sex shown in gray.*

Table 33 gives the area, depth, and location of the CDFs from this site. The small sample size precludes statistical analysis, especially with one CDF being so much larger than the others (Figure 35). Trauma occurred to the top and front of the male cranium, while females were only subjected to trauma to the top of the head. Despite the difference in location, however, there is no substantial difference in relative size or depth of the CDFs, suggesting that degree of force and/or weapon used to inflict the trauma was not different for the two groups.

Table 33. Kalavasos village tombs, Location, area, and depth of all CDFs by sex and tomb.

Tomb	**Sex**	**Location of CDF**	**Area of CDF**	**Depth of CDF**
T36	Male	Frontal	210.08	0.41
		Parietal	6.71	0.58
T36	Male	Frontal	32.87	0.29
T40	Indeterminate	Frontal	7.99	0.6
T51	Female	Parietal	49.93	0.38
T58	Female	Parietal	56.37	1.07
T65	Female	Parietal	34.33	0.39
T67	Indeterminate	Parietal	59.27	0.54
T67	Male	Frontal	25.72	0.58
T58	Male	Frontal	41.14	2.15

Two individuals from Tomb 36 exhibited healed CDFs, both are estimated to be male. One of these, T.36.SK1 is the only individual to have two CDFs. One of these is the largest CDF to be present in the Kalavasos village tombs remains, measuring 16.82 × 12.49 × .41 mm (Figure 35).

Figure 35. Kalavasos village tombs, T.36, SK1, large, shallow CDF on left frontal.

The other individual from Tomb 36 exhibiting a CDF is also male (Figure 36). This CDF presents with some reactive bone in the floor of the lesion, though it is well-integrated into the surrounding bone.

Figure 36. *Kalavasos village tombs, T36, SK2. CDF on the frontal of an adult male.*

Tomb 40 contains the cranial vault fragment of an adult of indeterminate sex (Figure 37). This presented a CDF on the right frontal to the right of midline. This is a small but relatively deep CDF that is completely integrated into surrounding bone.

Figure 37. *Kalavasos village tombs, T40, Small CDF on frontal of an adult of indeterminate sex.*

Tomb 51 contains the remains of an adult female. This tomb is the only tomb dating to the ProBA 3 period (all others date to the PreBA 2 period). There is one CDF that was found on the right parietal, near the boss. It is relatively small and shallow, and would not photograph well.

Tomb 58 SK2 is an adult male, aged between 35 and 40 years at death (based on morphology of the auricular surface). This individual has a deep triangular CDF on the right frontal approximately 35 mm inferior to the coronal suture and just to the right of the midline (Figure 38). This is the deepest CDF found at the site; proliferative bone is present at the edges of the lesion, but the lesion itself is fully healed and integrated. The location of this lesion above the hat brim line argues for a violent origin for the lesion.

Figure 38. Kalavasos village tombs, T58 SK2. Deep CDF on frontal of a middle adult male.

SK4 from Tomb 65 exhibits a shallow CDF on the right parietal, slightly anterior to obellion (Figure 39). Although shallow, the defect is clear. It has a slightly porous floor, but the bone itself appears to be well-healed and integrated.

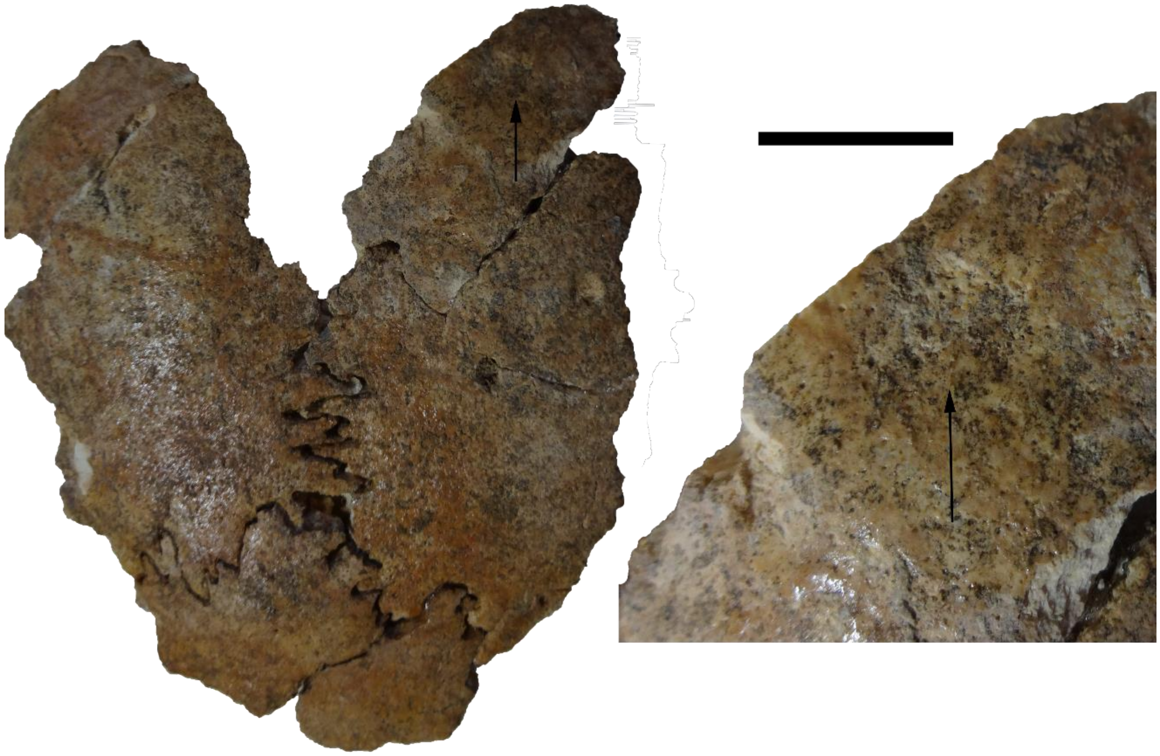


Figure 39. *Kalavasos village tombs, T65, SK4. Shallow CDFon right parietal of an adult female.*

Two cranial fragments from Tomb 67 exhibit CDFs. One cranial fragment with dimorphic browridges and orbits indicating a male exhibited a healed CDF superior to the right orbit. This is a linear fracture superior to the right orbit (Figure 40).

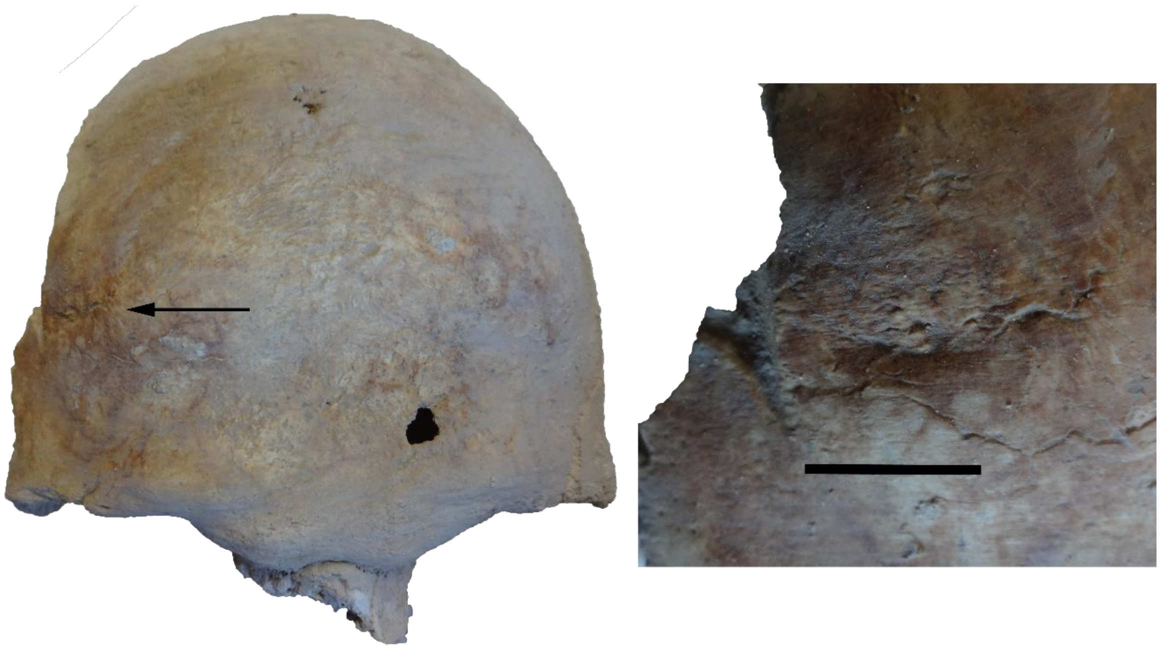


Figure 40. *Kalavasos village tombs, T67 SK2, Linear CDF on right frontal of an adult male.*

Postcranial Trauma

Only four cases of postcranial injury were identified from this site; this may be a product of poor preservation.

Tomb 63 contains a right radius from an adult of indeterminate sex. This radius exhibits a healed Colles’ fracture of the distal 1/3 of the shaft with a visible callus on the anterior surface and shaft displacement posteriorly (Figure 41). The large callus on the anterior shaft as well as the posterior displacement indicates that force came from the anterior direction. The origin of the fracture is likely to be accidental, caused by catching oneself during a fall with the palm outstretched (Owen, Melton, Johnson, Ilstrup, &

Riggs, 1982; H. D. Stewart, Innes, & Burke, 1985). This was fully healed at the time of death.

Figure 41. *Kalavasos village tombs, Tomb 63, left radius of an adult of indeterminate sex. Healed Colles' fracture of the distal 1/3 of the shaft. Lateral view is above (anterior is up), anterior view is below.*

Tomb 67 contains the left humerus of an adult of indeterminate sex. This humerus exhibits a large exostosis of the extensor insertions along the lateral border of the distal shaft (Figure 42). This is an isolated exostosis and is likely traumatically induced.

Figure 42. *Kalavasos village tombs, T67, Fragment T.67.32, left distal humerus (sex indeterminate). Large exostosis of extensor insertions. Lateral view is above, anterior view below.*

Two patellae from Tomb 65 exhibited osteochondral fractures. This type of fracture tends to be associated with torsional injuries (Fortis et al., 2002; Milgram, 1943; Triantafillopoulos et al., 2002).

SK 1 from Tomb 58 (a middle adult between the ages of 35 and 40 years of ambiguous sex) exhibits some remodeling of the left femoral greater trochanter. There is a moderately sized porous exostosis of the gluteus minimus insertion (Figure 44, left). Possibly in association with this exostosis is a smooth walled cavitation present on the lateral aspect of the greater trochanter measuring 5.64 × 3.44 × 4.4 mm. This may be a pressure lesion of the soft tissue in the area.

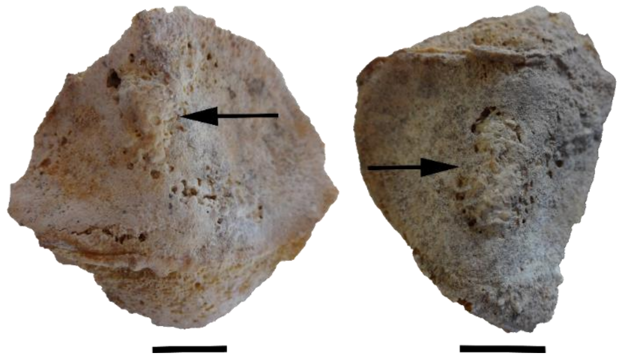


Figure 43. Kalavasos village tombs, T65, Fragments T.67.31 (on left) and T.67.36 (on right). Large osteochondral fractures present on ridge between medial and lateral articular surfaces.

Figure 44. Kalavasos village tombs, Tomb 58 (SK1), exostosis of the gluteal attachments with cavitation on the greater trochanter.

Mortuary Context

Mortuary context for each tomb will be discussed individually, but the excavation of many of the tombs occurred only after initial discover via bulldozer. This may limit the identification of some elements of the tomb, such as the method of entry or location of the dromos. Where these elements could be identified they are noted in the text below. Following the individual tomb descriptions, a discussion will follow.

Individual Tombs

Tomb 36, measuring approximately 3.1 × 1.95 m, was excavated as part of rescue excavations. Excavations were done quickly and without the fine controls present in the excavations in the valley in general. It is described as “jumbled” by the excavators, with no associations possible between artifacts and specific sets of remains (Todd, 1986, p. 25). One feature that is unique to this tomb is the presence of a niche along the northern wall containing a bowl. Based on stratigraphic evidence within the tomb, the excavators postulated at least two phases of tomb use separated by approximately 10 cm of inwashed fill. Based on the present analysis a total of 6 individuals were recovered from this tomb (4 males, 1 adult of ambiguous sex, and 1 child).

Tomb 37, measuring approximately 2.45 × 1.9 m, was also excavated in a rescue excavation. It was mostly destroyed by a bulldozer, and so the context of the bones to artifacts. Todd (1986) theorizes that the tomb was reused at least once, with older burials moved to the back of tomb to make room for new burials. The MNI of this tomb, based on the current analysis, is one adult of indeterminate sex.

Tomb 38 measures 2.45 × 2.3 m, is located in the central part of the excavation area and was also heavily damaged by bulldozer. Of interest in this tomb is that it appears to have been left open after completion for some time prior to being used for burials. Both the human remains and grave goods were located on top of approximately 10 cm of inwashed fill. Silty fill was analyzed using flotation; fragments of barley were recovered from the fill. No intact grave goods were recovered from this tomb, only ceramic sherds and a few small artifacts (Todd, 1986). The MNI of this tomb, based on the current analysis is 3 (one adult male, one adult of indeterminate sex, and one child).

Tomb 39 measures 1.84 x 2.53 m, and like Tomb 37, and was the most complete tomb excavated during the rescue excavations. The entrance to this tomb would have been through the roof (Todd, 1986).

Tomb 40 measures 3.58 × 2.21 m with a height of 1.82 m. It showed evidence of disturbance during construction about 35 years prior to excavations by Todd and colleagues. The upper levels held modern intrusive pottery, glass, and animal bones, but earlier deposits were found on the floor of the tomb along with disarticulated human remains (Todd, 1986). A minimum of 2 adults of indeterminate sex were recovered from this tomb based on the current analysis.

Tomb 41, measuring 1.07 × .78 m, lies at the northwest corner of the excavation area. It was largely covered by modern construction. The tomb appears relatively circular (Todd, 1986). The disarticulated remains of at least two individuals (one adult of indeterminate sex and one child) were recovered from this tomb.

Tomb 42 was largely destroyed by bulldozer. Dimensions of the tomb are 1.73 × 1.59 m and it located in the southern portion of the excavation area (Todd, 1986). The remains of at least one adult of indeterminate sex were recovered, based on the MNI of the current analysis.

Tomb 43, measuring .99 × 1.75 m., is located at the northern edge of the excavations and is partially covered by a modern stone building (Todd, 1986). Ceramic grave goods and human remains consisting of least 2 individuals (one adult of indeterminate sex and one subadult) were recovered.

Tomb 44 could only be partially excavated. This tomb also appears to have had a rooftop entrance (Todd, 1986). Various ceramic sherds were recovered in addition to the partial remains of a single adult of indeterminate sex.

Tomb 45 measures 2.4 × 1.46 m and was disturbed by bulldozer. Artifacts from this tomb were damaged, and the human remains were highly fragmentary, but yielded an MNI of 1 adult of indeterminate sex.

Tomb 46 measures 2.11 × 1.9 m. This tomb contains not only human but also animal bones dating to a later age, indicating that the tomb may have been reused later or at least was opened at a later date. The partially articulated remains of an adult of indeterminate sex were found in the tomb. Along each humerus, a long bronze pin was found with the head of the pin located near the shoulders; the excavators believe that these pins may have served as fasteners of a cloak or shroud in which the body was wrapped (Todd, 1986).

Tomb 47 measures 2.24 × 1.35 m; the contents of the tomb were heavily disturbed. The southeast corner of the tomb was damaged by a modern road, modern water pipes also ran across the upper part of the tomb (Todd, 1986). Both ceramics and human bones were highly fragmented. The remains of at least one adult of indeterminate sex were recovered.

Tomb 48 measures 1.79 × 1.97 m and was partially obscured by a modern building and a modern concrete pathway. Despite the damage to the tomb, an area on the northern way may either be an entryway or a niche, it is difficult to identify. This tomb has evidence of post-Bronze Age tomb reuse. There Middle Cypriot (PreBA 2) period ceramics are mixed with Iron Age ceramics. The thorough mixing of the ceramics has been interpreted by Todd (1986) to indicate that the tomb was filled in after the later reuse. The current analysis indicates an MNI of one adult of indeterminate sex.

Tomb 51 measures 2.45 × 2.35 m with a height of 1.32 m. In this case, the tomb dates to the LC I (ProBA 1) period. Excavators believed that only one individual was buried in the tomb, an adolescent under the age of 25 years. The skeleton was on the southern side of the chamber, with skull fragments under and near two ceramic vessels. Two stone “beads” were found near the remains, and may have been fasteners for a wrap or shroud. Of particular interest to Pearlman (1985) was the presence of a metal sword positioned so that the hilt was pointed towards the body. Pearlman used the presence of this artifact to identify the tomb occupant as an “unknown soldier.” The present analysis shows that this burial is an adult of indeterminate sex. Perhaps the remains were more complete during excavation, allowing for a more exact age at death estimate, but the remains as currently curated do not allow for a refined age estimate. There were no signs of trauma that might indicate military training or participation in battle.

Tomb 52 measures 2.59 × 2.37 m with a height of 1.12 m. The tomb contained six ceramic artifacts, most of which were found broken. Human remains were recovered throughout the chamber. There were no metal or other artifacts recovered from the tomb (Pearlman & Todd, 2007). Moyer (2007) identified this as the remains of an adult male. The current analysis found an MNI of one adult of indeterminate sex.

Tomb 53 measures 2.88 × 2.74 m with a height of 1.68 m. Numerous ceramics were found in the tomb as well as a few metal objects including two scraper/razor fragments and a copper spiral. Other artifacts recovered included "a considerable amount" of faience beads, numerous spherical beads, 3581 ring-like beads and three fluted beads (Pearlman & Todd, 2007, p. 31). Moyer identified five (possibly 6) individuals, including two late adolescent males, a young adult female, a middle adult male, and a young adult female. The current analysis found a very different demographic profile, indicating three adolescents (one of which is a possible male and one a possible female). These differences are likely related to fragment identification and lab taphonomy; it is very likely that remains that were poorly preserved to begin with were impacted by movement and over 30 years of storage.

Tomb 55 is located in the Panaya Church area and was discovered during backhoe trenching for telephone cables. The overall dimensions are unknown, but the N-S dimension is 1.4 m. Human remains within the tomb exhibited some disarticulation. The skull was resting along the southern edge with the feet to the north, possibly flexed (Todd

& Pearlman, 2007). Three vessels were adjacent to the skeleton, along with three other bowls in association with the remains. A few sherds dating to the first millennium BC were found in the tomb, indicating reentry but not significant disturbance of the tomb itself. The remains of a single adult female were recovered from the tomb, based on this analysis.

Tomb 56 was not scientifically excavated, but was discovered during the digging of a cesspit for a village house. Skeletal remains are limited to a skull fragment of an adult of indeterminate sex. A total of thirteen fragmentary ceramic vessels were retrieved but given the non-scientific nature of the excavations, few conclusions regarding mortuary activities can be drawn from this tomb (Pearlman & Todd, 2007).

Tomb 57 shares a dromos with Tombs 58 and 63. Numerous vessels were found within the dromos itself, which was initially located by bulldozer. Tomb 57 opened off the east side of this shared entrance chamber. This tomb measures 2.54 × 2.35 m; all together, the tomb contained 41 artifacts (34 ceramic vessels and 7 metal artifacts) in addition to broken sherds. Two skeletons were noted by excavators, lying parallel to each other. Skeleton 1 was flexed. A metal dagger or spearhead was associated with this individual. It had been bent over the shoulder of the individual with the sharp end extending toward the hands. Skeleton 2 lay in front of the tomb entrance. Numerous other artifacts were placed in the central area of the tomb (Todd & Pearlman, 2007). Based on the current analysis, this tomb contained the remains of an adult female and an adult male.

Tomb 58 opens off the north side of the shared dromos with T57 and T63. This tomb measures 2.07 × 1.94 m with a height of 1.45 m. During excavation, it was believed to contain the remains of three individuals, but the present analysis determined the MNI to be 4 adults (1 adult female, 1 middle adult male, 1 adult of ambiguous sex, and 1 adult of indeterminate sex). The bodies were intermixed with artifacts so that it is difficult to associate specific artifacts with specific individuals. One skeleton was laid out on the west side of the chamber with the head to the north and feet to the south. This individual is associated with a metal dagger and other metal ornaments. A second individual consisted of a skull with some fragments and elements inside many of the vessels. This suggests this individual may have been laid out on top of the ceramics; through natural decomposition the remains may have fallen into the vessels. A third set of remains was fragmented and found beneath the entrance to the tomb. The discrepancy in MNI between that based on in-field observation and this analysis is likely due to the concept of counting skulls. This is still a common method of estimating the number of individuals during excavation—they are easily identified and easily counted by non-experts. In discussing the demography, Todd and Pearlman (2007, p. 12) begin by saying "On the evidence of the skulls, three bodies were buried in the tomb."

Tomb 59 shares a dromos with Tombs 61 and 62. The dromos was located by machine, possibly removing the uppermost section. Tomb 59 opens off the north side of this shared dromos. This tomb measures 1.8 × 1.78 m with a height of 1.53 m. Human remains were found throughout the tomb, including intermixed with ceramics. The tomb was uncovered by bulldozer, but wasn't significantly damaged (Todd & Pearlman, 2007). The present analysis identified two adult females, one of which was a young adult. This is different from the original analysis, which reported the presence of a middle adult probable male and a young adult female. This discrepancy in the sex estimation of one individual is likely due to differences in methodology used to estimate sex.

Tomb 60 measures 2.0 × 1.84 m with a height of 1.35 m. This tomb appears to have been looted in antiquity, leading to the disarticulation and commingling of the human remains within the tomb (Todd & Pearlman, 2007). The original skeletal analysis identifies two individuals, a late adolescent female and a middle adult male. The current analysis identified two adult females and 1 adult male, indicating differences in methodology used to identify the MNI. Ceramics and metal artifacts were recovered from this tomb. Metal artifacts included jewelry as well as a dagger/knife and a scraper/razor. In addition to the ceramics and metal artifacts, faience and stone beads were recovered.

Tomb 61 opens off the south side of the shared dromos with Tombs 59 and 62. This tomb measures 1.63 × 1.5 m with a height of 1.33 m. Fragments of the stomion were recovered from within the tomb chamber itself. The human bones were found in two concentrations, on the southeast and west sides of the tombs (Todd & Pearlman, 2007). The excavators equated these two concentrations as individual burials (one adult male and one adult female), but the current analysis determined an MNI of 1 adolescent possible female. Ceramics, fragments of copper, and a fragment of stone adze were found in this tomb.

Tomb 62 opens off the west side of the shared dromos with Tombs 59 and 61. This tomb measures 2.3 × 1.97 m with a height of 1.3 m. This tomb appears to have been looted in antiquity, leading to fragmentation of the human remains. The excavators believed that the tomb held the remains of two individuals, one a possible male and one an older female (Todd & Pearlman, 2007). The current analysis finds 1 adult of ambiguous sex based on replication of features.

Tomb 63 opens off the south side of the shared dromos with T57 and T58. This tomb measures 1.52 × 1.18 m with a height of 1.29 m. Ceramics and a clay spindle-whorl were recovered in this tomb, but no metal artifacts were found (Todd & Pearlman, 2007). Previous analyses identified two individuals side by side in the tomb, at least one of whom was placed in a flexed position. Both were identified in the field as females. This coincides with the findings of this analysis.

Tomb 65 measures 2.23 × 2.22 m with a height of 1.43 m. The exact nature of the dromos is unclear. The tomb was encountered by mechanical cutting and so was entered through one of the walls. Modern disturbance is evident due to the piece of electrical wire complete with empty socket hanging inside the tomb. Despite this modern disturbance, there doesn’t appear to have been looting. This tomb exhibits reuse, with earlier burials pushed to the back of the tomb when a new interment was made. Excavators identified four individuals, identified by skulls. These were all identified as male by the excavators, but the current analysis identified two adult males and two adult females (Todd & Pearlman, 2007). Twenty-nine ceramic vessels were recovered as well as numerous metal artifacts including a copper pin fragment, an ax, a hair ornament, a dagger/knife, and several rivets. Over 60 faience beads were also recovered.

Tomb 66 measures 1.93 × 1.91 m with an unknown height. This tomb was poorly preserved with no stomion in situ. It was discovered by bulldozer. The excavators identified the remains of three individuals, 1 adult male, 1 adult female, and one infant (Todd & Pearlman, 2007). The current analysis identified three individuals as well, 2 adult females and one infant. The discrepancy in sex estimation is likely due to a difference in techniques used to estimate sex. Eleven ceramic vessels were recovered, but no metal artifacts were found in the tomb. Thirteen stone and faience beads were found as well.

Tomb 67 measures 2.9 × 2.85 with a height of at least 1.45 m. This tomb was discovered during school construction. Most of the remains were disarticulated and commingled, indicating probable tomb reuse (Todd & Pearlman, 2007). Multiple ceramics were recovered, as well as one chert blade. A few metal artifacts were in the tomb, including ornaments, a rivet, and a scraper/razor. Stone artifacts were also found including three pebbles and approximately 85 faience beads. This tomb had the largest number of individuals in a single tomb at the site. Excavators identified five individuals: three middle adult females and two young adult males. The present analysis identified three adult females, one adult male and one adult of indeterminate sex. Age at death for these individuals was initially estimated using dental wear (Moyer, 2007), but since there are no population specific standards for this methodology relating to Cyprus, this methodology was not used in the present analysis.

Tomb 68 measures 2.27 × 1.86 m with a height of 1.43 m. Five ceramic vessels were found with a few sherds and fragmentary human remains. The tomb appears to have been cleaned out in 1914 according to local informants. Excavators note the presence of at least two individuals, a young adult male and a young adult female. The current analysis identified an adult male and an adult female. The relative lack of grave goods is likely the result of looting in the early 20th century (Todd & Pearlman, 2007).

Tomb 69 was heavily damaged by mechanical scraping prior to excavation. The majority of bones and artifacts were clustered in the SW half of the tomb. Two individuals were identified in the tomb as well as a child represented solely by dentition and a few long bone shaft fragments. The current analysis of these remains indicates an adult female and an adult male; the long bone shaft fragments from the child were not relocated and dentition was not used to tabulate overall MNI because dentition, especially since subadult dentition can be lost during life. Numerous ceramic vessels were found in the tomb in association with the human remains. One chert blade was also recovered as were some metal artifacts and a single faience bead (Todd & Pearlman, 2007).

Tomb 70 shares a dromos with Tombs 71 and 72. Tomb 70 opens off the south side of the shared dromos. The tomb is roughly circular with a diameter of 1.75 m and a height of 1.2 m. This tomb was intact at the time of excavation. A total of 13 ceramic vessels were recovered as well as two curved copper fragments and three spherical faience beads. Four spherical clay spindle whorls were also found in the tomb (Todd & Pearlman, 2007). A total of two individuals were identified in the field, an adult male and a late adolescent female. The current analysis identified one adult female and one adult of indeterminate sex.

Tomb 71 opens off the west side of the dromos shared with T70 and T72. It measures 2.8 × 2.35 m with a height of 1.35 m. Human remains and grave goods were commingled on the west side of the tomb. These likely represent an earlier burial that was moved to the back of the tomb to make room for a new burial. Ceramics and metal artifacts including a copper pin were recovered from the tomb (Todd & Pearlman, 2007). Two individuals were identified in the tomb, both adult males. The current analysis identified two individuals as well, one young adult female and one middle adult male.

Tomb 72 opens off the north side of the dromos shared with T70 and T71. This is a roughly circular tomb with a diameter of 2.3 m and a height of 1.35 m. Disturbed human remains were intermixed with ceramics, metal artifacts, a spindle-whorl, an annular limestone object, and several faience beads (Todd & Pearlman, 2007). Moyer (2007) identified two individuals, but the current analysis could only identify a minimum of 1 adult of indeterminate sex.

Tomb 75 is roughly circular with a diameter of 2.2 m and a height of 1.5 m. The dromos was destroyed by bulldozer prior to excavation. Human remains were in poor condition but appeared to indicate a single individual. The fragmentary skull was on the south side of the chamber and the legs were in a flexed position. A dagger/spearhead with a hooked tang and bent tip was found lying parallel to a humerus and might have been laid between the arm and the body. Numerous ceramics were found in addition to the dagger/spearhead (Todd & Flourentzos, 2007). Moyer (2007) identified the single tomb occupant as a late adolescent female. The current analysis identified an MNI of two, one adult female and one child. The child is poorly represented.

Tomb 76 measures 1.65 × 1.32 m with a height of 1.05 m. The dromos of this tomb was not excavated, as the tomb was entered through a hole in the roof. This and Tomb 79 are the smallest Middle Cypriot tombs from the Kalavasos village tombs assemblage. One cranium was visible on the south side of the tomb. There were seven ceramic vessels recovered from the tomb, but no metal was encountered. A single decorated spindle whorl was found between the os coxa and arm bones in the southeast portion of the tomb (Todd & Flourentzos, 2007). Moyer (1997) identified an adult female as the sole occupant of the tomb. The current analysis confirmed this.

Tomb 77 measures 2.12 × 1.89 m with a height of 1.45 m. The tomb was damaged by mechanical scraping to the roof of the burial chamber, and the tomb was subsequently excavated through this hole. Twenty complete and fragmentary ceramic vessels were identified from this tomb, including one amphora. Two metal pins were found associated with the arm bones of the tomb occupant. The tomb occupant was located on the south side of the tomb facing east in a flexed position. There were no other artifacts recovered (Todd & Flourentzos, 2007). Moyer (2007) identified a single individual in the tomb, a young adult female. The current analysis identified a middle adult female; this discrepancy is likely due to interobserver error in the age estimation and the use of dental wear as an age at death estimation method.

Tomb 78 measures 2.75 × 2.6 with a height of at least 1.3 m. The tomb was damaged by mechanical scraping. The majority of the roof was removed mechanically and the tomb was excavated through the roof. The burial was found in a commingled state, position of the body could not be determined due to the fragmentary and disarticulated nature. Fourteen ceramic vessels were present in the assemblage, three of which were found high in the deposit in the tomb fill. The reason for this is unclear. a cluster of metal artifacts were found near the skull, including a sword with tip bent, a small dagger/knife, a scraper/razor and a copper awl with a bone handle (found in association with a whetstone) (Todd & Flourentzos, 2007). Moyer (2007) identified the tomb occupant as a young-middle adult male; the current analysis indicates the presence of a single adult male in the tomb.

Tomb 79 measures 1.61 × 1.42 m with a height of 1.25 m and would have been entered through a dromos. Excavators believe the tomb to have been looted in antiquity, thus explaining the small number of ceramic vessels and other artifacts found in the tomb. Very few human remains were also found, all in a fragmentary and commingled state (Todd & Flourentzos, 2007). Moyer identified a single adult of indeterminate sex; this was confirmed in the present analysis.

Summary

There are two basic tomb forms at the Kalavasos Village. The first is a rooftop entry form and the second is a dromos-entry type. There is no association between the MNI of the tomb and the overall size. Tomb size must therefore be a result of other factors, be they environmental or cultural. Environmental factors may include the quality of the bedrock in the area to be used. If the bedrock is much harder in an area where the individuals digging are required to place tombs (for whatever reason), it may be more feasible to construct a smaller tomb. Cultural reasons for tomb size may be as simple as the amount of space present due to the presence of other tombs nearby. Or they may be as complex as social class or status. The relative commonality of grave goods in all the tombs suggests similar economic resources for those who are performing the burials.

There are three instances where multiple tombs share a common dromos. These could be larger familial or corporate units that wanted to maintain a communal entrance to smaller lineage-based tombs. Or these could be related to space issues. If a family wished to construct a tomb in a specific portion of the necropolis, they may have been forced by a lack of space to share a dromos with an adjacent tomb.

Spindle-whorls are only found in association with female burials. They are also found in burial contexts containing individuals of indeterminate sex, but never in tombs where only adult males are present.

Metal artifacts are interred with both males and females of multiple age cohorts. Despite Pearlman's (1985) association of a sword as indicating a soldier's status, the presence with both males and females calls this into question. Additionally, these artifacts seem to be ritually "killed." Most of them have bent blades, meaning they couldn't be used when placed in a burial context. Daggers and knives also tend to be found in association with the upper limbs (when this association can be made).

Vasilikos Valley: Kalavasos *Ayios Dhimitrios*

Overall summary

This site dates to the ProBA 2 period and is typically viewed as a major regional center (Knapp, 2008b, 2013). Remains from at least 45 individuals were included in the analysis from multiple tombs. Childhood stress indicators of dental growth disruption were scored (LEHs), as well as caries, antemortem tooth loss, and dental wear patterns. Both cranial and postcranial pathological changes were scored where possible. Of interest is a single case of possible perinatal scurvy identified on an individual from Tomb 11. Enthesial changes were also scored for all individuals where this was possible. Both cranial and postcranial traumatic injury were noted. At this site, all trauma on female crania occurs on the frontal bone, including one large perimortem fracture. Male cranial trauma was located on the posterior portion of the cranium.

MNI and Demography

Kalavasos *Ayios Dhimitrios* is temporally associated with the ProBA 2 period. By this time we see far more individuals within each tomb. Seven of the 12 tombs included in the analysis contain at least two individuals. Tomb 5, for instance, contains the remains of at least 10 individuals. Five of the tombs contain single individuals. Four of these contain single adults, but Tomb 9 contains the remains of a single child.

Table 34. Kalavasos Ayios Dhimitrios*, MNI and demography by tomb, age at death, and sex.*

Tomb	Adult				Subadult						**Tomb Totals**
	Female	Male	Amb.	Indet.	Preterm	Perinatal	Infant	Child	Adolescent	Subadult Gen	
A50W							1				**1**
T1		1		1			1			1	**4**
T4				1							**1**
T5		1		4			1	3		1	**10**
T9								1			**1**
T11	2 (YA)			2		2	1			1	**8**
T12		1					1				**2**
T13	1			1			1	1			**4**
T14		1									**1**
T17				1							**1**
T18	2	2		2				1			**7**
T19				3				1			**4**
Total	**4**	**6**		**15**			**6**	**7**		**3**	**45**

Childhood Stress Indicators: LEH

A total of 106 incidences of stress were cataloged at Kalavasos *Ayios Dhimitrios*. The majority of them were found in dentition belonging to individuals who died at greater than 12 years of age based on dental development (Table 35, Figure 46). This produced an average age of stress incident of 3.41 years. The LEHs originating on dentition of individuals who died under 12 years of age had a slightly lower average age of stress incident (2.92 years). In all tombs except for Tomb 5, individuals who died younger had younger age of stress incidents. This pattern is discussed more below and in Chapter 5.

Table 35. Kalavasos Ayios Dhimitrios, *Total number of LEHs and age at stress incident, by age at death category.*

	Adolescent+		Child	
Tomb	Total N Insults	Mean Age of Insult	Total N Insults	Mean Age of Insult
T1	24	3.53	2	2.75
T4	2	2.87		
T5	19	3.68	4	3.70
T13	1		2	2.25
T18	19	3.42		
T19	23	3.57	10	2.98
Totals	88	3.41	18	2.92
			Total N of insults	106

Sex comparisons were not run on teeth from this site because there were no identified males or females. All dentition was either isolated or was recovered with individuals of indeterminate sex. Age comparisons were conducted. While these do not reach statistical significance, the general pattern of a lower mean age of stress incident is also present here (Figure 45). When the distributions are compared, those who died before 12 years of age have a wider distribution, suggesting that they were more susceptible to subsequent stress, possibly as a consequence of earlier exposure to initial stresses.

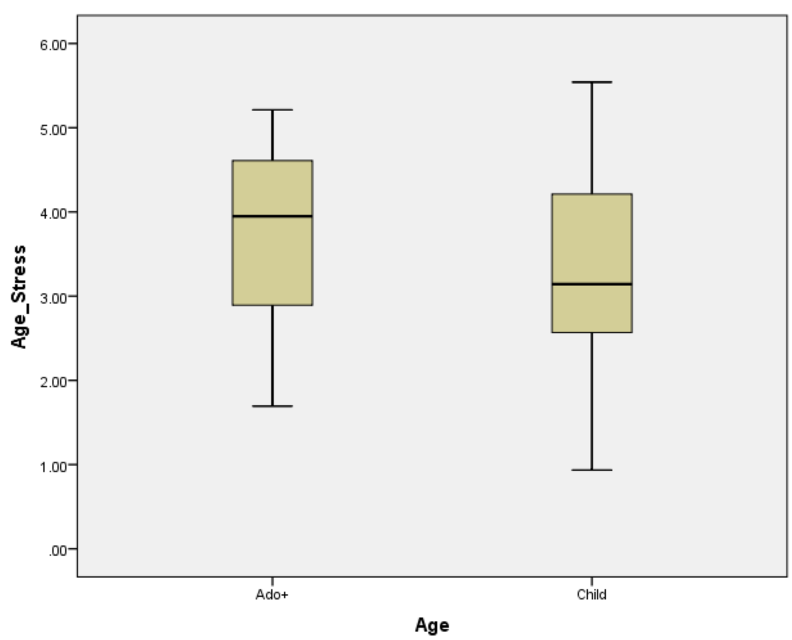


Figure 45. *Kalavasos* Ayios Dhimitrios, *Age of Stress Incident by age.*

A grand total of 37 teeth exhibited at least one LEH when all teeth that could be scored for LEHs were combined. A total of 202 exhibited no LEHs, for a total frequency of 15%.

Dental Analysis

Caries

Caries recorded at Kalavasos *Ayios Dhimitrios* are detailed in Table 36. Only those aged Adolescent+ or adult exhibited any caries. These were mostly interproximal, with half on the mesial surface and half on the distal surface.

Table 36. Kalavasos Ayios Dhimitrios, *Caries by age and lesion location.*

	Occlusal	Interproximal-Mesial	Interproximal-Distal	Smooth	Cervical	Large	No Lesion
Adolescent+		3	1				62
Adult			2		1	1	97
Child							59
indeterminate							3
Young Adult							10

Antemortem tooth loss

Two individuals had lost teeth during life. An adult female from Tomb 13 exhibited remodeling in the area of the permanent upper right first molar (overall rate of loss of this tooth at the site is 40%) and upper right fourth premolar (overall rate of loss of this tooth is 14%). An adult of indeterminate sex from Tomb 18 exhibited antemortem loss of the permanent upper right first molar, permanent upper right canine (overall rate of loss of this tooth is 20%), permanent upper right lateral incisor (overall rate of loss of this tooth is 25%), and the permanent upper right central incisor (overall rate of loss of this tooth is 17%).

Dental Wear

Only a few teeth were associated with remains where sex could be estimated. The majority of the teeth were isolated, and are therefore of indeterminate sex. Average wear by tooth is presented in

Table 37. As with the other sites, intrasite comparisons are not possible due to small sample sizes.

Extramasticatory tooth use is also indicated. This site exhibits dental notching in some anterior dentition, but as with Sotira *Kaminoudhia* (Figure 4), these were isolated teeth, and so estimation of sex is not possible (Figure 46).

Table 37. Kalavasos Ayios Dhimitrios, *summary of dental wear recorded by sex and number of teeth.*

	URM3		URM2		URM1		URP4		URP3		URC		URI2		URI1	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	4.00	2	10.00			1	3.00	2	5.00	2	4.50	2	4.50		
Indet.	2	4.50	3	12.33	2	16.00	6	2.33	5	2.80	10	2.20	6	1.67	9	2.55

	ULI1		ULI2		ULC		ULP3		ULP4		ULM1		ULM2		ULM3	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female									1	7.00	1	20.00	1	18.00		
Indet.	17	2.41	10	1.40			4	3.00	3	2.33			4	20.00	1	4.00

	LLM3		LLM2		LLM1		LLP4		LLP3		LLC		LLI2		LLI1	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female			1	8.00	2	16.00	1	5.00	1	4.00					1	9.00
Male																
Indet.	3	8.33	3	13.33	4	15.75	3	4.33	5	3.80	12	3.16	7	3.42	9	3.22

	LRI1		LRI2		LRC		LRP3		LRP4		LRM1		LRM2		LRM3	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Female	1	9.00			1	8.00	1	9.00	1	9.00						
Male	1	3					1	5	1	5	1	26				
Indet.	5	3.00	4	3.75	10	2.90	2	3.50	2	2.50	3	15.33	3	14.67		

URM3=upper right 3rd molar. URM2=upper right 2nd molar. URM1=upper right 1st molar. URP4=upper right 4th premolar.
URP3=upper right 3rd premolar. URC=upper right canine. URI2=upper right 2nd incisor. URI1=upper right 1st incisor.
ULM3=upper left 3rd molar. ULM2=upper left 2nd molar. ULM1=upper left 1st molar. ULP4=upper left 4th premolar.
ULP3=upper left 3rd premolar. ULC=upper left canine. ULI2=upper left 2nd incisor. ULI1=upper left 1st incisor.
LRM3=upper right 3rd molar. LRM2=upper right 2nd molar. LRM1=upper right 1st molar. LRP4=upper right 4th premolar.
LRP3=upper right 3rd premolar. LRC=upper right canine. LRI2=upper right 2nd incisor. LRI1=upper right 1st incisor.
LLM3=upper left 3rd molar. LLM2=upper left 2nd molar. LLM1=upper left 1st molar. LLP4=upper left 4th premolar.
LLP3=upper left 3rd premolar. LLC=upper left canine. LLI2=upper left 2nd incisor. LLI1=upper left 1st incisor.

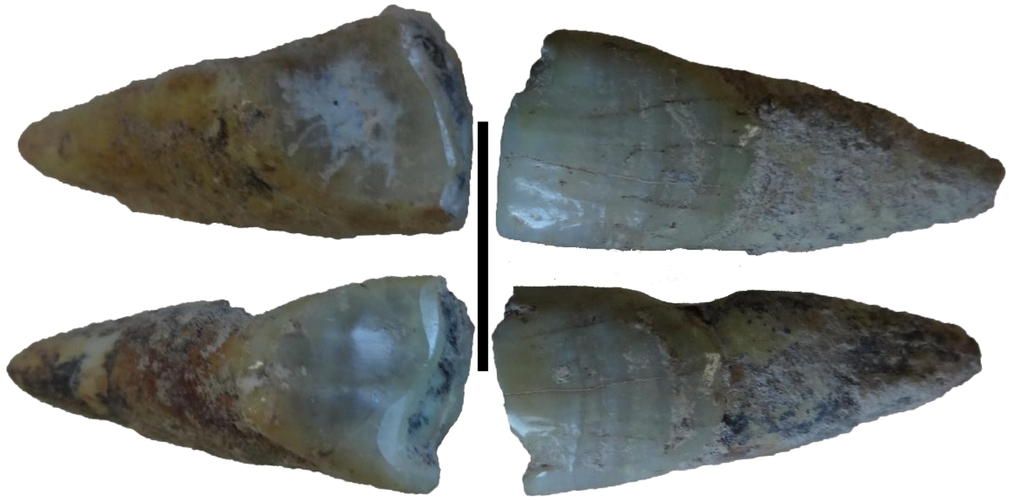


Figure 46. *Kalavasos* Ayios Dhimitrios*, Tomb 13. Notching visible on both right (above) and left (below) central incisors. Lingual view on left, labial view on right (ProBA 2 Period). Not also the presence of distinct LEHs on the labial surface.*

Pathology

Cranial Pathology

Cribra orbitalia

Though a number of fragments were unscorable, Kalavasos *Ayios Dhimitrios* produced a good number of fragments identified to element and therefore included in the analysis (Table 38). This site has the same pattern as the others examined, with subadults exhibiting only unhealed cribra orbitalia, while adults exhibited only healed lesions. As with the other sites, it suggests that the stress leading to the formation of cribra orbitalia occurred in childhood; the adults who exhibited healed lesions survived the stress, those who died before reaching adulthood did not.

Table 38. Kalavasos Ayios Dhimitrios*, summary of cribra orbitalia by age, sex scoring, and degree of expression.*

		Left				Right			
		CO NS	No CO	CO Unhealed	CO Healed	CO NS	No CO	CO Unhealed	CO Healed
Subadult	NA	1	1		1 Mo				1 Mo
		3	12	1 Mi		2	3	2 E, 1 Mi, 1 Mo	
Infant	NA								
Child	NA	1	2						
	Female	2	2		1 Mi		1		1 Mi
Adult	Male	2	5		2 Mo				
	Indeterminate	4	8						

CO NS=cribra orbitalia not scorable
No CO=cribra orbitalia not present
Mi=minimal expression
Mo=moderate expression
E=extensive expression

Porotic hyperostosis

For Kalavasos *Ayios Dhimitrios*, subadults exhibited only unhealed and healing lesions while the adults exhibiting porotic hyperostosis had only healed lesions (Table 39). Frequency data are not particularly illuminating as these figures refer to numbers of fragments, not individuals. Fragment size varied significantly, but if the fragment could be identified to element, it was included in the analysis.

Other Cranial Pathology

From a box labeled as "K-AD 79 West Area Feature 1" there is a pathological bone sample that is likely a mandible, but exhibits so many shape changes that it is difficult to identify accurately. There is what appears to be a mylohyoid groove with a cloaca present on the opposite side. Prolific bone deposition is present around the cloaca.

Table 39. Kalavasos Ayios Dhimitrios*, summary of porotic hyperostosis by age, scoring, healing and expression.*

		PH NS	No PH	PH Unhealed	PH Healing	PH Healed
Subadult	NA	1	2			
Infant	NA	15		1 Mi 3 Mo 4 E	3 Mo 1 E	
Child	NA		2			
	Female	2	2			1 Mi
Adult	Male	3	6			2 Mo
	Indeterminate	7	6			2 Mo
Y. Adult	Female	1				

PH NS=porotic hyperostosis not scorable
No PH=porotic hyperostosis not present
Mi=Minimal expression
Mo=moderate expression
E=extensive expression

A child cranium from Tomb 5 (Fragment T.5.65) contains a patch of healed periosteal bone on the superior portion of the parietal (Figure 47). This is well bounded and appears to be completely localized. This is the area of obellion and extends approximately 35.75 mm to the left of the sagittal suture to the suture with an anterior-posterior length of 37.6 mm. roughly circular; there is a defined edge to the lesion. This is likely the result of a localized scalp infection as there is no other indication of porotic hyperostosis.

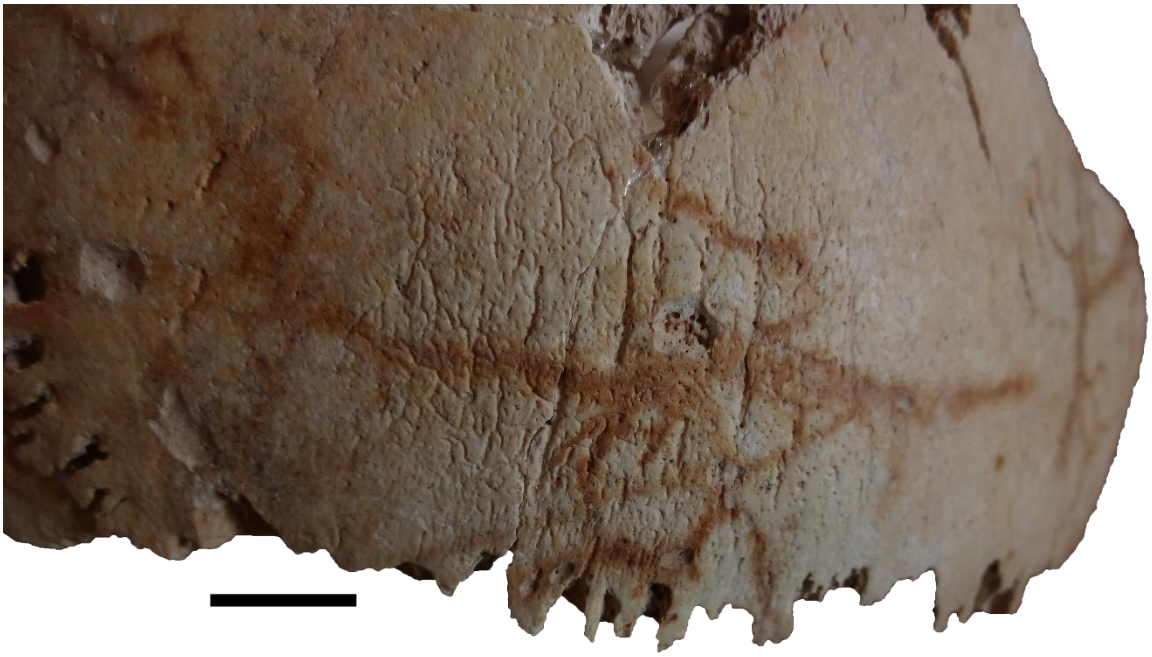


Figure 47. *Kalavasos* Ayios Dhimitrios, *T5. Area of healed periosteal bone on the left parietal, likely due to a localized infection.*

Possible perinatal scurvy

Tomb 11 contains the fragmentary remains of a perinate, aged between birth and 2 months based on dental development. This individual was recovered in a commingled state with one other perinate and two other individuals, but was recognizable due to the severe pathology present on the maxilla and malar. The left and right maxillae have significant periosteal development on the external and palatal surface (Figure 48). This type of porosity has been associated with scurvy in previous analyses (Brickley & Ives, 2006; Brown & Ortner, 2011; Ortner & Ericksen, 1997; Osterholtz, Bethard, et al., 2014). Also associated with these individuals are sphenoid greater wings with pathignomic lesions associated with scurvy as well. The identification of scurvy in an individual of this age group, who would have been breastfeeding must be indicative of maternal insufficiency during pregnancy (Osterholtz, Bethard, et al., 2014).

Figure 48. *Kalavasos* Ayios Dhimitrios*, Tomb 11, Cranium 5A, periosteal bone development on the right maxilla (also present on left and malar).*

Postcranial Pathology

Periosteal Reactions

Both upper and lower limbs were scored for pathological changes (Table 40,

Table 41).

Table 40. Kalavasos Ayios Dhimitrios, *summary of upper limb pathology recorded by element, age at death, and sex.*

Element	Age	Sex	N No path	N path NS	N path
Clavicle	Infant	NA	1		2
Humerus	Subadult	NA	2		3
	Infant	NA	10	1	4
	Child	NA	1		2
	Adolescent+	Indeterminate			1
	Adult	Indeterminate	11	1	5
	Y. Adult	Female		1	
	Indeterminate	Indeterminate	1	1	
Radius	Subadult	NA	5		1
	Infant	NA	5	1	3
	Child	NA	1		
	Adult	Indeterminate	17		3
	Indeterminate	Indeterminate	2		1
Ulna	Subadult	NA	5		
	Infant	NA	5	3	1
	Child	NA	1		1
	Adult	Female	1		
		Indeterminate	11	1	4
	Y. Adult	Female		1	

Table 41. Kalavasos Ayios Dhimitrios*, summary of lower limb pathology by element, age at death, and sex.*

Element	Age	Sex	N No path	N path NS	N path
Femur	Subadult	NA	4		1
	Infant	NA	9	4	7
	Child	NA	9	2	11
	Adult	Female	3	4	2
		Ambiguous		1	
		Male	8	2	7
		Indeterminate	23	20	26
	Y. Adult	Female			2
	Indeterminate	Indeterminate		1	
Tibia	Preterm	NA	1		
	Infant	NA	3		8
	Child	NA	2		2
	Adult	Female	1	1	6
		Male			5
		Indeterminate	5	12	16
	Y. Adult	Female			1
Fibula	Subadult	NA	4		4
	Adolescent+	Indeterminate			2
	Adult	Male			3
		Indeterminate	5	6	10
	Y. Adult	Female	1		1
	Indeterminate	Indeterminate	2		1

As with the other sites, subadults exhibited only unhealed and healing reactions. Adults exhibited active, healing, and healed lesions. Though the sample sizes are small, there is no visible difference in patterning between males and females in terms of expression of reaction or stage of healing (Table 42). Both males and females exhibited extensive reactions.

Table 42. Kalavasos Ayios Dhimitrios*, summary of pathological changes by element, age at death, sex, degree of healing, and expression.*

Element	**Age**	**Sex**	**Degree of Healing**	**Minimal**	**Moderate**	**Extensive**
Clavicle	Infant	NA	Unhealed		2	
Humerus	Subadult	NA	Unhealed	1	2	
	Infant	NA	Unhealed			1
	Child	NA	Unhealed		1	
	Adolescent+	Indeterminate	Healed	1		
	Adult	Indeterminate	Healed	2	2	
Radius	Subadult	Indeterminate	Healed		1	
	Infant	NA	Unhealed	1		1
			Healing			1
	Adult	Indeterminate	Healed		3	
	Indeterminate	Indeterminate	Healed			1
Ulna	Infant	NA	Unhealed	1		
	Child	NA	Unhealed	1		
	Adult	Indeterminate	Healing			1
			Healed		2	
Femur	Subadult	NA	Healed		1	
	Infant	NA	Unhealed		2	5
	Child	NA	Unhealed		4	2
			Healing		2	
			Healed		2	1
	Adult	Indeterminate	Unhealed	1		
			Healed	3	14	6
Tibia	Infant	NA	Unhealed		6	2
	Child	NA	Unhealed			2
	Adult	Female	Unhealed	1		
			Healed	1	2	2
		Male	Healing		1	1
			Healed		1	2
		Indeterminate	Unhealed	1	2	
			Healing		1	1
			Healed	2	6	3
Fibula	Subadult	Indeterminate	Unhealed			4
	Infant	NA	Unhealed	1		2
	Adolescent	Indeterminate	Healed		2	
	Adult	Indeterminate	Unhealed		2	
			Healed	3	3	1
		Male	Healed	1	1	1

Other postcranial pathology

A left second cuneiform from Tomb 5 has significant remodeling. The articular surface for second metatarsal is completely reorganized with the entire surface enlarged and lipping present on the dorsal surface. Eburnation is present on this surface, and the original shape of the articular surface is obliterated. The facet for the medial cuneiform is also reorganized with the loss of the articular surface on the plantar aspect and severe lipping present on the dorsal surface with extension of the surface well above the typical bone level. Significant lipping is also present plantar to the articular surface for the medial cuneiform. Lipping is also present on the facet for the navicular and the lateral cuneiform. This appears to be the result of trauma to the joint between the second metatarsal and the second cuneiform, altering their articulation and forcing the rest of the bone to alter to accommodate that change.

The clavicle fragment from this same bag is a small portion of left acromion with an extremely porous acromion with moderate lipping around the porous surface for the scapula. This may be traumatic, as in an injury to the shoulder girdle, or this may be the result of the development of an os acromion, without more of the bone present, it is not possible to tell for sure.

Fragments of at least three patellae are present. One of these is very large, though metrics are not taken due to the tremendous amount of lipping and pathological changes present (Figure 49). This patella exhibits large amounts of lipping all around the visible surface in the form of extensions of the articular surface that curl inward towards the articular surface. The lateral articular surface also exhibits a large area of eburnation as well.

Figure 49. *Kalavasos* Ayios Dhimitrios, *Tomb 5, Right patella of an adult exhibiting significant OA including lipping and eburnation.*

Entheses

Small samples with sexually dimorphic elements preclude analysis of these materials by sex. When the indeterminates were included in the analysis, there was no statistically significant difference based on side. These data are examined more thoroughly below with respect to time period.

The development of the gluteus maximus, iliopsoas, and the presence/absence of squatting facets were comparable for sex at Kalavasos *Ayios Dhimitrios*, but there were no significant results.

Traumatic Injury

Cranial Trauma

There are a few examples of cranial trauma at Kalavasos *Ayios Dhimitrios*; both males and females are affected (Figure 50). For this site, all trauma on female crania occurs on the frontal bone, including one large perimortem fracture. The trauma on male crania is restricted to the occipital. Despite the complete segregation of the two sexes in terms of location, conclusions regarding differential patterns of trauma that males and females are subject too should not be made. The sample sizes are simply too small and the preservation too marginal to draw any such conclusions.

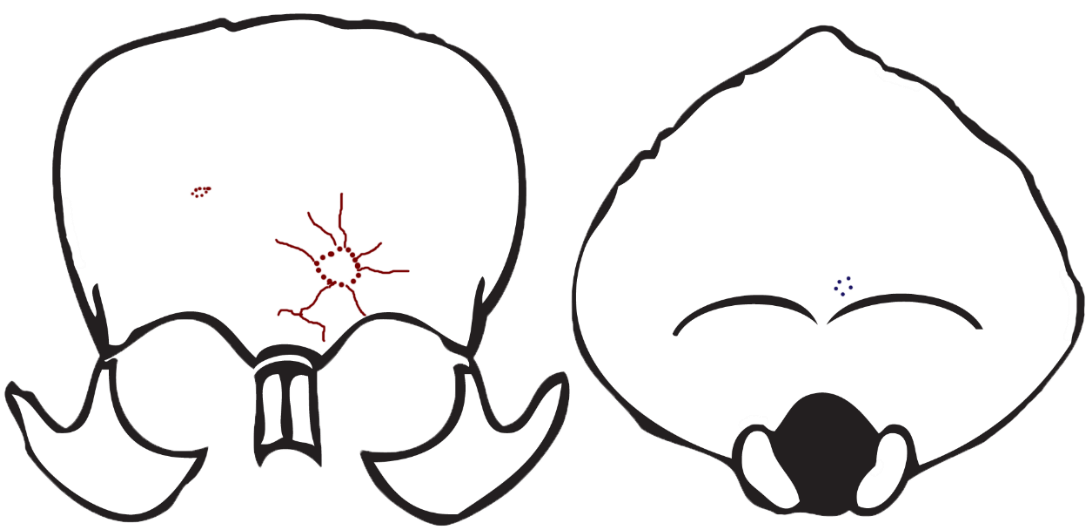


Figure 50. *Kalavasos* Ayios Dhimitrios*, diagram showing number, relative size, and location of CDFs. Males are visible in red, males in blue.*

A male skull from Tomb 14 exhibits a small CDF on the occipital. This is very small and in an area with significant taphonomic damage. Measuring only 3.22 × 3.4 × 1.5 mm, it is small and would not photograph well.

The skull of a very young adult female (or possibly an adolescent) cranium from Tomb 18 exhibits two distinct traumas. Sex is difficult to estimate for this individual because it is very gracile. Frontal bosses are prominent as well, but adult size has been attained. On the right frontal, there is a small linear CDF that is fully healed (visible on the left side of Figure 51). The left frontal exhibits a large perimortem trauma (visible on the right side of Figure 51). This is a large non-penetrating fracture with a depressed section of the frontal with radiating fractures extending from the depressed area. No signs of healing are present. The edges of the lesion were examined to determine if this is a taphonomic artifact; under magnification buckling of the edges of the lesion are visible. There is no attendant porosity of signs of healing.

Postcranial Trauma

Two patellas from Tomb 13 exhibit small osteochondral fractures, one on a left patella (T.13.SK1.6) and the other on a right (T.13.SK1.7).

A left tibia from Tomb 18 (Fragment T.18.83) exhibits possible trauma to the quadriceps tendon. The area is pitted and there is a shallow cavitation within the muscle marker itself. This reaction may be the result of an injury to the quadriceps tendon, either a severe strain or a partial tear of the tendon.

Figure 51. *Kalavasos* Ayios Dhimitrios, *Tomb 18, Fragment T.18..1, two traumas on adult female cranium.*

Mortuary Patterning

Tomb 1 was discovered via bulldozer causing partial collapse of the roof inward. The dromos is on the north side of the chamber, and the stomion was found in situ (but was partially damaged by the bulldozer). The tomb chamber itself is bilobate, measuring 3.5 × 2.0 m with a buttress in the rear wall projecting outward approximately 40 cm. The tomb was looted at some point in the past, and the fragmentary and scattered nature of the human remains in the tomb is likely the result. South and Russel (1989) interpret the relative lack of metal objects as an indication that the looting happened in antiquity. In addition to the presence of Aegean and Levantine ceramics found in the tomb, there were a ceramic wall bracket fragment, a dagger, a simple ring, a ribbed faience bead, several ivory objects (including rods and discoid beads, and a large stone pestle. Even with some of the original contents missing due to looting in antiquity, the presence of foreign and local ceramics, ivory and bronze objects suggests the tomb was used by prosperous people with outside contacts (South & Russel, 1989). The original MNI records 9 skulls, but some of the skulls from the tomb were not relocated for the present analysis despite thoroughly searching for them, so the remains from this tomb is incomplete in this analysis.

Tomb 4 measures approximately 3.2 × 2.5 m with the entrance located along the east wall. The tomb appears to have been looted in antiquity, with the remains scattered throughout the tomb. South and Russel (1989) believe that the looters were systematic in how they went through the tomb, with some ceramics being stacked in the process and others thrown into a pile. Other than ceramics left by these looters, three spindle-whorls were also left as was an undecorated cylinder seal. The original analysis indicates the presence of one individual of 17-21 years and one other young adult. The present analysis found only the remains of at least one individual, an adult of indeterminate sex. This discrepancy is likely related to differences in methodology. There was dentition consistent with two individuals, but dentition was not used to compute an overall MNI in this analysis.

Tomb 5 is roughly oval in shape, measuring 2.7 × 2.2 m. This tomb was also looted, probably in antiquity. The human remains were concentrated in some areas, and none were articulated. There are both local and nonlocal ceramics in the assemblage, along with luxury goods. Gold beads, a plain silver ring, a bronze bracelet, and a glass bead were recovered as well as three spindle-whorls and a small box cut from a single piece of ivory. South and Russel (1989) believe that the looters were somewhat haphazard in their approach to this tomb, overlooking several very worthwhile pieces. This may be an indication of exactly how rich this tomb was when it was closed after the last burial was placed in the tomb. Imported ceramics were present, suggesting wealth and prestige of the individuals who orchestrated the burials if not the individuals interred in the tomb.

Tomb 11 was the wealthiest tomb excavated at the site. It shares a dromos with Tomb 9 (not included in this analysis as it held no human remains). The dromos was under the street surface next to a large administrative building (Building X). There are signs of Roman reuse of ashlar stones from adjacent buildings, but the tomb does not appear to have been affected (South, pers. comm). This individual was analyzed as part of the Tomb 11 assemblage. Located in the niche were some human remains as well, the only instance known at the site. The burial chamber itself is bilobate, measuring 4.39 × 2.81 m with a height of 1.78 m. The north wall contains a buttress and benches are present on the east and west sides of the tomb. Burials were recovered from the benches as well as the floor deposits of the tomb, and consist of a minimum of 8 individuals through multiple periods of tomb reuse. The burials on both of the benches are extended, marking a change in posture from earlier periods. In addition to the human remains, nonlocal ceramics were recovered, beads, and other luxury items. Moyer and colleagues interpret this as the tomb of a leading family at KAD given the very rich tomb assemblage and elaborate architecture.

Human remains were found in a niche in the dromos of Tomb 11. These consisted of some rim fragments, long bone shaft fragments, and dentition from multiple individuals. The dentition present is from at least two infants, one aged between 3 and 9 months and one aged 1.25 and 2.75 years of age at death.

Detailed archaeological data for Tombs 12, 13, 14, 17, 18, 19 were unavailable. All are, however, located close to Building X, the large administrative structure at Kalavasos *Ayios Dhimitrios*. This structure housed multiple very large amphorae that were used to hold olive oil (some almost 2 m tall). It is theorized that the distribution of olive oil throughout the region was controlled by the hierarchy at Kalavasos Ayios Dhimitrios.

In general, the tombs at Kalavasos Ayios Dhimitrios present a picture of long term primary usage (Osterholtz, Baustian, & Martin, 2014a) with multiple periods of tomb reuse. It is also clear from the presence of both foreign and domestically produced ceramics that the inhabitants had access to a greater variety of goods than was previously true for earlier periods. The high quality of the ceramics as well as the presence of numerous gold artifacts and a cylinder seal suggests that those in the tomb were of high status. The tombs' location near the large administrative structure (Building X) suggests that there was a link between those who were in control of the tombs and those in control of Building X.

Vasilikos Valley: Kalavasos *Mangia*

Overall Summary

Kalavasos *Mangia* is temporally associated with the ProBA 2 period. Remains from at least 17 individuals were included in the analysis. Childhood stress indicators of dental growth disruption were scored (LEHs), as well as caries, antemortem tooth loss, and dental wear patterns. Both cranial and postcranial pathological changes were scored where possible. Enthesial changes were also scored for all individuals where this was possible. Both cranial and postcranial traumatic injury were noted.

MNI and Demography

Of the 6 contexts which yielded remains, 4 contained more than one individual (Table 43). B1 and the unstratified remains need to be examined separately from the rest of the individuals, as these are unassociated with the tombs. The unstratified materials come from backdirt piles, while it is unclear from the report where B1 was recovered from. Looking at Just Tombs 5-8, then, only one tomb had a single interment. All subadult burials were found with adult remains, indicating integration of these individuals into lineage or family based tombs. Analysis of these remains was severely hampered by the state of preservation of the remains. Figure 52 gives an idea of the state of preservation of these remains.

Figure 52. *Kalavasos* Mangia, *typical state of preservation of long bones.*

Table 43. Kalavasos Mangia, *summary of MNI and demography by context, age at death, and sex.*

	Adult				Subadult						
Tomb	Female	Male	Amb.	Indet.	Preterm	Perinatal	Infant	Child	Adolescent	Subadult Gen	**Tomb Totals**
B1							1				**1**
T5		1						1			**2**
T6				1							**1**
T7		1		1	1	3		1	2 (1 F?)	1	**8**
T8				1			1	1			**3**
US	1							1			**2**
Total	**1**	**1**		**2**	**1**	**3**	**2**	**3**	**2**	**1**	**17**

Childhood Stress Indicators: LEH

A total of 48 LEHs were recorded for Kalavasos *Mangia* (Table 44). Most of these were on the teeth of individuals who had survived to at least 12 years of age before death, the rest belong to children aged between 2 and 12 years at death. In general, the LEHs tended on the child teeth tended to occur at younger ages than those of the adolescent or older teeth, with the exception of T6, where the LEHs associated with children's teeth actually have a later age of stress incident. This does not fit the pattern discussed in detail below.

Table 44. Kalavasos Mangia, *Total number of LEHs and age at stress incident, by age at death category.*

	Adolescent+		Child	
Tomb	Total N Insults	Mean Age of Insult	Total N Insults	Mean Age of Insult
T5	3	4.25	4	4.19
T6	6	2.95	5	4.30
T7	22	3.70	8	2.47
US	9	4.26	3	2.22
Totals	31	3.63	17	3.65
			Total N of insults	48

Sex comparisons were not run on teeth from this site because there were no identified males or females. All dentition was either isolated or was recovered with individuals of indeterminate sex. Age comparisons were conducted. While these do not reach statistical significance, the general pattern of a lower mean age of stress incident is also present here (Figure 45). When the distributions are compared, those who died before 12 years of age have a wider distribution, suggesting that they were more susceptible to subsequent stress, possibly as a consequence of earlier exposure to initial stresses.

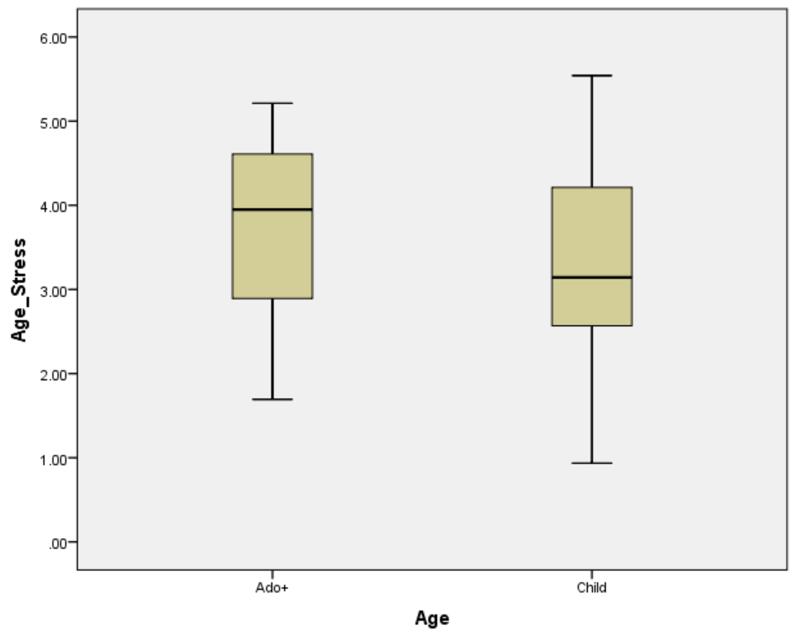


Figure 53. *Kalavasos* Mangia*, Age of Stress Incident by age.*

Kalavasos *Mangia* exhibited a 17% frequency of LEHs when all the available dentition was pooled regardless of how distinctly a tooth could be identified. A total of 95 teeth exhibited at least one LEH, though most of these could not be specifically identified and were not included in the analysis by age. An additional 468 teeth exhibited no LEHs.

Dental Analysis

Caries

Of the 74 teeth scored for caries, only one adult exhibited a carious lesion. This was located on the distal interproximal surface.

Antemortem tooth loss

There were no identified instances of antemortem tooth loss from this site.

Dental Wear

Dental wear was scored for all teeth; all teeth were isolated and so analysis of differences in wear based on sex cannot be examined (Table 45). Sample sizes by side are too small to analyze by side as well.

Table 45. Kalavasos Mangia, *summary of dental wear by sex and number of teeth.*

	URM3		**URM2**		**URM1**		**URP4**		**URP3**		**URC**		**URI2**		**URI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.											6	1.50	2	2.00	4	2.75
	ULI1		**ULI2**		**ULC**		**ULP3**		**ULP4**		**ULM1**		**ULM2**		**ULM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.	7	4.28	1	3.00												
	LLM3		**LLM2**		**LLM1**		**LLP4**		**LLP3**		**LLC**		**LLI2**		**LLI1**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.	2	12.00	2	16.00	3	12.67	1	3.00	1	2.00	4	5.75	2	1.67	3	4.67
	LRI1		**LRI2**		**LRC**		**LRP3**		**LRP4**		**LRM1**		**LRM2**		**LRM3**	
	N	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**	**N**	**wear**
Indet.	5	4.20	6	2.00	9	2.78	3	2.33	3	2.67	4	15.25	3	20.00	1	15.00

URM3=upper right 3rd molar. URM2=upper right 2nd molar. URM1=upper right 1st molar. URP4=upper right 4th premolar.
URP3=upper right 3rd premolar. URC=upper right canine. URI2=upper right 2nd incisor. URI1=upper right 1st incisor.
ULM3=upper left 3rd molar. ULM2=upper left 2nd molar. ULM1=upper left 1st molar. ULP4=upper left 4th premolar.
ULP3=upper left 3rd premolar. ULC=upper left canine. ULI2=upper left 2nd incisor. ULI1=upper left 1st incisor.
LRM3=upper right 3rd molar. LRM2=upper right 2nd molar. LRM1=upper right 1st molar. LRP4=upper right 4th premolar.
LRP3=upper right 3rd premolar. LRC=upper right canine. LRI2=upper right 2nd incisor. LRI1=upper right 1st incisor.
LLM3=upper left 3rd molar. LLM2=upper left 2nd molar. LLM1=upper left 1st molar. LLP4=upper left 4th premolar.
LLP3=upper left 3rd premolar. LLC=upper left canine. LLI2=upper left 2nd incisor. LLI1=upper left 1st incisor.

Pathology

Cranial Pathology

Cribra orbitalia

Though fragments were scored for cribra orbitalia, there were no cases where it could be identified (Table 46).

Table 46. Kalavasos Mangia*, summary of cribra orbitalia by age, sex scoring, and degree of expression.*

		Left				Right			
		CO NS	No CO	CO Unhealed	CO Healed	CO NS	No CO	CO Unhealed	CO Healed
Subadult	NA					1			
Preterm	NA	1	2						
Perinate	NA	1	1						
Adolescent+	Female	1					1		
Adult	Female		1				1		
	Indeterminate	2				2			

CO NS=cribra orbitalia not scorable
No CO=cribra orbitalia not present

Porotic hyperostosis

All identifiable fragments were scored for porotic hyperostosis. The perinatal and preterm remains listed in Table 47 are discussed below; this porotic hyperostosis likely related to a systemic disease and not a sign of general stress. As with other sites discussed here, adults exhibited healed reactions (Figure 54), while subadults (when scorable) exhibited unhealed remains.

Figure 54. *Kalavasos* Mangia, *Fragment KM.T.6.SK2.1, healed porotic hyperostosis on the right parietal of an adult.*

Postcranial Pathology

Both upper and lower limbs were examined for pathological changes (Tables 47 and 48). Perinatal remains listed in the tables are discussed below; these periosteal reactions are likely related to a more systemic disease and not indicators of general stress.

Table 47. Kalavasos Mangia, *summary of porotic hyperostosis by age, scoring, healing and expression..*

		PH NS	No PH	PH		
				Unhealed	Healing	Healed
Preterm	NA	1		1 E		
Perinate	NA	1		1 E		
Infant	NA			1 E		
Adolescent+	Female	1				
	Indeterminate	2				
Subadult	NA		1			
Adult	Female					1 Mo
	Indeterminate	1				1 Mi, 1 Mo

PH NS=porotic hyperostosis not scorable
No PH=porotic hyperostosis not present
Mi=minimal expression
Mo=moderate expression
E=extensive expression

Table 48. Kalavasos Mangia, *summary of pathological recording by element, age at death, and sex.*

Element	**Age**	**Sex**	**N No path**	**N path NS**	**N path**
Humerus	Perinate	NA			**2**
	Child	NA	1		
	Adult	Female	3		
		Indeterminate	5	2	
Radius	Perinate	NA		1	
	Child	NA			1
	Subadult	NA	1		
	Adolescent+	Indeterminate	1		
	Adult	Female		1	
		Male	1		
		Indeterminate	5	2	
Ulna	Perinate	NA	1	2	1
	Adult	Female	1	1	
		Male	1		
		Indeterminate		1	2
Femur	Perinate	NA	1	3	
	Subadult	NA	1		
	Child	NA	1	1	
	Adult	Female		2	
		Indeterminate		2	
Tibia	Perinate	NA			1
	Child	NA	1		
	Adult	Female		1	1
		Indeterminate		2	4
Fibula	Child	NA	1	1	
	Adult	Female		2	2
		Indeterminate		2	2

Table 49. Kalavasos Mangia*, summary of pathological changes by element, age at death, sex, and degree of healing.*

Element	Age	Sex	Degree of Healing	Minimal	Moderate	Extensive
Humerus	Perinate	NA	Unhealed		1	1
Radius	Child	NA	Unhealed		1	1
Ulna	Perinate	NA	Unhealed		1	1
	Adult	Indeterminate	Healed	2		
Tibia	Perinate	NA	Unhealed			1
	Adult	Female	Healed		1	
		Indeterminate	Healed		4	
Fibula	Adult	Female	Healed		2	
		Indeterminate	Healed		2	

Possible Perinatal Scurvy

The perinatal elements from Tomb 7 exhibited extensive unhealed periosteal reactions. These are likely all from the same individual; if this is the case, this perinate was suffering from systemic illness (Table 49). The patterning of periosteal deposition on the external surface of the greater wing of the sphenoid and malar (Figure 55) as well as the metaphysis long bones suggests infantile (Brickley & Ives, 2006; Ortner & Ericksen, 1997) or perinatal scurvy (Osterholtz, Bethard, et al., 2014). While there was no visible cribra orbitalia, Ortner, Butler, Carafella, and Milligan (2001) note that this is always present with scurvy. The pathignomic lesions on the sphenoid they discus are present in this case, and so the tentative identification of scurvy is likely. The presence of perinatal scurvy suggests that maternal health was suffering; the mother was unable to pass along sufficient vitamin C to the fetus, leading to the pathological changes and early death.

Figure 55. *Kalavasos* Mangia, *Fragment KM.T.7.192, left perinatal malar showing significant periosteal deposition consistent with scurvy.*

Traumatic Injury

Cranial Trauma

Only one individual from Kalavasos *Mangia* exhibits cranial trauma. A cranial fragment from an adult of indeterminate sex exhibits two distinct CDFs, both on the left posterior parietal. The superior CDF is roughly lozenge shaped with the lateral end significantly thicker than the medial end; this is completely surrounded by healed porotic hyperostosis, with porosity on the floor of the CDF as well. The inferior one is roughly circular, also with some healed woven bone deposition on the floor of the lesion. Both lesions appear healed (Figure 56).

Figure 56. *Kalavasos* Mangia, *Fragment KM.T.7.1, two healed CDFs on posterior parietal (indicated by arrows). Also note healed porotic hyperostosis.*

Postcranial Trauma

Only one instance of postcranial trauma was found. A right patella from an adult has an osteochondral fracture on the medial articular surface with nodule formation on the inferior surface.

Mortuary Patterning

All of the tombs at Kalavasos *Mangia* were heavily disturbed by the digging of irrigation trenches as well as the village road.

Tomb 5 is roughly circular, measuring 2.95 × 2.8 m. A bench surrounds the majority of the tomb. Most human remains from Tomb 5 came from screening the dump from construction, so it is impossible to know how the bodies were laid in the tomb. The present analysis identified an MNI of 1 (the highly fragmented nature of the remains made reanalysis very difficult), but due to the unscientific excavation techniques, this is less than helpful in reconstructing behavior. Pottery and metal artifacts were found both on the bench and in the center of the tomb. These included a Mycenaean bowl and some local ceramics (McClellan, Russel, & Todd, 1988).

Tomb 6 measures approximately 1.26 × 1.22 m. There is no visible bench in this tomb. Modern construction damage makes interpretation of the tomb relatively difficult, but it is likely that the dromos was entered from the east side (McClellan et al., 1988). The present analysis includes a single adult of indeterminate sex, though the report details the presence of multiple individuals. These were too fragmented to be scored on the present MNI, and a minimum of 1 individual plus dentition was recorded for this tomb.

Grave goods included an Egyptian blue bead, a cylinder seal, a stone mortar and pestle, as well as both local and nonlocal ceramics.

Tomb 7 shows signs of severe disturbance both in antiquity and due to modern construction. Brass and ceramic remains were both found within this tomb (McClellan et al., 1988). This tomb contains the largest number of individuals, according to the current analysis (n=8).

Tomb 8 shows signs of mechanical damage as well as years of water-laid deposits. Excavation was limited but few artifacts were recovered from the tomb (McClellan et al., 1988). These included some ceramic sherds as well as the human remains with an MNI of 3 individuals (based on the current analysis).

Temporal Comparisons

Mortuary Context

The only multiperiod site included in the analysis was the Kalavasos village tombs. The tombs associated with the later ProBA 1 period all contained multiple individuals and burials of subadults with adults. The earlier burials contained both individual interments and multiple burials. This earlier period also contained both subadults and adults within them. That the later burials contain multiple individuals may be the beginning of a pattern that becomes clear with the burials at Kalavasos *Ayios Dhimitrios*, Kalavasos *Mangia*, and Hala Sultan Tekke. All of these later periods (ProBA 2 and ProBA 3) contain multiple individuals and have both adults and subadults within them. This argues for the use of the tomb as a lineage-based place of burial, where everyone who is a member of that lineage is included regardless of age at death or sex.

Childhood Stress Indicators: LEH

When all individual teeth are compared, there is a statistically significant difference between the time periods when examined via Kruskal-Wallis test (p=.044). The mean age at stress incident fluctuations, reaching its peak in the PreBA 2 period (ca. 2000-1700 cal BC).

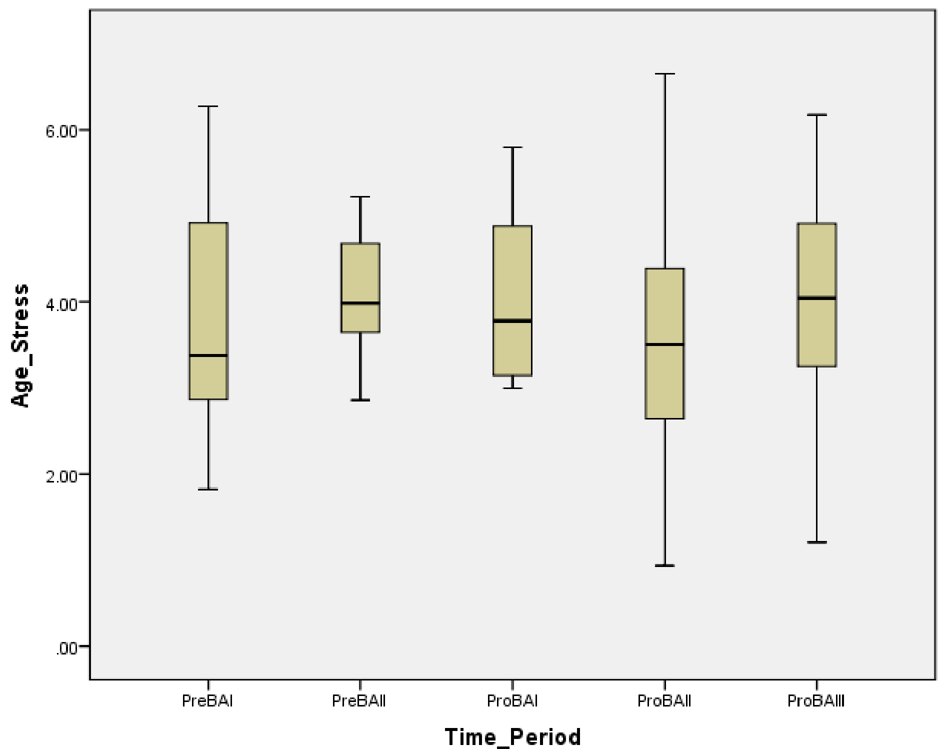


Figure 57. Comparison of Age of stress Incident across Time Periods (all age categories combined)

There are definite temporal trends visible with the frequency of LEHs. There is a general increase in frequency with time, possibly reflecting increased childhood nutritional stress commiserate with intensification of subsistence strategies, whether that be trade based (in the case of Hala Sultan Tekke) or olive oil based (in the case of Kalavasos *Ayios Dhimitrios*). The dip in frequency of the PreBA 2 period is likely due to the poor preservation at Kalavasos village tombs, the site comprising this time period.

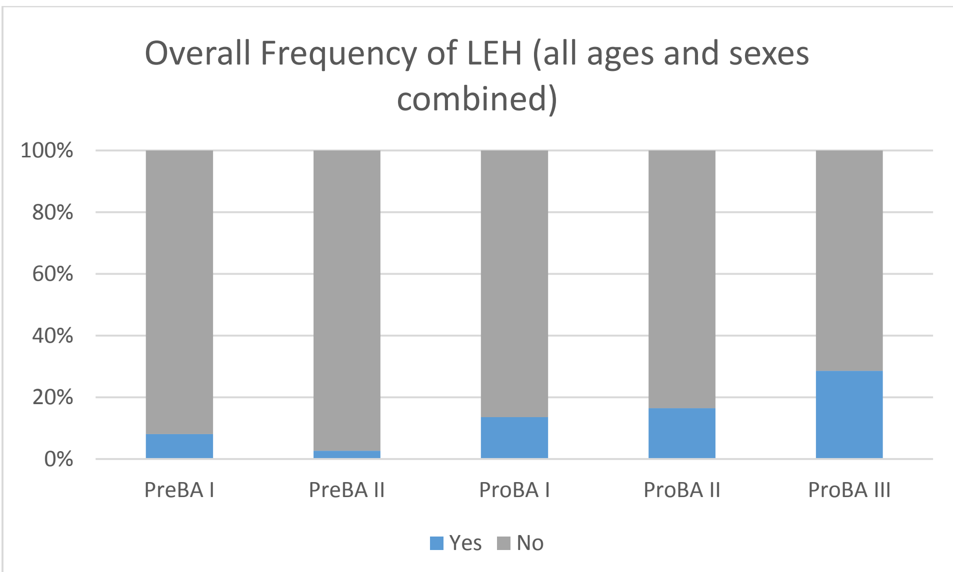


Figure 58. *Stacked column chart showing the change in frequency of LEHs through Time.*

Dental Analysis

Caries

There is no discernible pattern in the frequency of caries at sites through time. The frequency of caries ranges of 0 to 3.58% (Table 50).

Table 50. Overall Caries Frequency by Site.

	N Teeth w/ Caries	Total N Teeth scored	% w/ caries
SK	2	141	1.42%
KVT	11	307	3.58%
EP	0	74	0.00%
KAD	8	258	3.10%
KM	1	74	1.35%
HST	2	76	2.63%

SK=Sotira K*aminoudhia;* KVT=Kalavasos village tombs*;* EP=Episkopi *Phaneromeni;* KAD=Kalavasos *Ayios Dhimitrios;* KM=Kalavasos *Mangia;* HST=Hala Sultan Tekke.

Antemortem tooth loss

The majority of individuals exhibiting antemortem tooth loss are female. Of the remains available for study (a very small sample as only the jaws were available for study), only 2 of the 8 individuals where this could be positively scored were male. These dated to the ProBA 3 period. All the previous periods had only female remains with antemortem tooth loss. While this may represent a distinct and real change, either temporal or regional, it is more likely an artifact of the small sample size.

Dental Wear

The general pattern of tooth wear is difficult to identify due to poor preservation and a lack of any statically significant differences when sites were compared either temporally or regionally.

Kruskal-Wallis tests were conducted for each tooth to compare across time periods. For these tests, all the teeth were treated as indeterminate for sex, to increase the sample size. This is justified also by the fact that statistical tests were run comparing sex across the sites and across time periods and there were no statistically significant differences. The only tooth that yielded a significant result was the wear of the URI1, with a p-value of .026. The sample sizes are small (Episkopi *Phaneromeni*=1, Kalavasos *Ayios Dhimitrios* =9, Kalavasos *Mangia* =4, Kalavasos village tombs =8, and Sotira *Kaminoudhia*=2). HST was not included in this analysis as there were no identified URI1s from this site.

When examining the boxplot below (Figure 59), heavier wear occurs in earlier periods. This could indicate that the anterior dentition was more heavily used in this time period, or may essentially be a false positive. Given that no other dentition had significantly different patterns in dental wear, and the small sample sizes, the latter seems more likely.

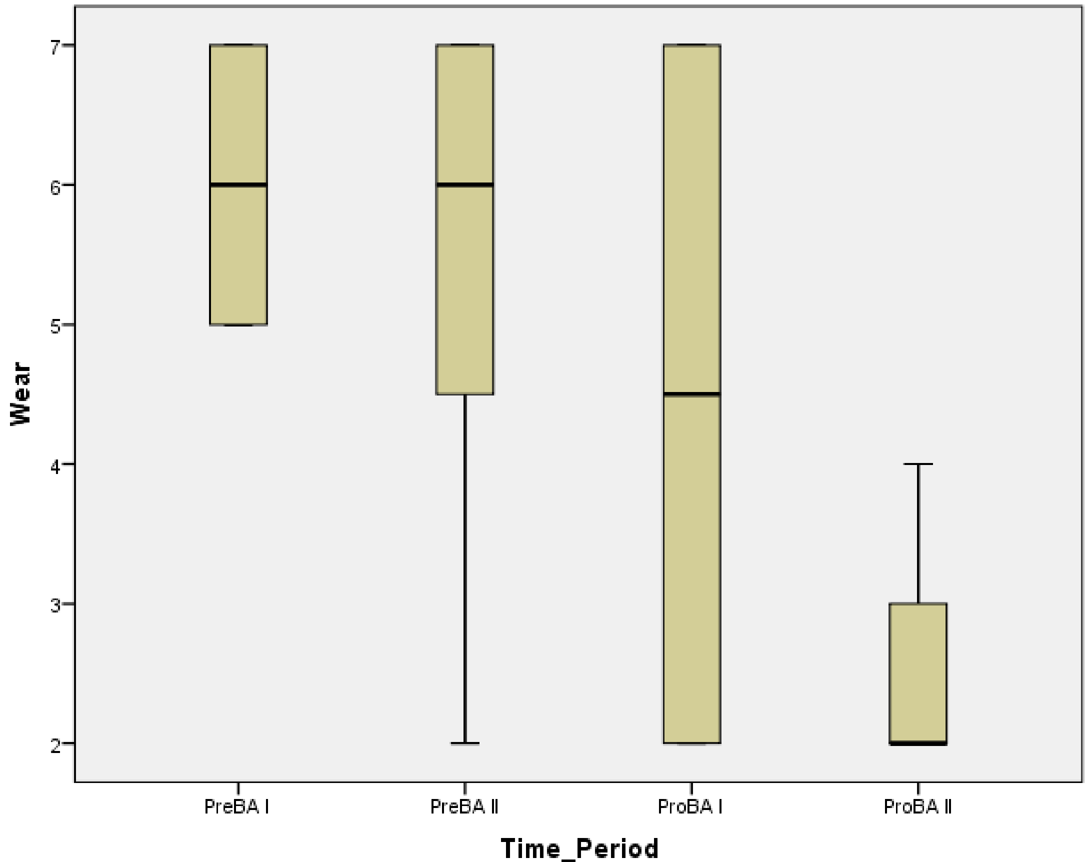


Figure 59. *Comparison of permanent upper right central incisor wear by time period.*

Several sites exhibit either notching of the anterior dentition or increased distal wear on the anterior dentition. These sites are spread through time and so the extramasticatory tooth use that this patterning indicates is likely varied. Multiple activities could lead to the same notching or tooth wear, so it is difficult to discuss patterns without more systematic data regarding age and sex. As Hillson notes, "In pre-industrial societies, heavy loads may well also have been imposed by their use of teeth as tools for craft work and food preparation… It is not clear what effect these additional factors have on either wear or jaw remodeling"(1996, p. 117). Also, recovery of the teeth is incomplete, and many teeth were recovered loose, so it is difficult to examine differential use by side. The case of the remains from Op H23D at Sotira *Kaminoudhia* illustrative of the difficulties inherent in such an analysis. This individual can be identified as a female based on cranial indicators. The dental wear associated with extramasticatory use is limited to the right incisors. In this case, the left can be scored as well, allowing for the identification of asymmetric tooth wear.

Pathology

Cranial Pathology

Regardless of time period or site, there is a general pattern present when examining the cranial pathology. In general (with the exception of a single adolescent that was likely an older adolescent), when subadults presented pathological changes, either cribra orbitalia or porotic hyperostosis, it was either unhealed or in a healing phase, indicating that they were actively fighting off infection or under stress at the time of death. Adults, on the other hand, exhibited only healed cribra orbitalia regardless of the degree of expression of the lesion. Whether it was extensive or mild, it was healed. This suggests that the stresses leading to cribra orbitalia were more common in childhood, and that the adults exhibiting cribra orbitalia had survived those stresses or infections. Porotic hyperostosis, due to its multiple etiologies (including localized scalp infection) is more difficult to interpret, but also follows the same general pattern. Most of the time adults exhibited either healing or healed lesions, while the subadults exhibited only unhealed and healing lesions for the most part. Without more complete crania, determining the nature of the lesion is far more difficult. Examining expression cannot be completed in the same way for a fragment the size of a quarter as it can for a complete cranium.

Postcranial Pathology

There does not appear to be any temporal patterning with the data relating to periosteal reactions on the long bones. Both adults and subadults are susceptible to these reactions, suggesting multiple etiologies for the lesions.

Other pathologies

There are at least two instances of possible perinatal and/or infantile scurvy, one from Kalavasos *Ayios Dhimitrios* and the other from Kalavasos *Mangia*. Both of these are ProBA 2 sites. These were the youngest individuals examined in this analysis, and the only perinates in any of the samples. This is suggestive of some degree of maternal insufficiency during pregnancy or very early postnatal life. While little can be stated about a sample of two individuals, it is worth noting that all of the perinatal remains examined showed these pathological changes. Without a larger sample size, it is difficult to assert more; a larger sample (perhaps perinatal individuals will be uncovered during forthcoming excavations at Kalavasos *Ayios Dhimitrios*) will hopefully help to illuminate this issue.

Entheses

Upper Limb

PreBA 1 samples come from both the Kalavasos village tombs and Sotira *Kaminoudhia*. The pectoralis, triceps brachii and biceps brachii were all comparable (there were no observations from Kalavasos village tombs for the other variables); there were no statistically significant differences in these markers. There were no side differences either.

The PreBA 2 remains are all from the Kalavasos village tombs, but the Kalavasos village tombs is the only multiperiod site in the analysis. Results from Kalavasos village tombs relating to the PreBA were completely insignificant for sex differences with indeterminates removed. When the indeterminates were included in the analysis (since there were no sex differences), there is a statistically significant difference in development of the brachioradialis marker, with a p-value of .018. The right side in this sample is significantly more developed than the left (Figure 60). This closely mirrors the intrasite comparison, and since all samples from the PreBA 2 are derived from the Kalavasos village tombs, this is not surprising.

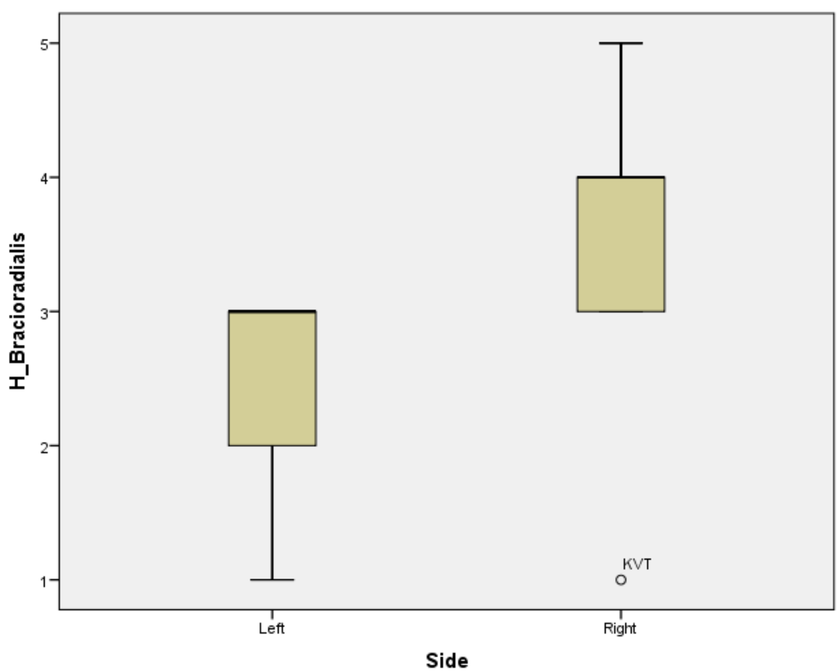


Figure 60. *PreBA 2, bracioradialis development by side (sexes combined).*

Small sample sizes preclude examination of sex differences during the ProBA 1 period. When the indeterminates are added to the analysis, there are no significant differences by side or site.

ProBA 2 consists of two sites: Kalavasos *Ayios Dhimitrios*, and Kalavasos *Mangia*. The indeterminates were removed from analysis for examination of sex differences. There were no statistically significant differences for this period. When the indeterminates are included in the analysis, there are no significant differences for side or site for this time differences.

Lower Limb

There are no remains from the PreBA 1 that can be examined for this analysis.

As with the upper limb, the PreBA 2 period is made up of elements derived solely from the Kalavasos village tombs. For the analysis of side differences, the indeterminates were included. There is a statistically significant difference in development of the iliopsoas marker for this time period, but as Figure 61 shows, this is likely due to a lack of observations for the right side. Only one observation was available for this side.

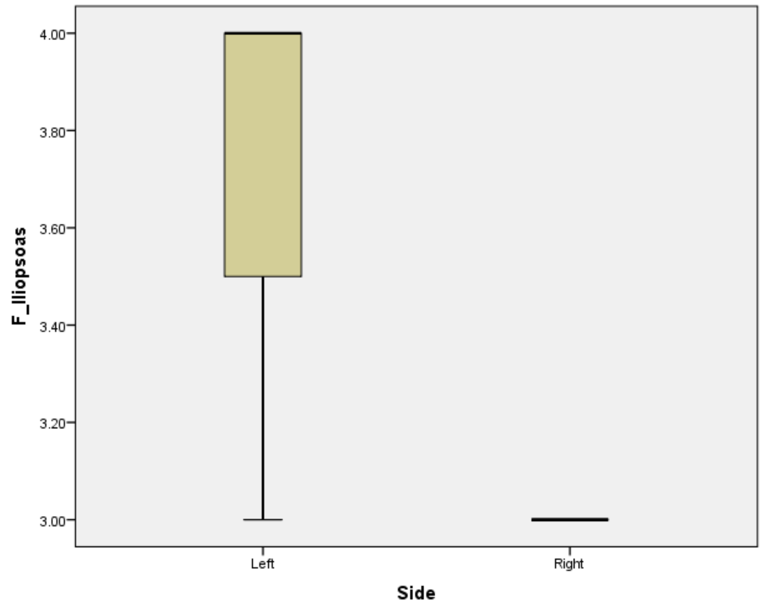


Figure 61. *PreBA 2, development of the iliopsoas by side (sexes combined).*

ProBA 1 is represented by a single burial from the Kalavasos village tombs and all the remains from Episkopi *Phaneromeni*. Because of this asymmetry, there are no comparisons of sites within the time period. There are also no statistically significant differences by side for this period.

ProBA 3 consists only of remains from Hala Sultan Tekke. There are no statistically significant differences in the development of markers by side.

Traumatic Injury

Cranial Trauma

All cranial depression fractures are listed in Table 51. Kruskal-Wallis tests were conducted to test for differences in area or depth of lesion by site, time period, sex, or location of the lesions. Likely at least partially due to small and skewed sample sizes, there were no statistically significant differences present.

Table 51. Summary of Cranial Depression Fractures by Site, Time Period, Sex, location of lesion, Area of lesion, and depth of lesion.

Site	Time Period	Sex	Location	Area	Depth
SK	PreBA 1	Female	Frontal	69.8358	0.83
SK	PreBA 1	Female	Frontal	18.7144	0.77
KVT	PreBA 2	Female	Parietal	56.37	1.07
KVT	PreBA 2	Female	Parietal	34.33	0.39
KVT	PreBA 2	Indeterminate	Parietal	59.27	0.54
KVT	PreBA 2	Indeterminate	Frontal	7.99	0.6
KVT	PreBA 2	Male	Frontal	210.08	0.41
			Parietal	6.71	0.58
KVT	PreBA 2	Male	Frontal	41.14	2.15
KVT	PreBA 2	Male	Frontal	25.72	0.58
KVT	ProBA 1	Female	Frontal	49.93	0.38
EP	ProBA 1	Male	Parietal	15.5805	0.72
KAD	ProBA 2	Female	Frontal	131.0904	0.4
			Frontal	2.8896	0.39
KM	ProBA 2	Indeterminate	Parietal	106.0836	0.48
			Parietal	29.3553	0.35
KAD	ProBA 2	Male	Occipital	10.948	1.5
HST	ProBA 3	Indeterminate	Frontal	3.96	0.25
HST	ProBA 3	Male	Frontal	0.44	0.26

SK=Sotira K*aminoudhia;* KVT=Kalavasos village tombs*;* EP=Episkopi *Phaneromeni;* KAD=Kalavasos *Ayios Dhimitrios;* KM=Kalavasos *Mangia;* HST=Hala Sultan Tekke.

Examination of the boxplots below show the overall distribution by time period. There is a general decrease in the area (Figure 62) and depth (Figure 63) of lesion through time, with the smallest and shallowest lesions occurring on remains associated with the ProBA 3 period. If violence were more prevalent in later periods, when Steel (2004) asserts that new social groups were defining themselves partially through armament and access to military equipment, this decrease in size could mean that individuals in this time period were more protected (through helmets) from interpersonal violence. The decrease in size could also be a result of small sample sizes. If there is no significant difference in lesion size, one of two hypotheses must be supported. Either weaponry and military equipment were not placed in burials in earlier periods or they did not exist in sufficient numbers and the placement of military artifacts in later period burials is indicative of a more ceremonial purpose.

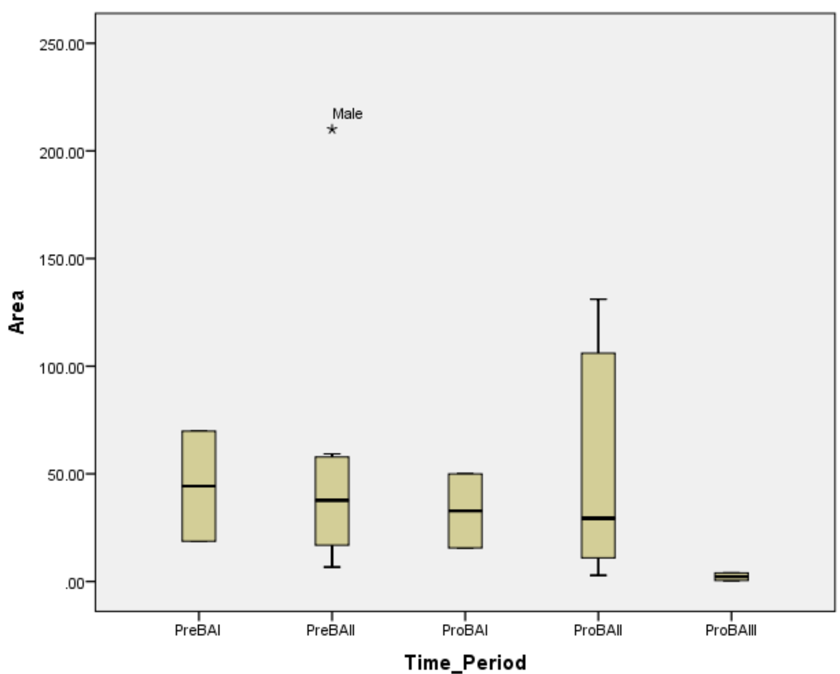


Figure 62. *Comparison of CDF lesion area by time period.*

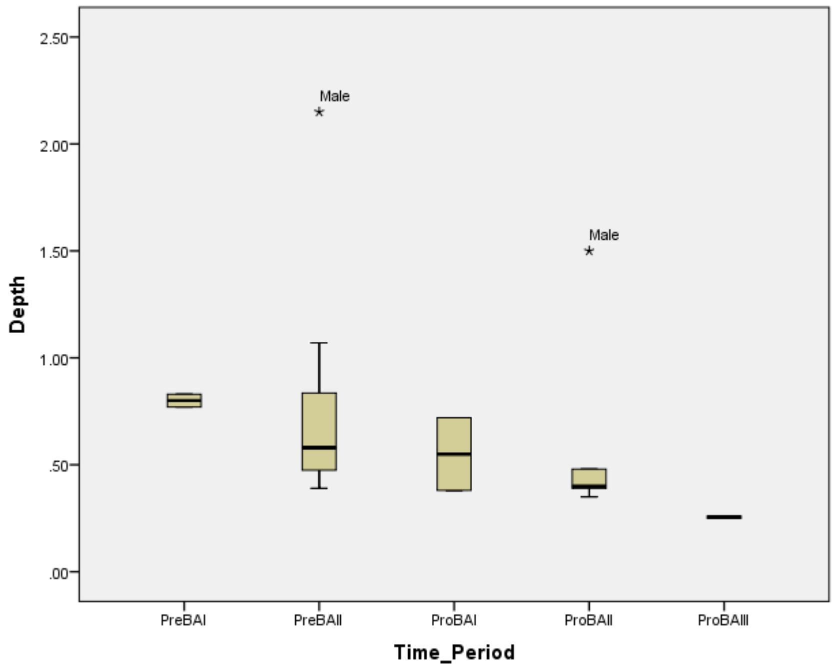


Figure 63. *Comparison of CDF lesion depth by time period.*

Since there was no statistically significant difference in lesion size by time period, the time periods were pooled to increase the sample size for comparison of lesion size by sex. For this analysis, the lesions occurring on individuals of indeterminate sex were excluded. In general, CDFs occurring on females had more variation and a greater mean than the males (Figure 64). The largest CDF occurs on a male from the PreBA 2 period, though.

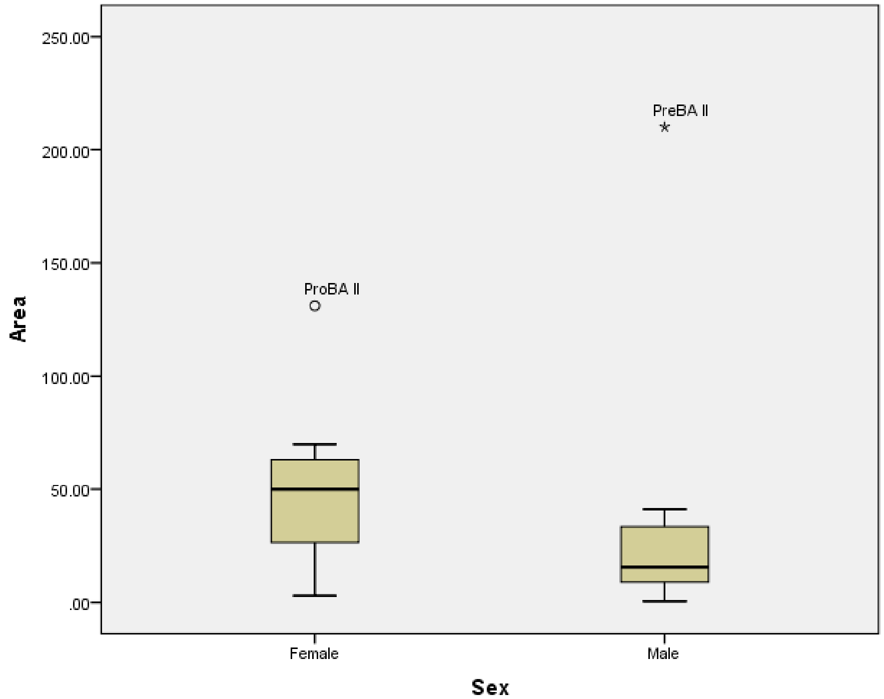


Figure 64. *Comparison of CDF lesion size by sex (all time periods combined).*

These data show a pattern of interpersonal violence present on Cyprus from the PreBA 1 onward. There is no increase in lesions resulting from interpersonal violence, as all the cranial depression fractures recorded were above the hat brim line and therefore more likely to be caused by interpersonal violence as opposed to accident. Steel interprets the inclusion of military artifacts in ProBA 3 period tombs as indicative of an emerging warrior elite (2004, p. 154). She also associates the burial of horses with this emerging result; a horse burial was recovered from Hala Sultan Tekke in addition to the human remains (Karageorghis, 1976). Unfortunately, the sample size from this time period is simply too small to contribute very much to this discussion.

Sources are silent on the presence of trauma before this time period. Chirikotia (a ceramic Neolithic site) is noted to have a wall that may have been defensive in nature (Knapp, 2013). Very few weapons have been recovered from tombs from early periods, and these may have been ritualistic in nature. Although a thorough literature search was completed, there were no mentions of cranial trauma or discussions of interpersonal violence in early periods. This has simply not been an area where aggregated data regarding trauma has been used in any way. This study shows that interpersonal trauma was present from the PreBA 1 period onward, with both males and females subject to violence, and that social changes occurring with agriculture continued to lead to violence to both males and females.

One serious limitation of these data is that frequency data are not useful. CDFs were scored on fragments as well as whole crania, and so it is difficult to determine what a true frequency rate of trauma would be. These data are presented solely to show that interpersonal violence occurred at all time periods and that both sexes were subject to violent interactions.

Regional Comparisons

Mortuary Context

The Vasilikos valley has two sites associated with the ProBA 2 period: Kalavasos *Ayios Dhimitrios* and Kalavasos *Mangia*. The tombs at Kalavasos *Mangia* were more heavily impacted by modern construction, but the quality of grave goods is roughly the same at both sites. Mycenaen vessels are comparatively more common at Kalavasos *Mangia* than at the contemporaneous tombs at Kalavasos *Ayios Dhimitrios* (McClellan et al., 1988).

Childhood Stress Indicators: LEH

Based on comparisons of the sites (keeping time period in mind), there do appear to be regional differences in these data. During the PreBA 1 and PreBA 2 periods, the sites are more consistent with each other. This begins to change by the ProBA 2 period, when regional patterns begin to become evident.

Within the Vasilikos valley itself, the Kalavasos village tombs age at first insult is similar to that seen at Episkopi *Phaneromeni*, perhaps indicating more consistency in weaning age between regions during the early and middle bronze ages (PreBA 2 and 2). The ProBA 1 period represents a transitional period, with mean age of stress incident in between that of the PreBA 2 and ProBA 2 periods. By the time of the ProBA 2 period, however, the Vasilikos Valley presents a different pattern (Figure 65). Mean age of insult at Kalavasos *Ayios Dhimitrios* and Kalavasos *Mangia* are lower than that seen at Hala Sultan Tekke.

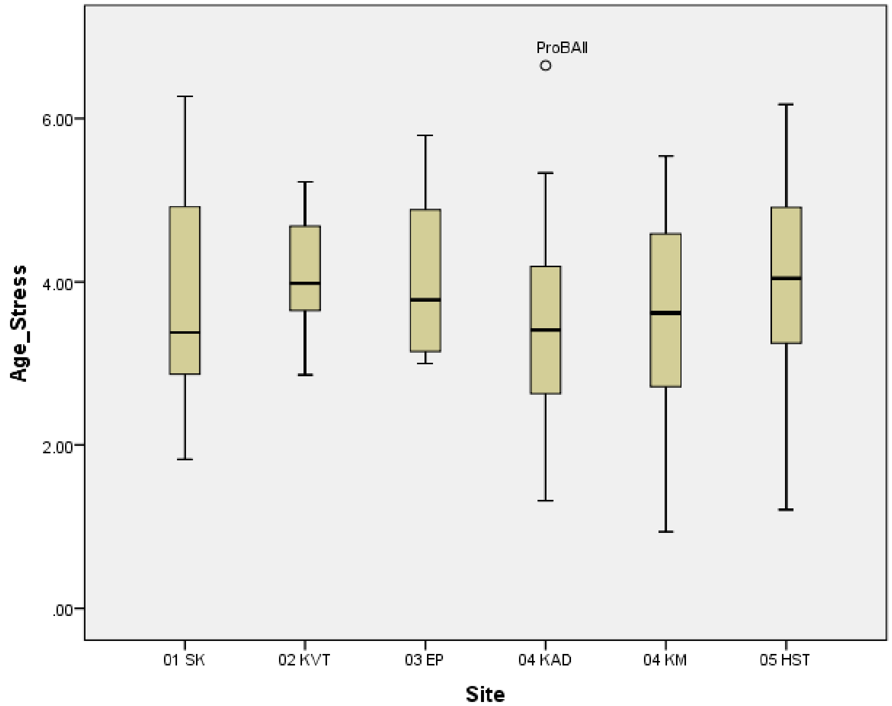


Figure 65. *Comparison of age of stress incident by site (ordered by time period). SK=Sotira Kaminoudhia;KVT=Kalavasos village tombs; EP=Episkopi Phaneromeni; KAD=Kalavasos Ayios Dhimitrios; KM=Kalavasos Mangia; HST=Hala Sultan Tekke.*

Dental Wear

Statistical analysis for each tooth was done comparing all the sites against each other to look for regional patterning. Of these, only the permanent upper right central incisor yielded any statistically significant differences. Kruskal-Wallis tests were conducted due to the small and asymmetrical samples (Episkopi *Phaneromeni* =1, Kalavasos *Ayios Dhimitrios* =9, Kalavasos *Mangia* =4, Kalavasos village tombs=8, SK=2). When the boxplot showing these results is examined (Figure 66), it is clear that the Kalavasos village tombs and Sotira *Kaminhoudia* exhibit far higher wear scores than any other site. These are the Pre-BA sites, dating to between 2400—1700 BC. While this may seem to indicate heavier wear in this earlier period, it should be noted that none of the other teeth had statistically significant results, and so this may not be indicative of more than the heavier wear of some individuals from those sites skewing the data.

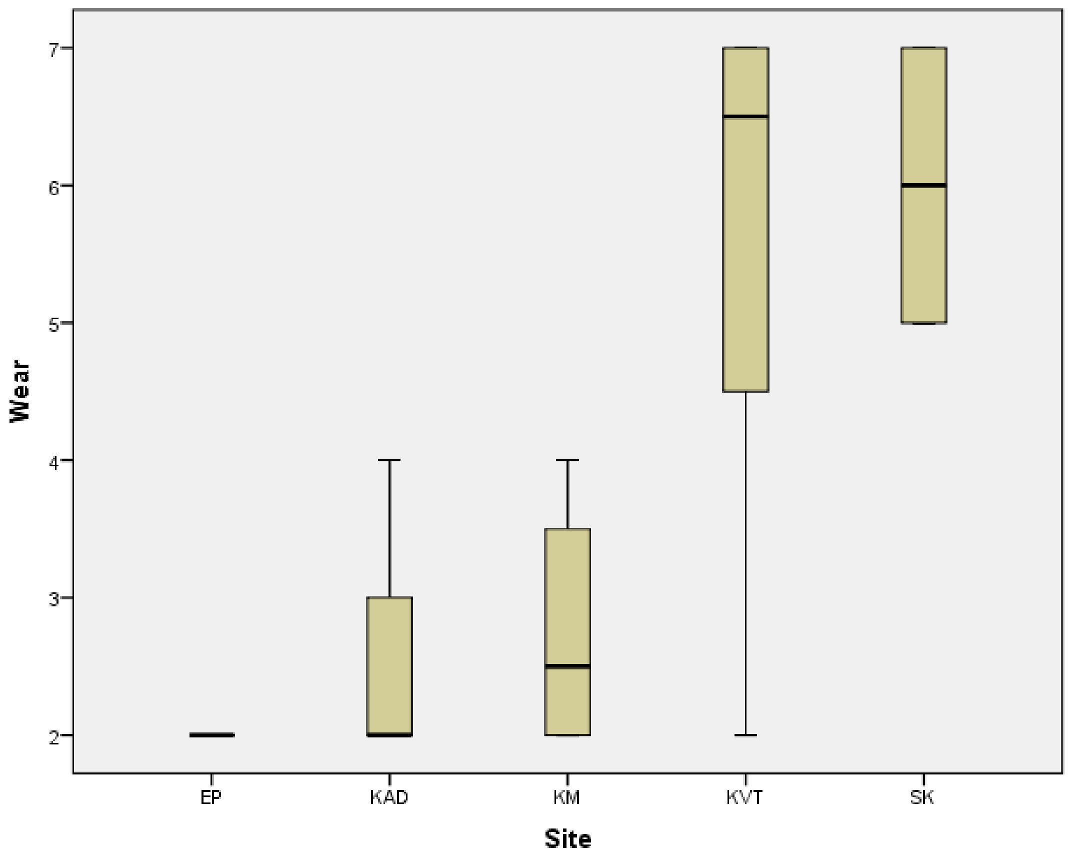


Figure 66. *Comparison of URI1 wear by site. SK=Sotira Kaminoudhia;KVT=Kalavasos village tombs; EP=Episkopi Phaneromeni; KAD=Kalavasos Ayios Dhimitrios; KM=Kalavasos Mangia; HST=Hala Sultan Tekke.*

Pathology

Very few regional differences can be identified with the pathological data. Kalavasos *Mangia* seems to have more severe reactions and fewer minimal reactions than

Kalavasos *Ayios Dhimitrios*, though they are contemporaneous and within the same valley. This is likely due to the preservation of the samples. Also, Kalavasos *Mangia* is skewed towards younger individuals. Subadults seem to exhibit more severe reactions than the adults regardless of time period. This is likely a preservation bias, though. When pathology could be scored for subadults, it tended to be on more complete elements where the expression could be more accurately determined. It is likely that the expression of at least some of the periosteal reactions in adult fragments is more widespread than the fragmentary nature of the data will allow for.

Entheses

Intersite comparisons were run to look for regional patterning, but there were no statistically significant differences in robusticity by site.

Traumatic Injury

Traumatic injury shows no visible regional patterning, though the samples are too small to submit to statistical testing. CDFs in males occur on the frontals, parietals, and occipital; in females they are limited to the frontal and parietals. All occur above the hat brim, indicating they probably resulted from interpersonal violence.

Summary of Results

Given the length of this chapter, it is worthwhile to highlight several aspects of the results. First, there are multiple instances of trauma within the individual sites. Generally, trauma to females tends to occur on the frontal bones, though some cranial depression fractures occur on the superior portion of the cranial vault. Trauma patterns on males are more evenly split between the superior cranial vault and frontal bones. This may indicate that males and females were subject to different patterns of violent interaction.

Trauma was not limited to the crania. A left tibia from Op H24A at Sotira *Kaminoudhia* has signs of a healed fracture to the proximal tibia (Figure 10). An adult female from Tomb 25D at Episkopi *Phaneromeni* exhibits two distinct traumas. The left humerus has a reorganized shoulder joint due to an improperly set fracture of the humeral neck. The second trauma is to the right hip joint. Trauma led to reorganization of both the acetabulum and femoral head (Figure 16, Figure 17) leading to an altered gait.

There are two cases of possible perinatal scurvy. The first is from Kalavasos *Ayios Dhimitrios*. This is in an individual aged between birth and 2 months at death (Figure 48). The second is from Tomb 7 at Kalavasos *Mangia* (Figure 55). This individual was aged between birth and six months at death. The young age at death suggests that the dietary insufficiency is likely reflective of maternal insufficiency, as the infants would most likely have been breastfeeding at this young age. One additional fragment of infant frontal from Hala Sultan Tekke also exhibited increased vascularization, which has been associated with scurvy (Figure 20), but this individual is too fragmentary and lacking any pathignomic indicators of scurvy.

Chapter 5. Discussion and Conclusions

Discussion

Despite the challenges of working with commingled and fragmentary assemblages, there is a great deal of information that can be gleaned from them. They also provide interesting and exciting mechanisms for looking at social cohesion and prompt the reworking and combination of theoretical models. Looking at the body as a material object that can be manipulated both physically and socially is just one aspect. Commingled and fragmentary assemblages, especially on an island like Cyprus with marginal preservation, can often provide an important line of evidence for the examination of migration patterns, identity and the negotiation of social space.

As is clear from Chapter 4, working with commingled and fragmentary collections leads to some serious limitations that should be acknowledged at the forefront of any analysis. First, the estimation of age and sex are far more difficult than when working with whole burials. The estimation of “indeterminate” for sex is far more likely than would be found in single or well-preserved burials. Despite this limitation, data such as dental defects and entheses can be used to talk generally about population trends, change through time, and identity. Given how common commingled and fragmentary assemblages are throughout the world, forgoing analysis of these assemblages because of the limitations they present would mean the conscious exclusion of great amounts of data from our understanding of the past. On Cyprus, in particular, if commingled and fragmentary remains were discounted, the analysis of human remains would be severely limited.

In any analysis of commingled and fragmentary remains, the individual is usually not identifiable, leading to a discussion of population-level health, stress, and materiality. Each element becomes a distinct line of evidence. This was clear with the examination of teeth from the assemblages included in this analysis. For some teeth, especially those where identification was less precise (i.e., a tooth could only be identified as an upper molar) certain variables can still be scored, such as the presence of dental defects reflecting childhood stress, the presence of carious lesions, and the degree of wear. For other analyses, such as the age of onset of stress incidence for dental defects, the tooth had to be identified, and so the sample for these analyses were smaller. Yet both provide different levels of data that when combined allow for the identification of the overall rates of dental defects as well as their timing. This allowed for the identification of changing social practices involving weaning.

Following here are patterns that were identified using multiple lines of evidence. Together, these lines of evidence based on individual skeletal elements elucidate change through time, regional trends, and overall health profiles of the populations.

Anemia and Nutritional health

Nutritional Defeciency, Anemia, and metabolic diseases

In terms of cribra orbitalia, there is a consistent pattern visible regardless of site. Generally, subadults presented with unhealed or healing CO, while adults presented with healed lesions. Providing frequencies for these data are not helpful for two reasons. First, preservation of the bone varied greatly; frequency data, particularly for comparison of intersite variation, would tend to reflect preservation more than pathological processes. Second, for some sites such as Hala Sultan Tekke, it is known that collection was incomplete, particularly for subadults. Without an understanding that collection of the element was complete, frequency data will not be reflective of actual pathological changes. The presence of only healed and healing cribra orbitalia within subadults is indicative of a general stress that occurs in childhood. Those who died younger than about age 12 had not fully healed from this stress, but those who reached this age and older had survived this general stress. Many adults had healed lesions indicating this. The adults who lacked healed lesions may not have been exposed to this stress, but the small and skewed samples make an estimation of what this stress was impossible.

The data regarding porotic hyperostosis is more complex than CO. Adults exhibited both healing and healed lesions. Scoring for subadults was very incomplete with most individuals being either not scorable or having no expression of porotic hyperostosis. Active PH is found in subadult crania though, indicating that they were under significant stress. The fragmentary nature of the remains and the poor preservation overall did not allow for any differential diagnosis, and so the presence of thalassemia could not be either discounted or affirmed (contrary to Angel, 1966, 1978). It should be noted, however, that Angel had access to more complete crania that were better preserved. These remains have since been lost, but are believed to have been subsumed into the teaching collections at the University of Pennsylvania (Harper, pers. com). They were not labeled and have since lost all context.

The two cases of probable perinatal scurvy at Kalavasos *Ayios Dhimitrios* and Kalavasos *Mangia* indicates that maternal health may have suffered. Scurvy is caused by insufficient Vitamin C. Vitamin C cannot by synthesized by the body and so must be obtained through diet. For an individual aged between birth and 2 months, breastfeeding would have been the sole source of nutrition. This indicates that the mother was not able to obtain enough Vitamin C to pass along to her fetus. That both of these individuals were from the same valley at roughly the same time frame may indicate a regional insufficiency or regional dietary restriction imposed upon women during pregnancy. This cannot have been a wide-spread cultural practice or insufficiency or it would have been more prevalent in the burial population. These individuals were buried within the standard burial program, indicating that they were not seen as separate by those who buried them. The presence of two individuals from the same region and time period suggest that there may have been regional differences in subsistence and possibly in dietary restrictions during pregnancy. Further excavations at Kalavasos *Ayios Dhimitrios* may shed more light on this.

No adult remains presented with lesions that appeared to be scorbutic from any of the sites. This appears to be a single instance of maternal insufficiency, not a cultural system. This can be compared to work conducted using a medieval Romanian assemblage of 70 perinates who all presented with differing degrees of scorbutic lesions (Bethard, Osterholtz, Gonciar, & Nyaradi, 2014; Osterholtz, Bethard, et al., 2014). This Romanian sample gave a very different picture of a community where maternal diet was likely restricted by cultural prohibitions, leading to prenatal and perinatal scurvy on a large scale.

Infectious processes, osteoarthritis, and trauma

Limitations of the pathological analysis are significant. It can be stated that periosteal reactions occurred on both males and females and there is no visible patterning in the extent. Both upper and lower limbs are affected, indicating that for some individuals at the very least, systemic infection was present. Subadults exhibited only unhealed and healing periosteal lesions, no matter what site or time period the assemblage comes from. This indicates that these subadults were fighting active infectious processes at the time of death. Adults exhibited unhealed, healing, and healed reactions. Adults who exhibited healed periosteal reactions survived earlier episodes of infection.

Frequency data for these remains are not very informative for several reasons. First, it is likely that quickly deposited woven bone associated with active periosteal reaction is likely to be taphonomically compromised. These assemblages all exhibit a relatively high degree of taphonomic damage, and so elements with this type of reactive bone are less likely to preserve under these circumstances. Second, small nondiagnostic long bone shaft fragments (those that could not be identified to element) were not included in the analysis. This decision was made due to time constraints as well as the large number of fragments that yielded very little other information. Fragmentation tended to co-occur with severe taphonomic damage and havara concretions; these fragments were analytically unhelpful on numerous levels. If fragmentation was significant enough, the potential loss of data regarding periosteal damage may be significant. Finally, havara concretions were present on many of the fragments. This is a concretion of limestone that adheres to the bones, obscuring the appearance of the outer cortex. When attempts were made to remove the havara, the bony cortex was also removed. Very few attempts were made; the decision was made to keep the bones intact in hopes of a future solution that might help dissolve this havara without damage to the bones.

Osteoarthritic changes were not systematically recorded for this analysis. Anecdotal observations were made, but without any way to estimate age and sex for many of the postcranial elements, data relating to the prevalence of osteoarthritis is not contextualized. Osteoarthritis can occur as a secondary process related to altered gait, trauma, or occupational use, or can occur as a normal age-related change. As in most cases, the right and left sides frequently could not be compared, and the analysis of osteoarthritis is not meaningful in a comparative sense. There are numerous examples of osteoarthritis present on the bones (for instance, patellar osteoarthritis including lipping and eburnation was present on the patella from Tomb 5 at Kalavasos *Ayios Dhimitrios*). While it is impossible to contextualize these data, it is important to note that osteoarthritic changes did occur in all populations included in this analysis regardless of time period or site location.

Childhood stress indicators: dental defects

The interpretation of dental data is limited by a few factors, including the commingled and fragmentary nature of the assemblage as described in numerous places in this work. In addition, severe wear can also hamper analysis of dentals. Figure 67 is an example of the type of heavy wear that is present on many of the teeth included in this sample. Essentially, the male exhibited in the figure may have worn through any early LEHs (since teeth form from the incisal edge), thus skewing the data toward older ages of stress incident that occur closer to the cemento-enamel junction.

Figure 67. *HST, T1, Fragment 1.7.1, heavy wear.*

Despite these inherent limitations, age at death patterns were clearly visible, as were inferences regarding regional variability and temporal patterning.

The lower age of stress incident for those individuals who died younger suggests that individuals experiencing significant stress early in life are more prone to additional stress, pathology and have a shortened life expectancy. This concept of “damaged goods” has been noted in other populations (Armelagos, Goodman, Harper, & Blakey, 2009), and so it is not surprising to see this pattern expressed here as well. Unfortunately, the nature of the assemblage precludes comparison of dental defect rates for individuals to rates of porotic hyperostosis or postcranial pathology rates. Younger age at death, however, is certainly suggestive of increased susceptibility to stress (Armelagos et al., 2009).

When the totality of all dental defects are examined, regardless of tooth or time period examined, a pattern emerges. Individuals showing higher numbers of dental defects overall are more likely to have a lower age at first insult. While these data are incomplete, based on incomplete sets of dentition, it is an intriguing pattern. Generally, this can be interpreted as a pattern of increased stress when the initial stress occurred at a younger age. In effect, early stress set an individual up for a life of decreased health status overall. One of the main issues in examining commingled remains is the lack of ability to compare dental defect data with other pathological and stress data, so the presence of dental defects at a younger age than other individuals cannot be compared to the presence of periosteal reaction or growth stunting systematically. While this is a large limitation to the study, the dental defect data are suggestive of exactly such a pattern.

The interval between stress incidents was examined to determine if the interval represented a cycle, possible crop related. This does not appear to be the case, although it is possible. The tooth that had the most dental defects (n=5) exhibited an interval between the first and second stress incident of .69 years, the second and third were separated by 1.23 years, the third and fourth were separated by .9 years, and the fourth and fifth were separated by .7 years. These intervals may represent shortage, but this individual may also have more prone to react to stresses (possibly due to a young age of first stress incident).

When examined by time period, the intervals are more illuminating. There is only one from the PreBA, an individual tooth with stress incidents occurring at 3.97 years, 4.4 years, and 5.22 years. The interval between the first and second incidents is .44 years, and between the second and third .82 years. This could suggest crop failure, but it is unclear given the small sample size. During the ProBA II period, more individuals with multiple incidents occurred at Kalavasos *Mangia* than Kalavasos *Ayios Dhimitrios* (in a ratio of 5:1). Taken together, the interval between first and second stress incident is .95 and between the second and third incidents .98 years. The interval between third and fourth incidents is .71 years. When the individuals from Kalavasos *Mangia* are examined alone, the values are slightly lower, with the S1-S2 interval at .91 years and the S2-S3 interval .89 years (the S3-S4 interval remained at .71 years). The individual from Kalavasos *Ayios Dhimitrios* has slightly higher values than those at Kalavasos *Mangia*, with an S1-S2 interval of 1.14 years and an S2-S3 interval of 1.39 years. If these incidences of stress are indeed related to scarcity, the differences in interval times may indicate different storage strategies. Kalavasos *Ayios Dhimitrios* may have had more storage facilities or been in a position to obtain grain in terms of tribute or in exchange for olive oil (that was the primary industry at Kalavasos *Ayios Dhimitrios*).

The comparison of age at stress incident across time periods may be used to examine approximate weaning age, since this time is known to cause significant stress in the infant or young child. This may be related to large scale social changes that have been noted in the architecture, subsistence, and living patterns for the entire island. This pattern culminates with an average age of first insult of slightly over 4 years of age for Hala Sultan Tekke, an important coastal site and the only site contributing to the ProBA 3 period. This later age of insult may be due to later weaning and increased birth interval between births, but given the incomplete recovery and retention of early excavations, many of which dealt with sites in this period, the relationship between social changes and dental defects are not be clear. Earlier periods exhibit a slightly lower weaning age, consistent with interpretations of decreased interbirth interval co-occuring with intensification of agriculture (Armelagos, Goodman, & Jacobs, 1991) (which was occurring in the PreBA 1 and PreBA 2 periods).

The regional patterning that begins to emerge in the ProBA 2 period (with lower ages of stress incident occurring at the Vasilikos Valley sites compared to Hala Sultan Tekke) may be indicative of different regional strategies related to subsistence. Hala Sultan Tekke was a prominent trading community on the coast with ties to both the Levant and Egypt, while Kalavasos *Ayios Dhimitrios* and Kalavasos *Mangia* were both more inland, and more closely linked to olive oil production, agriculture, and possibly copper manufacture.

Dental Wear

The anterior dentition has been used by multiple researchers to look at extramasticatory tooth use (teeth as tools). This can present as assymetrical wear facets, notching, or wear facets away from the incisive edge. Typical extramasticatory uses include hide or fiber processing, inferred from large lingual facets caused by habitual pulling of the hide or fiber along the surface of the front teeth (Irish & Turner, 1987;

Lukacs & Pastor, 1988; Molnar, 2011; Turner & Machado, 1983) or notching due to pipe use or the habitual holding of sewing needles or awls in the teeth. Grooves and notches may also be the result of processing fiber or sinews. Molnar (2011) cautions against the attribution of extramasticatory use to specific activities unless a clear ethnographic record can be established. One such study was conducted by Berbesque and colleagues (2012). Using dental casts of the Hadza, an extensively studied group of modern hunter-gatherers, they found that wear differences between males and females indicated not only differential uses of the teeth for tools but also dietary differences between the sexes. Wear patterns are complex, and may be reflective of numerous social processes including extramasticatory tooth use, diet, and gendered practices.

The relatively poor state of preservation precluded a systematic recording of the presence and absence of extramasticatory tooth use in the samples included for this research. There are two distinct anecdotal patterns that are present, however. The first is the presence of significant lingual wear on the anterior dentition (described for teeth from the Kalavasos Village Tombs and from EP), and the second is dental notching. Lingual wear is relatively rare in the assemblage and occurs in assemblages dating to the PreBA 2 and ProBA 1 periods. The ProBA period, based on overall dental wear, seems transitional between the relatively lighter wear of the earlier periods and the heavier wear of the later periods. This heavier wear in later periods may be indicative of the industrialization of food production.

This lingual wear pattern suggests that the use of tools was most common before the ProBA 2 period. Drawing conclusions based on three examples, though, is not a sound practice. The presence of this wear pattern, however, hints that teeth were used as tools more extensively in earlier periods.

The second pattern is that of notching of the anterior dentition, seen at both Kalavasos *Ayios Dhimitrios* and Sotira *Kaminhoudia*. Sotira *Kaminhoudia*. is an early site, dating to the PreBA 1 period. Kalavasos *Ayios Dhimitrios* dates to the ProBA 2 period, approximately 800-1000 years later. This large span of time indicates that notching is related to activities that persisted for a very long time.

That all the identified instances of labial wear facets occur in earlier time periods may indicate a shift in the production of hand tools or other subsistence patterns. Berbesque and colleagues found that a good portion of asymetrical wear was caused by working arrows and tightening bow strings by Hadza men (2012), if subsistence methods were to change, so would the ways in which the teeth were used in the manufacture of tools for hunting or farming. Social changes in the PreBA periods on Cyprus included a major transformation in agricultural practices, namely a shift from hoe cultivation to plow agriculture (Knapp, 2013). By the ProBA 1 period, extramasticatory tooth use seems to have changed. The dental record for Kalavasos *Ayios Dhimitrios* is not excellent, but dentition was examined on all surfaces for extramasticatory wear patterns, and only one individual was found to have extramasticatory facets was found. The social changes at the beginning of the ProBA would have caused a shift in both subsistence from a strictly agricultural society to one engaged in a regional sphere of influence. Surpluses in trade and prestige goods such as olive oil and copper would have increased social stratifications (Keswani, 1993), possibly leading to occupational specialization and more variation in the use of teeth as tools. It could be that the burials uncovered for this time period are simply those of individuals/lineages that were engaged in occupations where the teeth were not heavily employed as tools.

Entheses

As was noted in Chapter 4, there are severe limitations to the study of muscle insertions in a commingled and fragmentary assemblage. Without fine control of age (i.e., being able to estimate an individual is a young, middle, or old adult), it is impossible to know if the development of the muscle marker is due to increased use of the muscle or a product of age. The same is true for the estimation of sex, when the majority of individuals are scored as “indeterminate” for sex, a level of analysis is lost. Lumping all age categories together and discounting sex fundamentally dilutes the power of the analysis of muscle markers.

Aside from the issues with age at death estimation and sex, there are some other complicating factors that might account for negative results. The data set is incomplete, with several of the sample sizes falling below 30 observations. This in itself would weaken any statistical relationship. The data set is incomplete due to the fragmentary nature of the assemblage, one of the limitations of working with these assemblages is dealing with incomplete data sets (especially with regard to baseline data). Also, the lack of association could argue for diverse activities undertaken by the entire population that are not capturable with this incomplete data set. The association of groups of entheses that could be examined in full burials (i.e., how the arm and leg muscle use changes) through time cannot be examined with fragmentary and isolated remains such as those that make up this sample. Finally, these may be reflective of a lack of difference in muscle marker development between the sexes and through time. This seems somewhat unlikely, however, given that entheses tend to change with intensification of agriculture or the adaptation of specialized labor (such as the production of olive oil or acting as a middle man in trade) (e.g., Perry, 2004). Recent research has shown that age has a far greater effect than occupation or sex on the development and rugosity of muscle insertions (Cardoso & Henderson, 2013; Henderson, Mariotti, Pany-Kucera, Villotte, & Wilczak, 2013; Villotte & Knüsel, 2013). It is likely that differences in enthesial development visible in the assemblages of this analysis are the result of age at death rather than gendered labor or changes in labor through time.

While noting the limitations of this analysis, some patterns were noted. The remains from the Kalavasos village tombs show increased development of the bracioradlis muscle marker in males. There is a general pattern visible of increased musculature on the right side, as evidenced by the development of the brachioradialis in the PreBA 2.

Traumatic Injury

Both examples of cranial depression fractures from Sotira *Kaminhoudia* were found on adult female skulls. Conclusions regarding increased violence towards women, however, should not be drawn from this sample. The preservation of remains at this site is too marginal; both of the cranial depression fractures in question are relatively deep (and one is quite large), and it is likely that havara concretions obscured other cranial depression fractures. These incidents of cranial trauma, though, does show that such violence existed and was directed (at least in part) towards women. Both of these cranial depression fractures were located above the "hat brim" line, a line that is used in forensic medicine to determine the nature of traumatic injury. Injuries occurring above this line are far more likely to be the result of interpersonal violence, below are more likely to be the result of accidental injury (Guyomarc'h et al., 2010; Kremer et al., 2008).

The large size and location of the CDF on the Room 44 skull from Sotira *Kaminhoudia* suggests interpersonal violence. This is a large wound and would possibly have caused significant behavioral changes for this person (Blackmer & Marshall, 1999). There were no additional traumatic injuries associated with this individual, so this CDF can only be examined as a sole incident. Light dental wear on this individual suggests a young age at death. The fracture is fully healed, though, and given the young age at death, this individual might have been exposed to additional violence later in life (had she not died young) (Caufield, Snghal, Moulto, Brenneman, & Baker, 2004).

The cranial trauma found on the individual in Tomb 51 of the Kalavasos village tombs is interesting. This tomb was believed to have been a soldier due to the presence of a bronze dagger (Pearlman, 1985). The current analysis shows this to be a female, suggesting that either the female within the tomb was a soldier herself or that the dagger was added to her grave assemblage for another reason. She was subjected to trauma to the top of her cranium, above the hat brim. This suggests interpersonal violence as the origin of the fracture. This fracture is similar to other found in the Kalavasos village tomb materials as well as numerous other examples from different time periods presented in this dissertation. While the sample sizes preclude quantitative analysis of the distribution, it is clear from these data that both males and females were subject to violent interactions.

Mortuary Context

There is a general pattern present with regard to the number of individuals within tombs through time. Generally, most tombs from earlier periods have single interments.

This begins to change fundamentally in the ProBA I period. Both sites associated with ProBA I contain multiple tombs with multiple individuals. By the time of ProBA II, multiple interments are more common than single interments. All of the ProBA III tombs available for study indicate the presence of multiple individuals. This may indicate that the use of lineage or family-based tombs was becoming more important. Specifically for sites such as KAD and HST, which can be seen as hubs of administrative power (in the case of KAD, in control of the olive oil distribution throughout the valley and the heavy involvement in trade at HST), the social control over resources may have been at least partially tied to the presence of ancestors near important structures. Both of these tombs also have tombs either in (in the case of KAD) or near administrative structures.

Typically, one of the conservative aspects of a society is mortuary ritual. On Cyprus, during the early parts of the Late Bronze Age, multi-generational tombs are common, which Keswani has argued points to economic or political stability in this time frame (2004), but in the 12th century BCE, shaft graves become more common at sites throughout the island. Tomb re-use is not uncommon in this period either, perhaps indicating that entire dynasties were no longer either politically extant or socially relevant. Keswani believes that the introduction of shaft graves are an indicator of a generally unsettled atmosphere in Cyprus, with displacement of population from ancestral lands or communities (1989). Possibly because of this unsettled nature, grave goods in these shaft tombs are highly variable. Most contain minimal artifacts, usually consisting of a few ceramic vessels, but at least some of these shaft tombs are exceedingly rich. Hala Sultan Tekke Tomb 23 is a prime example, containing fiancé bowls, a wine set, gaming boards, gold pendants, lapis, a silver ring, and a scarab marked with the cartouche of Rameses II. Tomb 2 is another prime example, being the first recognized burial that contained both the remains of humans and horses together on the island. Karagheorghis interprets this as horse sacrifice, something not seen on the island again for approximately 700 years.

Performance and the relationship between the living and the dead

The movement of tombs from outside the community to intramural spaces indicates a change in the role that the dead play in society. The linking of tomb space to administrative centers suggest the dead remained important for the legitimation of power and the formulation and maintenance of social relationships and hierarchies. As noted in Chapter 1, the body can be seen as manipulatable, a form of social currency that can be used both ritually and politically. The interplay of mortuary ritual occurring near administrative structures indicates that performative elements were likely important to the maintenance of social hierarchy. Spectacle and the use of space are believed to have been important for the development of Cypriot identity and social structure (Fisher, 2006, 2007, 2009a, 2009b). The elaborate funerary assemblages visible throughout the Bronze Age on Cyprus are indicative of the importance of funerary ritual as well.

While ritual does not necessitate a performance, the location of the tombs in intramural spaces is suggestive of a performative element. In this view, the body is seen as a material object that can be used and shaped as needed to negotiate power relationships. Through performance surrounding the dead, including the inclusion of additional individuals into existing tomb space or the reuse of tomb space by later lineages as a mechanism for establishing fictive kin or legitimizing a new hierarchy, the body is used to cement and reinforce relationships.

Conclusions

Three general conclusions can be drawn from the data presented within this dissertation. First, there is no statistical difference in any of the identifiable groups examined (age at death, sex, regional, or temporal affiliation) in the presence of general childhood stress as evidenced by dental and osseous lesions. Dentition shows a subtle change in weaning age toward the later periods, but all time periods exhibit similar amounts and degrees of expression of stress in subadults.

Second, there are no visible regional differences in health profiles. All periods show a consistent pattern in osseous indicators of stress. Subadults died while lesions were in an active or healing phase, while adults showed a pattern of healed lesions for postcranial and cranial indicators of stress (cribra orbitalia and porotic hyperostosis). This indicates that juveniles were subject to episodes of stress, and that individuals who survived to adulthood were likely subjected to similar stress.

Third, there are no visible difference in trauma or enthesial development for any of the sites when either the Vasilikos valley is compared to the other sites or through a temporal lens. Enthesial changes are difficult to interpret, and are likely more related to age at death than to occupation (Marco Milella, Giovanna Belcastro, Zollikofer, & Mariotti, 2012; Perréard Lopreno, Alves Cardoso, Assis, Milella, & Speith, 2013). These were included in the analyses strictly to look for changes in pattern, not to assign occupation. The lack of substantial statistically identifiable differences is reflective of similarities between muscle use and/or age structure at the sites. Given the limitations of fine age at death estimates for the majority of the materials precludes strong interpretation of which pattern is present: similar age or similar use of the muscles between the sites and time periods. These data do, however, show consistency across the sites and time periods.

Taken together, these results are consistent with a model of migration and cultural integration throughout the time frame examined. Good's (2008) edited volume looks at the effect of postcolonial social structure in modern settings. This focus allowed for examination of physical and psychological impacts of colonialism through ethnographic research. In the introduction to this work, Good and colleagues (2008, pp. 14-15) argue that any discussion of postcolonial theory must not overlook elements of postcolonial interaction that not overtly stated, "… that which is unspeakable and unspoken, to that which appears at the margins of normal speech and everyday presentations of self, manifest in the Imaginary, in dissociated spaces…" The application of postcolonial theory to archaeological and bioarchaeological studies does exactly this, particularly in societies lacking a written language. Expressions of social hierarchy (or the lack thereof) are expressed in the bones and architecture used to interpret culture change. In the case of Cyprus, we see architectural changes as well as movements of individuals towards the coasts, but we do not see substantial health differences between the two areas. There are some social changes evident, such as the relatively younger age of onset for developmental defects in the teeth during later periods, indicating a change in child-rearing tactics.

The lack of skeletal indicators of social upheaval argues that the integration of individuals and groups from off-island was a relatively smooth transition. Likely, Cypriots were familiar with these groups from generations of trading, and so their movement onto the island that had incorporated elements of their cultures (including religious elements, architectural elements, and trade goods) made for a smooth combination of external and internal to form a uniquely post-colonial Cyprus.

Bibliography

Alock, S. E. (1993). *Graecia Capta: The Landscapes of Roman Greece*. Cambridge: Cambridge University Press.

Ames, K. M. (2001). Slaves, chiefs, and labour ont he northern Northwest Coast. *World Archaeology, 33*(1), 1-17.

Ammerman, A. J., Flourentzos, P., Gabrielli, R., Higham, T., McCartney, C., & Turnbull, T. (2008). Third report on early sites on Cyprus. *Report of the Department of Antiquities Cyprus, 2008*, 1-32.

Angel, J. L. (1966). Porotic Hyperostosis, Anemias, Malarias, and Marshes in the Prehistoric Eastern Mediterranean. *Science, 153*, 760-763.

Angel, J. L. (1972a). Appendix B: Late Bronze Age Cypriotes from Bamboula: The Skeletal Remains. In J. L. Benson (Ed.), *Bamboula at Kourion: The Necropolis and the Finds*. Philadelphia: University Museum, University of Pennsylvania Press.

Angel, J. L. (1972b). Genetic and Social Factors in a Cypriote Village. *Human Biology, 44*, 53-79.

Angel, J. L. (1978). Porotic Hyperostosis in the Eastern Mediterranean. *Medical College of Virginia Quarterly, 14*, 10-16.

Antonaccio, C. M. (1995). *An Archaeology of Ancestors*. Lanham: Rowman and Littlefield.

Anwar, N. H. (2014). The postcolonial city in South Asia. *Singapore Journal of Tropical Geography, 35*(1), 22-38. doi: 10.1111/sjtg.12048

Armelagos, G. J. (2011). Histories of Scholars, Ideas, and Disciplines of Biological Anthropology and Archaeology. *Reviews in Anthropology, 40*(2), 107-133.

Armelagos, G. J., Goodman, A. H., Harper, K. N., & Blakey, M. L. (2009). Enamel hypoplasia and early mortality: Bioarcheological support for the Barker hypothesis. *Evolutionary Anthropology: Issues, News, and Reviews, 18*(6), 261-271. doi: 10.1002/evan.20239

Armelagos, G. J., Goodman, A. H., & Jacobs, K. (1991). The Origins of Agriculture: Population Growth During a Period of Declining Health. *Population and Environment: A Journal of Interdisciplinary Studies, 13*(1), 9-22.

Ashmore, W. (2004). Social Archaeologies of Landscape. In L. Meskell & R. W. Preucel (Eds.), *A Companion to Social Archaeology* (pp. 255-271). Malden: Blackwell.

Åström, P., Bailey, D. M., & Karageorghis, V. (1976). *Hala Sultan Teke I: Excavations 1897-1971*. Göteborg: Paul Åström Förlag.

Aufderheide, A. C., & Rodriguez-Martin, C. (1998). *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.

Bar-Yosef, O. (2001). The world around Cyprus: from Epipaleolithic foragers to the collapse of the PPNB civilization. In S. Swiny (Ed.), *The Earliest Prehistory of Cyprus: From Colonization to Exploitation* (pp. 129-151). Boston: American Schools of Oriental Research.

Barber, E. J. W. (2010). On Middle Minoan Sites and Sight Lines: Communication Strategies in the Bronze Age Mediterranean. *The Journal of Indo-European Studies, 38*(1-2), 1-25.

Bass, W. (1995). *Human Osteology: A Laboratory and Field Manual*. Columbia, MO: Missouri Archaeological Society.
Baustian, K. M., & Falvey, L. W. (2013). *You are Who You Meet: Identity Formation in the Mimbres Valley*. Paper presented at the 78th Annual meeting of the Society for American Archaeology, Honolulu, HI.
Baustian, K. M., Osterholtz, A. J., & Cook, D. C. (2014). Taking Analyses of Commingled Remains into the Future: Challenges and Prospects. In A. J. Osterholtz, K. M. Baustian & D. Martin (Eds.), *Commingled and Disarticulated Human Remains: Working Toward Improved, Theory, Method, and Data* (pp. 265-274). New York: Springer.
Berbesque, J. C., Marlowe, F., Pawn, I., Thompson, P., Johnson, G., & Mabulla, A. (2012). Sex Differences in Hadza Dental Wear Patterns. *Human Nature, 23*(3), 270-282. doi: 10.1007/s12110-012-9145-9
Bethard, J. D., Osterholtz, A. J., Gonciar, A., & Nyaradi, Z. (2014). *Of infants and elderly: a bioarchaeological analysis of a 17th century mortuary context from Transylvania, Romania*. Paper presented at the 79th Annual Meeting of the Society for American Archaeology, Austin, TX.
Bietti Sestieri, A. M. (1988). The "Mycenaean connection" and its impact on the central Mediterranean societies. *Dialoghi di Archeologia, 1*(6), 23-51.
Blackmer, J., & Marshall, S. C. (1999). A Comparison of Traumatic Brain Injury in the Saskatchewan Native North American and Non-Native North American Populations. *Brain Injury, 13*(8), 627-635.
Boardman, J. (2001). Aspects of "Colonization". *Bulletin of the American Schools of Oriental Research*(322), 33-42.
Borić, D., & Robb, J. (2008). Body theory in archaeology. In D. Borić & J. Robb (Eds.), *Past Bodies: Body-Centered REsearch in Archaeology* (pp. 1-8). Oxford: Oxbow Books.
Branigan, K. (1970). *The Foundations of Palatial Crete*. London: Praeger.
Brickley, M., & Ives, R. (2006). Skeletal Manifestations of Infantile Scurvy. *American Journal of Physical Anthropology, 129*, 168-172.
Brink, O., Vesterby, A., & Jensen, J. (1998). Pattern of Injuries Due to Interpersonal violence. *Injury, International Journal of the Care of the Injured, 29*(9), 705-709.
Broodbank, C. (2013). *The Making of the Middle Sea: A History of the mediterranean from the Beginning to the Emergence of the Classical World*. Oxford: Oxford Universit Press.
Brooks, S., & Suchey, J. (1990). Skeletal Age Determination Based on the Os Pubis: A Comparison of the Acsadi-Nemeskeri and Suchey-Brooks Methods. *Human Evolution, 5*, 227-238.
Brown, M., & Ortner, D. J. (2011). Childhood Scurvy in a Medieval Burial from Macˇvanska Mitrovica, Serbia. *International Journal of Osteoarchaeology, 21*, 197-207.
Buckland, P. (1997). Bronze Age myths? Volcanic activity and human response in the Mediterranean and North Atlantic regions. *Antiquity, 71*(273), 581-593.
Buikstra, J. E., & Ubelaker, D. H. (Eds.). (1994). *Standards for Data Collection from Human Skeletal Remains: Proceedings of a Seminar at the Field Museum of*

Natural History, Organized by Jonathan Haas. Fayettevilla, AR: Arkansas Archaeological Survey.
Cadogan, G. (1996). Maroni: Change in Late Bronze Age Cyprus. In P. Åström & E. Herscher (Eds.), *Late Bronze Age Settlement in Cyprus: Function and Relationship* (pp. 15-22). Jonsered: Paul Åström Förlag.
Çaglar, A. S. (2001). Constraining metaphors and the transnationalisation of spaces in Berlin. *Journal of Ethnic and Migration Studies, 27*(4), 601-613. doi: 10.1080/13691830120090403
Cannavò, A. (2010). The Cypriot Kingdoms in the Archaic Age: A Multicultural Experience in the Eastern mediterranean. *Bolletino di Archeologia On Line, Speciale B/B3/5*, 37-46.
Caraher, W., Moore, J. S., Noller, J. S., & Pettegrew, D. (2005). The Pyla-*Koutepetria* Archaeological Project: first preliminary report (2003-2004 seasons). *Report of the Department of Antiquities Cyprus, 2005*(245-267).
Cardoso, F. A., & Henderson, C. (2013). The Categorisation of Occupation in Identified Skeletal Collections: A Source of Bias? *International Journal of Osteoarchaeology, 23*(2), 186-196. doi: 10.1002/oa.2285
Castles, S. (2010). Understanding Global Migration: A Social Transformation Perspective. *Journal of Ethnic and Migration Studies, 36*(10), 1565-1586. doi: 10.1080/1369183X.2010.489381
Catling, H. W., & Karageorghis, V. (1960). Minoika in Cyprus. *The Annual of the British School at Athens, 55*(ArticleType: research-article / Full publication date: 1960 / Copyright © 1960 British School at Athens), 108-127.
Caufield, J., Snghal, A., Moulto, R., Brenneman, D., & Baker, A. J. (2004). Trauma recidivism in a large urban Canadian population. *The Journal of Trauma, Injury, Infection, and Critical Care, 57*(4), 872-876.
Cauwe, N. (2001). Skeletons in Motion, Ancestors in Action: Early Mesolithic Collective Tombs in Southern Belgium. *Cambridge Archaeological Journal, 11*(02), 147-163. doi: doi:10.1017/S0959774301000087
Cherry, J. (1983). Evolution, Revolution, and the Origins of Complex Society in Minoan Crete. In O. Kryszkowska & L. Nixon (Eds.), *Minoan Society* (pp. 33-45). Bristol: Gerald Duckworth & Co Ltd.
Cherry, J. (2009). Polities and Palaces: Some Problems in Minoan State Formation. In C. Renfrew & J. Cherry (Eds.), *Peer Polity Interaction and Socio-Political Change* (pp. 19). Cambridge: Cambridge University Press.
Cita, M. B., Camerlenghi, A., Kastens, K. A., & McCoy, F. W. (1984). New findings of Bronze Age homogenites in the Ionian Sea: Geodynamic implications for the Mediterranean. *Marine Geology, 55*(1–2), 47-62. doi: http://dx.doi.org/10.1016/0025-3227(84)90132-4
Cohen, M. N., & Armelagos, G. J. (Eds.). (1984). *Paleopathology at the Origins of Agriculture*. Orlando: Academic Press, Inc. .
Cohen, M. N., & Crane-Kramer, G. M. M. (Eds.). (2007). *Ancient Health: Skeletal Indicators of Agricultural and Economic Intensification.* Gainesville: University Press of Florida.

Collinson, S. (2009). The Political Economy of Migration Processes: An Agenda for Migration Research and Analysis. *Working Papers of the International Migration Institute, 2009*(Paper 12).

Cowgill, G. L. (1975). On causes and consequences of ancient and modern population changes. *American Anthropologist, 77*, 505-525.

Crewe, L. (1998). *Spindle Whorls: A Study of Form, Function and Decoration in Prehistoric Bronze Age Cyprus*. Jonsered, Sweden: P. Åström Förlag.

Crewe, L. (2007). Sophistication and Simplicity: The First Production of Wheelmade Pottery on Late Bronze Age Cyprus. *Journal of Mediterranean ARchaeology, 20*, 209-238.

Crewe, L. (2012). BEYOND COPPER: COMMODITIES AND VALUES IN MIDDLE BRONZE CYPRO-LEVANTINE EXCHANGES. *Oxford Journal of Archaeology, 31*(3), 225-243. doi: 10.1111/j.1468-0092.2012.00387.x

Croft, P. (1988). Animal Remains from Maa *Palaeokastro*. In V. Karageorghis & M. Demas (Eds.), *Excavations at Maa-Palaeokastro 1979-1986* (pp. 449-457). Nicosia: Department of Antiquities.

Croft, P. (2003a). The Animal Remains. In S. Swiny, G. R. Rapp & E. Herscher (Eds.), *Sotira Kaminoudhia: An Early Bronze Age Site in Cyprus* (Vol. Cyprus American Archaeological Research Institute Monograph Series, Volume 4, pp. 439-448). Boston: American Schools of Oriental Research.

Croft, P. (2003b). Water-holes and cowboys - animal remains from the Paphian Neolithic. In J. Guilaine & A. Le Brun (Eds.), *Le Neolithique de Chypre* (pp. 269-278). Athens: Ecole Francaise d'Athenes.

Croft, P. (2006). Animal Bones *in Marki Alonia: An Early and Middle Bronze Age Settlement in Cyprus. Excavations 1995-2000 by D. Frankel and J.M. Webb* (Vol. Studies in Mediterranean Archaeology 123.2, pp. 263-281). Savedalen: Astrom.

Curta, F. (2007). Some remarks on ethnicity in medieval archaeology. *Early Medieval Europe, 15*(2), 159-185.

Davis, S. J. M. (2003). The zooarchaeology of Khirokitia (Neolithic Cyprus), including a view from the mainland. . *Bullentin de Correspondance Hellenique Suppliment, 43*, 253-268.

Derriennic, J.-P. (1972). Theory and Ideologies of Violence. *Journal of Peace Research, 9*(4), 361-374. doi: 10.2307/422517

Dikaios, P. (1948). Trial Excavations at Sotira, Site Teppes, on Behalf of the University Museum Cyprus Expedition. *Bulletin of the University Museum, University of Pennsylvania, 13*(3), 16-23.

Driessen, J. (1997). *The Troubled Island: Minoan Crete Before and After the Santorini Eruption*. Liege: Aegaeum.

Duncan, W. N., & Schwarz, K. R. (2014). Partiable, Permeable, and Relational Bodies in a Maya Mass Grave. In A. J. Osterholtz, K. M. Baustian & D. Martin (Eds.), *Commingled and Disarticulated Human Remains: Working Toward Improved, Theory, Method, and Data* (pp. 149-172). New York: Springer.

Evans, A. (1921-1935). *The Palace of Minos at Knossos (4 Volumes)*. London: Macmillan.

Falconer, S. E., Monahan, E. M., & Fall, P. L. (2014). A Stone Plank Figure from Politiko-Troullia, Cyprus: Potential Implications for Inferring Bronze Age

Communal Behavior. *Bulletin of the American Schools of Oriental Research*(371), 3-16.

Fall, P. L., Falconer, S. E., Galletti, C. S., Shirmang, T., Ridder, E., & Klinge, J. (2012). Long-term agrarian landscapes in the Troodos foothills, Cyprus. *Journal of Archaeological Science, 39*(7), 2335-2347. doi: http://dx.doi.org/10.1016/j.jas.2012.02.010

Ferguson, B. (2008). Ten Points of War. *Social Analysis, 52*(2), 32-49.

Fisher, K. D. (2006). Messages in Stone: Constructing Sociopolitical Inequality in Late Bronze Age Cyprus. In E. C. Robertson, J. W. Seibert, D. C. Fernandez & M. U. Zender (Eds.), *Space and Spatial Analysis in Archaeology* (pp. 123-132). Calgary, Canada: University of Calgary Press, University of New Mexico Press.

Fisher, K. D. (2007). *Building Power: Monumental architecture, place and social interaction in late bronze age Cyprus.* (Ph.D. Ph.D. Dissertation), University of Toronto, Toronto. Retrieved from http://ezproxy.library.unlv.edu/login?url=http://search.proquest.com/docview/304750362?accountid=3611

Fisher, K. D. (2009a). Elite Place-making and Social Interaction in the Late Cypriot Bronze Age. *Journal of Mediterranean ARchaeology, 22*(2), 183-209.

Fisher, K. D. (2009b). Placing Social Interaction: An Integrative Approach to Analyzing Past Built Environments. *Journal of Anthropological Archaeology, 28*, 439-457.

Fortis, A. P., Milis, Z., Kostopoulos, v., Tsantzalis, S., Kormas, P., Tzinieris, N., & Boudouris, T. (2002). Experimental investigation of hte tension band fractures of the patella. *Injury, International Journal of the Care of the Injured, 33*, 489-493.

Foster, A., Buckley, H., & Tayles, N. (2012). Using Enthesis Robusticity to Infer Activity in the Past: A Review. *Journal of Archaeological Method and Theory, 21*, 511-533.

Fowler, C. (2008). Fractal bodies in the past and present. In D. Borić & J. Robb (Eds.), *Past bodies: Body-centered research in archaeology* (pp. 47-57). Oxford: Oxbow Books.

Frankel, D. (1974). *Middle Cypriot White Painted Pottery: An Analytical Study of the Decoration*. Göteborg, Sweden: P. Åström Förlag.

Frankel, D. (1988). Pottery production in prehistoric Bronze Age Cyprus: assessing the problem. *Journal of Mediterranean ARchaeology, 1*(2), 27-55.

Frankel, D. (2000). Migration and Ethnicity in Prehistoric Cyprus: Technology as Habitus. *European Journal of Archaeology, 3*(2), 167-187. doi: 10.1177/146195710000300202

Frankel, D., & Webb, J. (2006a). Denia-*Kafkalla* 2004 Field Report. *Report of the Department of Antiquities Cyprus, 2006*, 107-126.

Frankel, D., & Webb, J. (2006b). Neighbours: negotiating space in a prehistoric village. *Antiquity, 80*(308), 287-302.

Frankel, D., & Webb, J. (2010). Social strategies, ritual and cosmology in Early Bronze Age Cyprus: an investigation of burial data from the north coast. *Levant, 42*, 185-209.

Friesen, T. M. (1999). Resource structure, scalar stress, and the development of Inuit social organization. *World Archaeology, 31*(1), 21-37.

Galtung, J., & Höivik, T. (1971). Structural and Direct Violence: A Note on Operationalization. *Journal of Peace Research, 8*(1), 73-76. doi: 10.2307/422565

Glencross, B. A. (2011). Skeletal Injury Across the Life Course: Towards Understanding Social Agency. In S. Agarwal & B. A. Glencross (Eds.), *Social Bioarchaeology* (pp. 390-409). Oxford: Wiley-Blackwell.

Glick Schiller, N., & Salazar, N. B. (2012). Regimes of Mobility Across the Globe. *Journal of Ethnic and Migration Studies, 39*(2), 183-200. doi: 10.1080/1369183X.2013.723253

Good, B. J., Good, M.-J. D., Hyde, S. T., & Pinto, S. (2008). Postcolonial Disorders: Reflections on Subjectivity in the Contemporary World. In M.-J. D. Good (Ed.), *Postcolonial Disorders* (pp. 1-40). Berkeley: University of California Press.

Good, M.-J. D. (Ed.). (2008). *Postcolonial Disorders*. Berkeley: University of California Press.

Goodman, A. H., Martin, D., Armelagos, G. J., & Clark, G. (1984). Indications of Stress from Bones and Teeth. In M. N. Cohen & G. J. Armelagos (Eds.), *Paleopathology at the Origins of Agriculture* (pp. 13-49). New Yrok: Academic Press.

Goodman, A. H., & Rose, J. C. (1990). Assessment of systemic physiological pertubations from dental enamel hypoplasias and associated histological structures. *Yearbook of Physical Anthropology, 33*, 59-110.

Goodman, A. H., Thomas, R. B., Swedlund, A. C., & Armelagos, G. J. (1988). Biocultural Perspectives on Stress in Prehistoric, Historical, and Contemporary Population Research. *American Journal of Physical Anthropology, 31*, 169-202.

Goren, Y., Bunimovitz, S., Finkelstein, I., & Na'Aman, N. (2003). The Location of Alashiya: New Evidence from Petrographic Investigation of Alashiyan Tablets from El-Amarna and Ugarit. *American Journal of Archaeology, 107*(2), 233-255.

Greenfield, H. (2010). The Secondary Products Revolution: the past, present and hte future. *World Archaeology, 42*(1), 29-54.

Gustafson, G., & Koch, G. (1974). Age estimation up to 16 years of age based on dental development. *Odontologisk Revy, 25*, 297-306.

Guyomarc'h, P., Campagna-Vailancourt, M., Kremer, C., & Sauvageau, A. (2010). Discrimination of Falls and Blows in Blunt Head Trauma: A Multi-Criteria Approach. *Journal of Forensic Sciences, 55*(2), 423-427.

Hadjisavvas, S. (1992). *Olive Oil Processsing in Cyprus from the Bronze Age to the Byzantine Period*. Nicosia: Paul Åström Förlag.

Hall, J. M. (1997). *Ethnic Identity in Greek Antiquity*. Cambridge: Cambridge University Press.

Halstead, P. (1977). A Preliminary Report on the Faunal Remains from Late Bronze Age Kouklia, Paphos. *Report of the Department of Antiquities Cyprus, 1977*, 261-275.

Halstead, P. (1981). From Determinism to Uncertainty: Social Storage and the Rise of the Minoan Palace. In A. Sheridan & G. Bailey (Eds.), *Economic Archaeology* (pp. 187-213). Oxford: British Archaeological Reports.

Harrod, R. P. (2013). *Chronologies of Pain and Power: Violence, Inequality, and Social Control Among Ancestral Pueblo Populations (AD 850-1300).* (Ph.D. Dissertation), University of Nevada, Las Vegas, Las Vegas, NV. Retrieved from http://www.catalhoyuk.com

Harrod, R. P., Osterholtz, A. J., & Martin, D. (2013). *Cranial Depression Fractures of the Frontal Bones from a Bronze Age Arabian Commingled Tomb*. Paper presented at the 2013 Meetings of the American Association of Physical Anthropology, Knoxville, TN.

Henderson, C. Y., Mariotti, V., Pany-Kucera, D., Villotte, S., & Wilczak, C. (2013). Recording Specific Entheseal Changes of Fibrocartilaginous Entheses: Initial Tests Using the Coimbra Method. *International Journal of Osteoarchaeology, 23*(2), 152-162. doi: 10.1002/oa.2287

Henrich, J. (2001). Cultural Transmission and the Diffusion of Innovations: Adoption Dynamics Indicate That Biased Cultural Transmission Is the Predominate Force in Behavioral Change. *American Anthropologist, 103*(4), 992-1013.

Hillson, S. (1996). *Dental Anthropology*. Cambridge: Cambridge University Press.

Hirschfeld, N. E. (1992). Cypriot Marks on Mycenean Pottery. In J.-P. Olivier (Ed.), *Mykenaïka. BCH Suppl. XXV* (pp. 315-319). Paris: Diffusion de Boccard.

Hirschfeld, N. E. (2000). Marked Late Bronze Age Pottery from the Kingdom of Ugarit. In M. Yon, V. Karageorghis & N. E. Hirschfeld (Eds.), *Ceramiques Myceniennes. Ras-Shamra-Ougarit XII* (pp. 163-200). Nicosia: A.G. Leventis Foundation.

Holmes, Y. L. (1971). The Location of Alashiya. *Journal of the American Oriental Society, 91*(3), 426-429. doi: 10.2307/600261

Horowitz, L. K., Tchernov, E., & Hongo, H. (2004). The domestic status of the early Neolithic fauna of Cyprus. In E. J. Peltenburg & A. Wasse (Eds.), *Neolithic Revolution: New Perspectives on Southwest Asia in Light of Recent Discoveries on Cyprus* (Vol. 1). Oxford: Oxbow.

Iacovou, M. (1999). The Greek exodus to Cyprus: The antiquity of Hellenism. *Mediterranean Historical Review, 14*(2), 1-28.

Iacovou, M. (2001). Cyprus from *Alashiya* to *Iatnana* - The Protohistoric Interim. In S. Bohm (Ed.), *Ithake Festschrift für Jörg Schäfer* (pp. 89-92). Wurzburg.

Iacovou, M. (2007). Site Size Estimates and the Diversity Factor in Late Cypriot Settlement Histories. *Bulletin of the American Schools of Oriental Research, 348*, 1-23.

Iacovou, M. (2008). Cultural and Political Configurations in Iron Age Cyprus: The Sequel to a Protohistoric Episode. *American Journal of Archaeology, 112*(4), 625-657.

Irish, J. D., & Turner, C. G., II. (1987). More lingual surface attrition of the maxillary anterior teeth in American Indians: prehistoric Panamanians. *American Journal of Physical Anthropology, 73*, 209-213.

Janes, S. (2010). Negotiating Island Interactions: Cyprus, the Aegean and the Levant in the Late Bronze to Early Iron Ages. In P. van Dommelen & A. B. Knapp (Eds.), *Material Connections in the Ancient Mediterranean: Mobility, Materiality and Mediterranean identities* (pp. 127-146). London: Routledge.

Joyce, R. A. (2005). Archaeology of the Body. *Annual Review of Anthropology, 34*(ArticleType: research-article / Full publication date: 2005 / Copyright © 2005 Annual Reviews), 139-158.

Karageorghis, V. (1940-1948). Finds From Early Cypriot Cemeteries. *Report of the Department of Antiquities Cyprus, 1940-1948*, 115-152.

Karageorghis, V. (1976). Two Late Bronze Age Tombs from Hala Sultan Tekke. In P. Åström, D. M. Bailey & V. Karageorghis (Eds.), *Hala Sultan Teke I: Excavations 1897-1971* (pp. 71-90). Göteborg: Paul Åström Förlag.

Karageorghis, V. (1982). *Cyprus From the Stone Age to the Romans*. London: Thames and Hudson.

Karageorghis, V. (1990). *The End of the Late Bronze Age in Cyprus*. Nicosia: Pierides Foundation.

Karageorghis, V. (1998). Mycenaean deffensive outposts in the Aegean and Cyprus: some comparisons. In E. H. Cline & D. Harris-Cline (Eds.), *The Aegean and the Orient in the Second Millennium* (pp. 127-136). Liége: Universitè de Liége.

Kelder, J. M. (2009). Royal Gift Exchange between Mycenae and Egypt: Olives as "Greeting Gifts" in the Late Bronze Age Eastern Mediterranean. *American Journal of Archaeology, 113*(3), 339-352. doi: 10.2307/20627592

Keswani, P. (1989). *Mortuary Ritual and Social Hierarchy in Bronze Age Cyprus.* (Ph.D. Dissertation), University of Michigan, Ann Arbor.

Keswani, P. (1993). Models of Local Exchange in Late Bronze Age Cyprus. *Bulletin of the American Schools of Oriental Research, 292*(Perspectives on Cypriot Social Complexity), 73-83.

Keswani, P. (2004). *Mortuary Ritual and Society in Bronze Age Cyprus*. London: Equinox Publishing Ltd.

Keswani, P. (2005). Death, Prestige, and Copper in Bronze Age Cyprus. *American Journal of Archaeology, 109*(3), 341-401.

Knapp, A. B. (1990a). Ethnicity, Entrepreneurship, and Exchange: Mediterranean Inter-Island Relations in the Late Bronze Age. *The Annual of the British School at Athens, 85*(ArticleType: research-article / Full publication date: 1990 / Copyright © 1990 British School at Athens), 115-153.

Knapp, A. B. (1990b). Production, Location, and Integration in Bronze Age Cyprus. *Current Anthropology, 31*(2), 147-176.

Knapp, A. B. (1991). Spice, drugs, grain and grog: Organic goods in Bronze Age Eastern Mediterranean Trade. In N. H. Gale (Ed.), *Bronze Age Trade in the Mediterranean* (pp. 21-68). Göteborg, Sweden: P. Åström's Förlag.

Knapp, A. B. (1997a). *The Archaeology of Late Bronze Age Cypriot Society: The Study of Settlement, Survey and Landscape*. Glasgow: Department of Archaeology, University of Glasgow.

Knapp, A. B. (1997b). Bodies of Evidence on Prehistoric Cyprus. *Cambridge Archaeological Journal, 7*(2), 183-204.

Knapp, A. B. (1997c). Mediterranean Maritime Landscapes: Transport, Trade, and Society on Late Bronze Age Cyprus. In S. Swiny, R. L. Hohlfelder & H. W. Swiny (Eds.), *Res Maritimae: Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity* (Vol. 4, pp. 153-162). Atlanta, GA: Scholars Press.

Knapp, A. B. (2008a). *Prehistoric and Prohistoric Cyprus: Identity, Insularity and Connectivity*. Oxford: Oxford University Press.

Knapp, A. B. (2008b). *Prehistoric and Protohistoric Cyprus: Identity, Insularity, and Connectivity*. New York: Oxford University Press.

Knapp, A. B. (2012). Matter of Fact: Transcultural Contacts int he Late Bronze Age Mediterranean. In J. Maran & P. W. Stockhammer (Eds.), *Materiality and Social*

Practice: Transformative Capacities of Intercultural Entcounters (pp. 32-50). Oxford: Oxbow Books.
Knapp, A. B. (2013). *The Archaeology of Cyprus: From Earliest Prehistory through the Bronze Age.* . Cambridge: Cambridge University Press.
Knüsel, C., & Outram, A. K. (2004). Fragmentation: the Zonation Method Applied to Fragmented Human Remains from Archaeological and Forensic Contexts. *Environmental Archaeology, 9*, 85-97.
Kremer, C., Racette, S., Dionne, C.-A., & Sauvageau, A. (2008). Discrimination of Falls and Blows in Blunt Head Trauma: Systematic Study of the Hat Brim Line Rule in Relation to Skull Fractures. *Journal of Forensic Sciences, 53*(3), 716-719.
Krohn-Hansen, C. (1994). The anthropology of violent interaction. *Journal of Anthropological Research, 50*(4), 367-382.
Leriou, A. (2002). Constructing an archaeological narrative: The Hellenisation of Cyprus. *Stanford Journal of Archaeology, 1*. Retrieved from http://archaeology.stanford.edu/journal/newdraft/leriou/paper.pdf website:
Levitt, P., & Lamba-Nieves, D. (2010). Social Remittances Revisited. *Journal of Ethnic and Migration Studies, 37*(1), 1-22. doi: 10.1080/1369183X.2011.521361
Lewis, M. E. (2007). *The Bioarchaeology of Children: Perspectives from Biological and Forensic Anthropology*. Cambridge: Cambridge University Press.
Lovejoy, C. O., Meindl, R. S., Pryzbeck, T. R., & Mensforth, R. P. (1985). Chronological metamorphosis of the auricular surface of the ilium: A new method for the dtermination of adult skeletal age at death. *American Journal of Physical Anthropology, 68*, 15-28.
Lukacs, J. R., & Pastor, R. F. (1988). Activity-induced patterns of dental abrasian in prehistoric Pakistan: evidence from Mehrgarh and Harappa. *American Journal of Physical Anthropology, 76*, 377-398.
Lutz, H. (2010). Gender in the Migratory Process. *Journal of Ethnic and Migration Studies, 36*(10), 1647-1663. doi: 10.1080/1369183X.2010.489373
Mains, S. P., Gilmartin, M., Cullen, D., Mohammad, R., Tolia-Kelly, D. P., Raghuram, P., & Winders, J. (2013). Postcolonial migrations. *Social & Cultural Geography, 14*(2), 131-144. doi: 10.1080/14649365.2012.753468
Malley, L. M. (2004). *Linear enamel hypoplasia as an indicator of nutritional stress in two distinct economic and geographic Celtic populations of Austria.* (1419866 M.A.), California State University, Fullerton, Ann Arbor. ProQuest Dissertations & Theses Full Text database.
Manning, S. W. (1993). Presitge, distinction and competition: the anatomy of socioeconomic complexity in 4th-2nd millennium B.C.E. Cyprus. *Bulletin of the American Schools of Oriental Research, 292*, 35-58.
Manning, S. W. (1998). Changing pasts and socio-political cognition in Late Bronze Age Cyprus *World Archaeology, 30*(39-58).
Manning, S. W., & Hulin, L. (2005). Maritime Commerce and Geographies of Mobility in the Late Bronze Age of the Eastern Mediterranean: Problematizations. In E. Blake & A. B. Knapp (Eds.), *The Archaeology of Mediterranean Prehistory* (pp. 270-302). Malden, MA: Blackwell Publishing.

Mariotti, V., Facchini, F., & Belcastro, M. G. (2007). The Study of Entheses: Proposal of a Standardized Scoring Method for Twenty-Three Entheses of the Postcranial Skeleton. *Collegium Antropologium, 31*(1), 291-313.

Martin, D. (1997). Violence Against Women in the La Plata River Valley (A.D. 1000-1300). In D. Martin & D. W. Frayer (Eds.), *Troubled Times: Violence and Warfare in the Past* (pp. 45-75). New York: Routledge.

Martin, D., Goodman, A. H., & Armelagos, G. J. (1985). Skeletal pathologies as indicators of quality and quantity of diet. In R. I. Gilbert, Jr. & J. H. Mielke (Eds.), *The Analysis of Prehistoric Diets* (pp. 227-279). Orlando, FL: Academic Press.

Martin, D., Harrod, R. P., & Pérez, V. (2013). *Bioarchaeology: An Integrated Approach to Working with Human Remains*. New York: Springer.

Mason, R. W., Moore, T. e., Walker, C. W., & kathol, M. H. (1996). Patellar fatigue fractures. *Skeletal Radiol, 25*, 329-332.

McCartney, C. (2005). Preliminary report on the re-survey of three early Neolithic sites in Cyprus. *Report of the Department of Antiquities Cyprus, 2005*, 1-21.

McCartney, C., Manning, S. W., Sewell, D., & Stewart, S. T. (2007). The EENC 2006 field season: excavations at Agia Vavara *Asprokremnos*. *Report of the Department of Antiquities Cyprus, 2008*, 67-86.

McClellan, M. C., Russel, P., & Todd, I. (1988). Kalavasos-Mangia: Rescue Excavations at a Late Bronze Age Cemetery. *Report of the Department of Antiquities Cyprus, 1988*, 201-222.

McEnroe, J. C. (2010). *Architecture of Minoan Crete: Constructing Identity in the Aegean Bronze Age*. Austin: University of Texas Press.

Milella, M., Giovanna Belcastro, M., Zollikofer, C. P. E., & Mariotti, V. (2012). The effect of age, sex, and physical activity on entheseal morphology in a contemporary Italian skeletal collection. *American Journal of Physical Anthropology, 148*(3), 379-388. doi: 10.1002/ajpa.22060

Milella, M., Mariotti, V., & Belcastro, M. (2011). *You can't tell a book by its cover: the effects of age, sex and physical activity on theseal changes in an Italian contemporary skeletal collection.* Paper presented at the 80th Annual Meeting of the American Association of Physical Anthropologists, Minneapolis, MN. Podium Presentation retrieved from

Milgram, J. E. (1943). Tangential Osteochondral fracture of the Patella. *The Journal of Bone and Joint Surgery, 25*, 271-280.

Molnar, P. (2011). Extramasticatory dental wear reflecting habitual behavior and health in past populations. *Clinical Oral Investigations, 15*(5), 681-689. doi: 10.1007/s00784-010-0447-1

Moyer, C. J. (2007). Human Skeletal Remains. In I. Todd (Ed.), *Vasilikos Valley Project 11: Kalavasos Village Tombs 52-79* (pp. 262-324). Savedalen: Paul Astrom Forlag.

Muhley, J. D., Madden, R., & Stech, T. (1988). Cyprus, Crete, and Sardinia: Copper Ox-Hide Ingots and the Bronze Age Metals Trade. *Report of the Department of Antiquities Cyprus, 1988*, 281-298.

Murphy, C. G., McGuire, C. M., O'Malley, N., & Harrington, P. (2010). Cow-related trauma: A 10-year review of injuries admitted to a single institution. *Injury, International Journal of the Care of the Injured, 41*, 548-550.

Novak, S. A. (2007). Battle-related Trauma. In V. Fiorato, A. Boylston & C. Knüsel (Eds.), *Blood Red Roses: The archaeology of a mass grave from the Battle of Towton AD 1461* (2nd ed., pp. 90-102). Oxford: Oxbow Books.

Nystrom, K. C. (2006). Late Chachapoya Population Structure Prior to Inka Conquest. *American Journal of Physical Anthropology, 131*, 334-342.

Ortner, D. J. (2003). *Identification of Pathological Conditions in Human Skeletal Remains*. New York: Academic Press.

Ortner, D. J., Butler, W., Carafella, J., & Milligan, L. (2001). Evidence of Probable Scurvy from Archaeological Sites in North America. . *American Journal of Physical Anthropology, 114*, 343-351.

Ortner, D. J., & Ericksen, M. F. (1997). Bone Changes in the Human Skull Probably Resulting from Scurvy in Infancy and Childhood. . *International Journal of Osteoarchaeology, 7*, 212-220.

Osterholtz, A. J. (2012). The social role of hobbling and torture: Violence in the prehistoric Southwest. *International Journal of Paleopathology, 2*(2–3), 148-155. doi: http://dx.doi.org/10.1016/j.ijpp.2012.09.011

Osterholtz, A. J. (2013). Hobbling and Torture as Performative Violence: An Example from the Prehistoric Southwest. *Kiva, 78*(2), 123-144.

Osterholtz, A. J., Baustian, K. M., & Martin, D. (2012). *Determining the Minimum Number of Individuals (MNI) for Tell Abraq, UAE*. Paper presented at the 77th Annual meeting of the Society for American Archaeology, Memphis, TN.

Osterholtz, A. J., Baustian, K. M., & Martin, D. (2014a). Introduction. In A. J. Osterholtz, K. M. Baustian & D. Martin (Eds.), *Commingled and Disarticulated Human Remains: Working Toward Improved, Theory, Method, and Data* (pp. 1-16). New York: Springer.

Osterholtz, A. J., Baustian, K. M., & Martin, D. (Eds.). (2014b). *Commingled and Disarticulated Human Remains: Working Toward Improved, Theory, Method, and Data*. New York: Springer.

Osterholtz, A. J., Baustian, K. M., Martin, D., & Potts, D. T. (2014). Commingled Human Skeletal Assemblages: Integrative Techniques in the Determination of the MNI/MNE. In A. J. Osterholtz, K. M. Baustian & D. Martin (Eds.), *Commingled and Disarticulated Human Remains: Working Toward Improved, Theory, Method, and Data* (pp. 35-50). New York: Springer.

Osterholtz, A. J., Bethard, J. D., Gonciar, A., & Nyaradi, Z. (2014). *Possible Prenatal and Perinatal Scurvy at Telekfalva, Romania*. Paper presented at the Annual Meeting of the American Association of Physical Anthropologists.

Osterholtz, A. J., Harrod, R., & Martin, D. (2011). *Differential Diagnosis of Patellar Pathology: Use-Wear Patterns and Pathology from Tell Abraq (2200-2000 BC)*. Paper presented at the Poster presented at the 80th Annual Meeting of the American Association of Physical Anthropologists, Minneapolis, MN.

Osterholtz, A. J., & Stodder, A. L. W. (2010). *Conjoining a neighborhood: Data structure and methodology for taphonomic analysis of the very large assemblage* *from Sacred Ridge.* Paper presented at the American Association of Physical Anthropologists Meetings, Albuquerque, NM. Poster retrieved from

Owen, R. A., Melton, L. J., Johnson, K. A., Ilstrup, D. M., & Riggs, B. L. (1982). Incidence of Colles' fracture in a North American community. *American Journal of Public Health, 72*(6), 605-607. doi: 10.2105/AJPH.72.6.605

Papastergiadis, N. (2005). Hybridity and Ambivalence: Places and flows in contemporary Art and Culture. *Theory, Culture and Society, 22*, 39-64.

Parker Pearson, M. (1999). *The Archaeology of Death and Burial*. College Station: Texas A&M University Press.

Parsons, K. (2007). Structural Violence and Power. *Peace Review: A Journal of Social Justice, 19*, 173-181.

Pearlman, D. (1985). Kalavasos Village Tomb 51: Tomb of an Unknown Soldier. *Report of the Department of Antiquities Cyprus, 1985*, 164-179.

Pearlman, D., & Todd, I. (2007). Tombs in the Mosque/Mavrovouni Area. In I. Todd (Ed.), *Vasilikos Valley Project 11: Kalavasos Village Tombs 52-79* (pp. 27-31). Savedalen: Paul Astrom Forlag.

Peltenburg, E. J. (1993). Settlement Discontinuity and Resistence to Complexity in Cyprus, ca. 4500-2500 B.C.E. *Bulletin of the American Schools of Oriental Research, 292*, 9-23.

Peltenburg, E. J., & Members, P. (1998). *Lemba Archaeological Project II. 1A: Excavations at Kissonerga-Mosphilia 1979-1992* (Vol. 70). Jonsered, Sweden: P. Åström’s Förlag.

Pérez, V. (2006). *The Politicization of the Dead: An analysis of cutmark morphology and culturally modified human remains from La Plata and Penasco Blanco (A.D. 900-1300).* (Doctor of Philosophy Dissertation), University of Massachusetts Amherst.

Perréard Lopreno, G., Alves Cardoso, F., Assis, S., Milella, M., & Speith, N. (2013). Categorization of Occupation in Documented Skeletal Collections: Its Relevance for the Interpretation of Activity-Related Osseous Changes. *International Journal of Osteoarchaeology, 23*(2), 175-185. doi: 10.1002/oa.2301

Perry, E. M. (2004). *Bioarchaeology of labor and gender in the prehispanic American Southwest.* (3158137 Ph.D.), The University of Arizona, Ann Arbor. ProQuest Dissertations & Theses Full Text database.

Preston, L. (1999). Mortuary Practices and the Negotiation of Social Identities at LM II Knossos. *Annual of the British School at Athens, 94*, 131-143.

Rapp, G. R., & Swiny, S. (2003). Introduction. In S. Swiny, G. R. Rapp & E. Herscher (Eds.), *Sotira Kaminoudhia: An Early Bronze Age Site in Cyprus* (Vol. 4, pp. 1-8). Boston, MA: American Schools of Oriental Research.

Rappa, A. L. (1999). Imprisoning the Other. *Peace Review: A Journal of Social Justice, 11*(1), 157-159.

Reese, D. S. (1996). Animal bones and shells. In J. E. Coleman, J. A. Barlow, M. Mogelonsky & K. W. Scharr (Eds.), *Alambra: A Middle Bronze Age Site in Cyprus. Investigations by Cornell University, 1975-1978* (Vol. 118, pp. 477-514). Jonsered, Sweden: Paul Åström's Förlag.

Renfrew, C. (2011). *The Emergence of Civilisation: The Cyclades and the Aegean in the Third Millennium BC.* Oxford: Oxbow Books.

Ritzman, T. B., Baker, B. J., & Schwartz, G. T. (2008). A Fine Line: A Comparison of Methods for Estimating Ages of Linear Enamel Hypoplasia Formation. *American Journal of Physical Anthropology, 135*, 348-361.

Robertson, I. (1990). *Blue Guide Cyprus*. London: A.C. Black.

Rogers, E. M. (1995). *Diffusion of Innovations* (4th Edition ed.). New York: The Free Press.

Rose, J. C., Condon, K. W., & Goodman, A. H. (1985). Diet and dentition: developmental disturbances. In R. I. Gilbert, Jr. & J. H. Mielke (Eds.), *The Analysis of Prehistoric Diets* (pp. 281-305). Orlando, FL: Academic Press.

Rothschild, N. A. (2008). Colonised bodies, personal and social. In D. Borić & J. Robb (Eds.), *Past Bodies: Body-Centered Research in Archaeology* (pp. 135-144). Oxford: Oxbow.

Sakellarakis, Y., & Sapouna-Sakellaraki, E. (1997). *Archanes: Minoan Crete in a New Light*. Athens: Archanes.

Saunders, S., & Spence, M. W. (1986). Dental and skeletal age determinations of Ontario Iroquois infant burials. *Ontario Archaeology, 46*, 45-54.

Saxe, A. A. (1970). *Social Dimensions of Mortuary Practices.* (Doctor of Philosophy), The University of Michigan, Ann Arbor, MI.

Scheuer, J. L., & Black, S. (2000). *Developmental Juvenile Osteology*. San Diego: Academic Press.

Scheuer, J. L., & Black, S. (2004). *The Juvenile Skeleton*. Amsterdam: Elsevier.

Schmidt, B. E., & Schröder, I. W. (Eds.). (2001). *Anthropology of Violence and Conflict*. London: Routledge.

Schoep, I. (2002). Social and Political Organization on Crete in the Protopalatial Period: The Case of MM II Malia. *Journal of Mediterranean ARchaeology, 15*, 102-125.

Scott, E. C. (1979). Dental Wear Scoring Technique. *American Journal of Physical Anthropology, 51*, 213-218.

She, R., & Szakacs, J. (2004). Hyperostosis Frontalis Interna: Case Report and Review of Literature. *Annals of Clinical and Laboratory Science, 34*(2), 206-208.

Sherratt, A. (1981). Plough and pastoralism: aspects of the secondary products revolution. In I. Hodder, G. Isaac & N. Hammond (Eds.), *Pattern of the Past: Studies in honour of David Clarke* (pp. 261-306). Cambridge: Cambridge University Press.

Sherratt, A. (2007). Diverse origins: regional contributions to the genesis of farming. In S. Colledge & J. Conolly (Eds.), *The Origins and Spread of Domestic Plants in Southwest Asia and Europe* (pp. 1-20). Walnut Creek, CA: Left Coast Press.

Sherratt, S. (1991). Cypriot Pottery of Aegean Type in LCII-III: Problems of Classification, Chronology and Interpretation. In J. A. Barlow, D. Bolger & B. Kling (Eds.), *Cypriot Ceramics: Reading the Prehistoric Record* (pp. 185-198). Philadelphia: University Museum, University of Pennsylvania.

Sherratt, S., & Sherratt, A. (1993). The Growth of the Mediterranean Economy in the Early First Millennium BC. *World Archaeology, 24*(3), 361-378.

Simmons, A. (1998). Of Tiny Hippos, Large Cows and Early Colonists in Cyprus. *Journal of Mediterranean ARchaeology, 11.2*, 232-241.

Simmons, A. (2005). *Ais Giorkis*, an upland Aceramic Neolithic site in western Cyprus: progress report of the 2003 excavations. *Report of the Department of Antiquities Cyprus, 2005*, 23-30.

Simmons, A. (2009). Until the cows come home: cattle and Early Neolithic Cyprus. *Before Farming, 2009*(1 (Article 5)), 1-10.

Simmons, A., & DiBenedetto, c. b. K. (2014). *Stone Age Sailors: Paleolithic Seafaring in the Mediterranean*. Walnut Creek, CA: Left Coast Press.

Simmons, A., & Mandel, R. (2007). Not such a new light: a response to Ammerman and Noller. *World Archaeology, 39*, 475-482.

Simmons, A. H. (1999). *Faunal extinction in an island society: pygmy hippopotamus hunters of Cyprus*: Springer.

Smith, B. H. (1984). Patterns of molar wear in hunter–gatherers and agriculturalists. *American Journal of Physical Anthropology, 63*(1), 39-56. doi: 10.1002/ajpa.1330630107

Smith, F. H. (1984). Fossil hominids from the Upper Pleistocene of Central Europe and the origin of modern humans. In F. H. Smith & F. Spencer (Eds.), *The Origins of Modern Humans: a World Survey of Fossil Evidence* (pp. 137-209). New York, NY: Liss.

Smith, J. S. (1994). *Seals for Sealing in the Late Cypriot Period.* (Ph.D. Dissertation), Bryn Mawr College, Bryn Mawr.

Sofaer, J. R. (2006). *The Body as Material Culture: A Theoretical Osteoarchaeology*. Cambridge: Cambridge University Press.

Sommer, M. (2007). Networks of Commerce and Knowledge in the Iron Age: The Phoenicians. *Mediterranean Historical Review, 22*(1), 97-111.

South, A. K., & Russel, P. (1989). Tombs 1-7 and 10. In A. K. South, P. Russel & P. Keswani (Eds.), *Vasilikos Valley Project 3: Kalavasos-Ayios Dhimitrios II Ceramics, Objects, Tombs, Specialist Studies* (Vol. LXI: 3, pp. 41-57). Goteborg: Paul Astroms Forlag.

Stam, R., & Shohat, E. (2012). Whence and Whither Postcolonial Theory? *New Literary History, 43*(2), 371-390.

Steel, L. (2004). *Cyprus Before History: From the Earliest Settlers to the End of the Bronze Age*. London: Gerald Duckworth & Co. Ltd.

Steel, L. (2010). Late Cypriot Ceramic Production: Heterarchy or Hierarchy? In D. Bolger & L. Maguire (Eds.), *The Development of Pre-State Communities in the Ancient Near East. Studies in Honour of Edgar Peltenburg* (pp. 106-116). Oxford: Oxbow.

Steel, L. (2013). *Materiality and Consumption in the Bronze Age Mediterranean*. New York: Routledge.

Stevens, P. A. J., Charalambous, P., Tempriou, A., Mesaritou, E., & Spyrou, S. (2014). Testing the Relationship between Nationalism and Racism: Greek-Cypriot Students' National/Ethnic Identities and Attitudes to Ethnic Out-groups. *Journal of Ethnic and Migration Studies, 40*(11), 1736-1757. doi: 10.1080/1369183X.2013.872985

Stewart, E., & Stewart, J. (1950). *Vounous 1937-38: Field-Report on the Excavations Sponsored by the British School of Archaeology at Athens*. Sweden: Hakan Ohlssons Boktryckeri.

Stewart, H. D., Innes, A. R., & Burke, F. D. (1985). Factors affecting the outcome of Colles' fracture: an anatomical and functional study. *Injury, 16*(5), 289-295. doi: http://dx.doi.org/10.1016/0020-1383(85)90126-3

Stodder, A. L. W., & Osterholtz, A. J. (2010). Analysis of the Processed Human Remains from the Sacred Ridge Site: Methods and Data Collection Protocol. In E. M. Perry, A. L. W. Stodder & C. A. Bollong (Eds.), *Animas-La Plata Project: XV-Bioarchaeology* (pp. 243-278). Pheonix: SWCA Environmental Consultants.

Stuart-Mcadam, P. (1992). Anima in Past Human Populations. In P. Stuart-Mcadam & S. Kent (Eds.), *Diet, Demography and Disease* (pp. 151-172). New York: Aldine de Gruyter.

Stuart-Mcadam, P., & Kent, S. (Eds.). (1992). *Diet, Demography, and Disease*. New York: Aldine de Gruyter.

Swantek, L. (2006). *'There's no Jewelry without a State of Society'. The Cultural Biography of Picrolite in Prehistoric Cyprus.* . (M.A. Thesis), State University of New York at Albany, Albany.

Swiny, S. (1982). The Environment. In H. W. Swiny (Ed.), *An Archaeological Guide to the Ancient Kourion Area and the Akrotiri Peninsula* (pp. 1-5). Nicosia: Department of Antquities, Cyprus.

Swiny, S. (1986). *The Kent State University Expedition to Episkopi Phaneromeni: Part 2* (Vol. LXXIV: 2). Nicosia: Paul Astroms Forlag.

Swiny, S. (1989a). From round house to duplex: a re-assessment of prehistoric Cypriot Bronze Age society. In E. J. Peltenburg (Ed.), *Early Society in Cyprus* (pp. 14-31). Edinburgh: Edinburgh University Press.

Swiny, S. (1989b). From round house to duplex: A reassessment of prehistoric Bronze Age Cypriot Society. In E. J. Peltenburg (Ed.), *Early Society in Cyprus* (pp. 14-31). Edinburgh: Edinburge University Press.

Swiny, S. (2003). The Ground Stone. In S. Swiny, G. R. Rapp & E. Herscher (Eds.), *Sotira Kaminoudhia: An Early Bronze Age Site in Cyprus* (Vol. 4, pp. 221-288). Boston, MA: American Schools of Oriental Research.

Swiny, S. (2008). Of Cows, Copper, Corners, and Cult: The Emergence of the Cypriot Bronze Age. *Near Eastern Archaeology, 71*(1-2), 41-51.

Swiny, S., & Herscher, E. (2003). The Cemetery. In S. Swiny, G. R. Rapp & E. Herscher (Eds.), *Sotira Kaminoudhia: An Early Bronze Age Site in Cyprus* (Vol. 4, pp. 103-144). Boston, MA: American Schools of Oriental Research.

Swiny, S., Rapp, G. R., & Herscher, E. (Eds.). (2003). *Sotira Kaminoudhia: An Early Bronze Age Site in Cyprus* (Vol. 4). Boston, MA: American Schools of Oriental Research.

Thomas, J., & Tilley, C. (1993). The Axe and the Torso: Symbolic Structures in the Neolthic of Brittany. In C. Tilley (Ed.), *Interpretive Archaeology* (pp. 225-326). Providence: Berg.

Todd, I. (2001). Kalavasos *Tenta* Revisited. In S. Swiny (Ed.), *The Earliest Prehistory of Cyprus: From Colonization to Exploitation* (Vol. Cyprus American Archaeological Resarch Institute Monograph Series, Volume 2, pp. 95-108). Boston, MA: American Schools of Oriental Research.

Todd, I. (Ed.). (1986). *Vasilikos Valley Project 1: The Bronze Age Cemetery in Kalavasos Village* (Vol. LXXI:1). Goteborg: Paul Astroms Forlag.

Todd, I. (Ed.). (2004). *The Field Survey of the Vasilikos Valley* (Vol. Volume 1). Sävedalen, Sweden: P. Åström's Förlag.
Todd, I., & Flourentzos, P. (2007). Tombs in Cinema Area *Vasilikos Valley Project 11: Kalavasos Village Tombs 52-79* (Vol. LXXI: 11, pp. 32-39). Savedalen: Paul Astroms Forlag.
Todd, I., & Pearlman, D. (2007). Tombs in the Panayia Church Area *Vasilikos Valley Project 11: Kalavasos Village Tombs 52-79* (Vol. LXXI: 11, pp. 4-25). Savedalen: Paul Astroms Forlag.
Triantafillopoulos, I. K., Papagelopoulos, P. J., Politi, P. K., & Nikiforidis, P. A. (2002). Articular changes inexperimentally induced patellar trauma. *Knee Surg, Sports Traumatol, Arthrosc, 10*, 144-153.
Turner, C. G., II, & Machado, L. M. C. (1983). A new dental wear pattern and evidence for high carbohydrate consumption in a Brazilian archaic skeletal population. *American Journal of Physical Anthropology, 61*, 125-130.
Ubelaker, D. H. (1999). *Human Skeletal Remains (3rd Edition)*. Washington D.C.: Taraxacum.
van Dommelen, P. (2005). Colonial Interactions and Hybrid Practices: Phoenician and Carthaginian Settlements in the Ancient Mediterranean. In G. J. Stein (Ed.), *The Archaeology of Colonial Encounters: Comparative Perspectives* (pp. 109-142). Santa Fe: School of American Research Press.
Van Hear, N. (2010). Theories of Migration and Social Change. *Journal of Ethnic and Migration Studies, 36*(10), 1531-1536. doi: 10.1080/1369183X.2010.489359
Vertovec, S. (2001). Transnationalism and identity. *Journal of Ethnic and Migration Studies, 27*(4), 573-582. doi: 10.1080/13691830120090386
Vigne, J.-D. (2001). Large Mammals of Early Aceramic Neolithic Cyprus: Primilinary Results from Parekklisha *Shillourokambos*. In S. Swiny (Ed.), *The Earliest Prehistory of Cyprus: From Colonization to Exploitation* (Vol. Cyprus American Archaeological Research Institute Monograph Series, Volume 2, pp. 55-60). Boston: American Schools of Oriental Research.
Vigne, J.-D., Carrère, I., & Guilaine, J. (2003). Unstable status of early domestic ungulates in the Near East: the example of Shillourokambos (Cyprus IXth-VIIIth millenia cal BC). In J. Guilaine & A. Le Brun (Eds.), *Néolithique de Chypre* (pp. 239-251). Athens: École Française de' Athèns.
Vigne, J.-D., Carrère, I., Saliège, Person, A., Bocherens, H., Guilaine, J., & Briois, F. (2000). Predomestic cattle, sheep, goat and pit during the late 9th and the 8th millennium Cal BC on Cyprus: preliminary results of Shillourokambos (Parkklisha, Limassol). In M. Mashkour, A. M. Choyke, H. Buitenhuis & F. Poplin (Eds.), *Archaeozoology of the Near East IVA. Proceedings of the Fourth International Symposium on the ARchaeozoology of Southwestern Asia and Adjacent Areas* (pp. 83-106). Groningen, The Netherlands: Centrum voor Archeologische Research and Consultancy.
Vigne, J.-D., Debue, K., Haye, L., & Gérard, P. (2004). Early taming of the cat in Cyprus. *Science, 304*(9 April 2004), 259.
Villotte, S., & Knüsel, C. J. (2013). Understanding Entheseal Changes: Definition and Life Course Changes. *International Journal of Osteoarchaeology, 23*(2), 135-146. doi: 10.1002/oa.2289

Voskos, I., & Knapp, A. B. (2008). Cyprus at the End of the Late Bronze Age: Crisis and Colonization or Continuity and Hybridization? *American Journal of Archaeology, 112*(4), 659-684.
Wachsmann, S. (1986). Is Cyprus Ancient Alashiya? New Evidence from an Egyptian Tablet. *The Biblical Archaeologist, 49*(1), 37-40.
Waldron, T. (2009). *Paleopathology*. Cambridge: Cambridge University Press.
Walker, P. L. (1989). Cranial Injuries as Evidence of Violence in Prehistoric Southern California. *American Journal of Physical Anthropology, 80*, 313-323.
Walker, P. L. (1997). Wife Beating, Boxing, and Broken Noses: Skeletal Evidence for the Cultural Patterning of Violence. In D. Martin & D. W. Frayer (Eds.), *Troubled Times: Violence and Warfare in the Past* (pp. 145-175): Gordon and Breach.
Warren, P. (2002). Political Structure in Neopalatial Crete *Monuments of Minos: Rethinking the Minoan Palaces* (pp. 201-205). Liege: Aegaeum.
Webb, J. (1998). Lithic technology and discard at Marki, Cyprus: consumer behavior and site formation in the prehistoric Bronze Age. *Antiquity, 18*, 64-70.
Webb, J. (1999). Characterising the Philia facies. Material Culture, chronology and the origins of the Bronze Age in Cyprus. *American Journal of Archaeology, 103*, 3-43.
Webb, J., & Frankel, D. (1994). Making an Impression: Storage and Surplus Finance in Late Bronze Age Cyprus. *Journal of Mediterranean ARchaeology, 7*, 5-26.
Webb, J., Frankel, D., Eriksson, K., & Hennessy, J. B. (2009). *The Bronze Age Cemeteries at Karmi Paleolana and Lapatsa in Cyprus. Excavations by J.R.B. Stewart* (Vol. 136). Göteborg, Sweden: P. Åström Forlag.
Willcox, G. (2002). Geographical variation in major cereal components and evidence for independent domestication events in Western Asia. In R. Cappers & S. Bottema (Eds.), *The Dawn of Farming in the Near East* (Vol. 6, pp. 133-140). Berlin: Ex Oriente.
Zejdlik, K. J. (2014). Unmingling Commingled Museum Collections: A Photographic Method. In A. J. Osterholtz, K. M. Baustian & D. Martin (Eds.), *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data* (pp. 173-192). New York: Springer.
Zohary, D. (1996). The mode of domesticatino of the founder crops of southwest Asian agriculture. In D. R. Harris (Ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia* (pp. 142-158). London: University College London Press.
Zuckerman, M. K., & Armelagos, G. J. (2011). The Origins of Biocultural Dimensions in Bioarchaeology. In S. Agarwal & B. A. Glencross (Eds.), *Social Bioarchaeology* (pp. 15-43). Oxford: Blackwell Publishing.

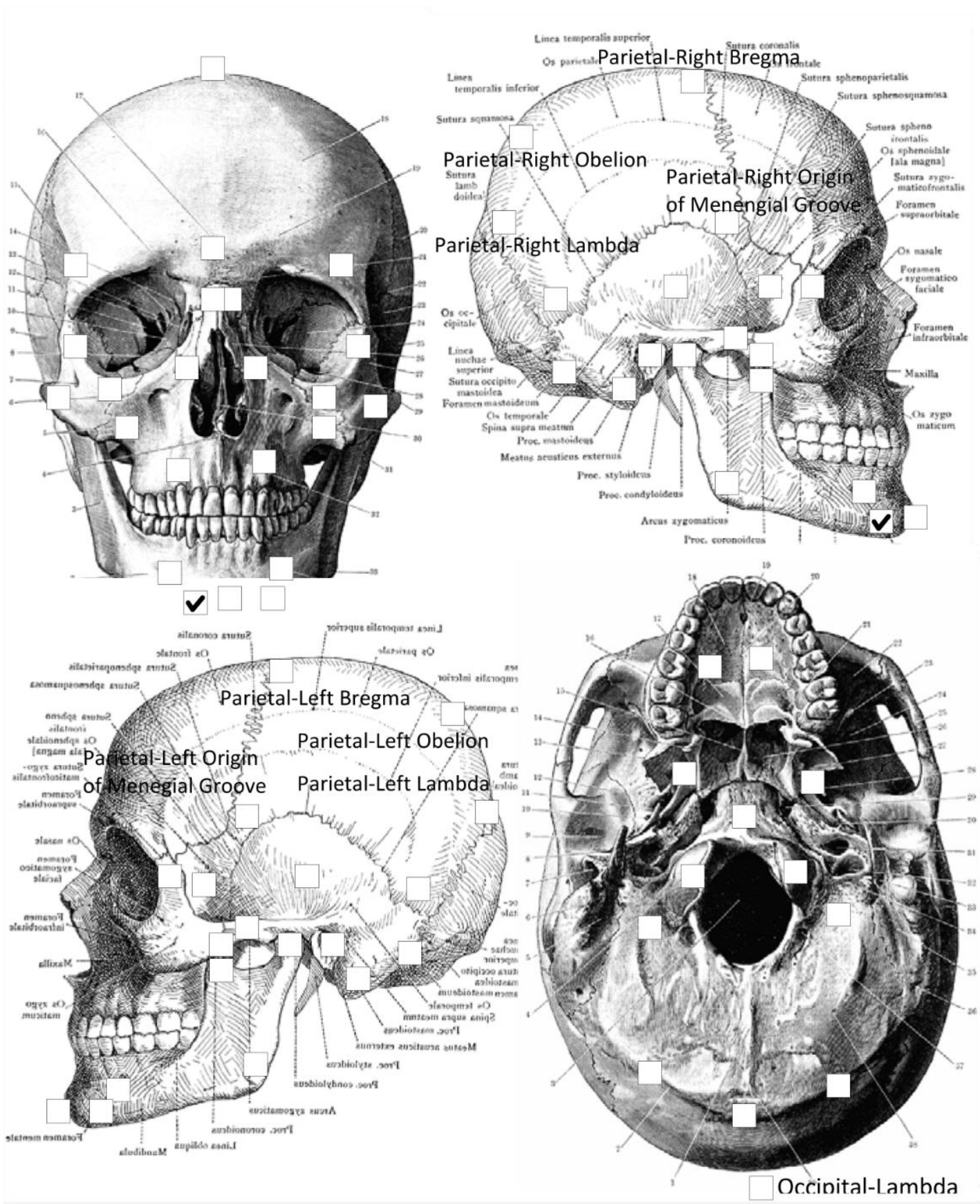
Appendix: Data Collection Forms

Cranial MNI Form

Site Name KAD ID Number T.13.1

Estimated Age Infant Refined Ag 6 MO +/- 3 MO

Estimated Se Not Appli Demographic Notes



Cranial Pathology Form

ID number(s KAY.B.1.1

Site Name KAY Conjoin ID

Estimated Age Child

Estimated Se Not Applicable

Nuchal Crest

Mastoid Process

Orbital Margi

Browridge

Mental Eminenc

☑ Pathology NS ☐ No pathology ☐ Pathology

CO

☐ L CO NS ☐ L No CO ☐ R CO NS ☐ R No CO

☐ CO Left Orbit ☐ CO Right Orbi

Healing Healing

Extent Extent

Composite Vault Scor

Vault Associated Ag

Composite L-A Scor

L-A Associated Age

Dental Ag 5 ± 1.5 YRS

PH

☐ PH NS ☐ No PH ☐ PH

Distributio

Extent

Healing

Trauma

☐ NS ☐ None ☐ Present

Trauma 1

fracture type Healing

Location

max mi dept

Trauma 2

fracture type Healing

Location

max mi dept

Isolated Dentition Form

Tooth ID LLC Site Name KAD

Tooth Presence

Tooth Development 1 ID Number T.13.31

Conjoin ID

if Molar if non-Molar

Wear M M DB DL

Caries

Abscess

LEH? LEH not scorable

	Type	Dist from CEJ
LEH 1	1	3.03
LEH 2	1	2.04
LEH 3		
LEH 4		
LEH 5		
LEH 6		

Dental Recording Form: Upper Right Quadrant

Estimated Age	Infant	Site Name	KAD
Refined Age	6 MO +/- 3 MO	Label Info	KAD 92 T.1
Estimated Sex	Not Applicable	ID Number	T.13.1
		Conjoin ID	

☐ LEH not scorable

	Presence	Development	Wear	Caries	Abscesses	Calculus
URM			M M DB DL			
URM			M M DB DL			
URM			M M DB DL			
URP						
URP						
URC						
URI2						
URI1						
uri1						
uri2						
urc	1	R I				
urm1						
urm2						

Dental Recording Form: Upper Left Quadrant

Estimated Age	Infant	Site Name	KAD
Refined Age	~1 YR	Label Info	KAD 92 T.13 7.1
Estimated Sex	Not Applicable	ID Number	T.13.2
		Conjoin ID	

☐ LEH not scorable

	Presence	Development	Wear				Caries			Abscesses	Calculus
ULI1											
ULI2											
ULC											
ULP3											
ULP4											
ULM1			M			M					
			DB			DL					
ULM2			M			M					
			DB			DL					
ULM3			M			M					
			DB			DL					
uli1											
uli2											
ulc											
ulm1	1	R c									
ulm2											

Dental Recording Form: Lower Left Quadrant

Estimated Age	Adult	Site Name	KVT
Refined Age		Label Info	
Estimated Sex	Indeterminate	ID Number	T.38.32
		Conjoin ID	

☐ LEH not scorable

	Presence	Development		Wear	Wear		Caries	Caries	Caries	Abscesses	Calculus
LLM3			M / DB			M / DL					
LLM2	2		M / DB	5 / 6	5 / 5	M / DL	0	0	0		
LLM1	4		M / DB			M / DL					
LLP4											
LLP3											
LLC											
LLI2											
LLI1											
lli1											
lli2											
llc											
llm1											
llm2											

Dental Recording Form: Lower Right Quadrant

Estimated Age	Infant	Site Name	KAD
Refined Age	6 MO +/- 3 MO	Label Info	KAD 92 T.13 7.1
Estimated Sex	Not Applicable	ID Number	T.13.1
		Conjoin ID	

☐ LEH not scorable

	Presence	Development	Wear	Caries		Abscesses	Calculus
LRI1							
LRI2							
LRC							
LRP3							
LRP4							
LRM1			M DB M DL				
LRM2			M DB M DL				
LRM3			M DB M DL				
lri1							
lri2	1	R 1/2					
lrc	1	Cr c					
lrm1							
lrm2	1	Cr 3/4					

Dental Recording Form: Metrics

Site Name	KVT	Conjoin ID	
ID number	T.60.1		

Tooth	MD Diam	BL Dia	Crown H	Notes
LLC	6.77	8.27	10.11	

Dental Recording Form: Dental Defects

Estimated Age	Child	Site Name	KAD
Refined Age		Label Info	
Estimated Sex	Not Applicable	ID Number	T.13.3
		Conjoin ID	

Tooth	LEH Type	Dist. from CEJ	Tooth	LEH Type	Dist. from CEJ
URI1	1	6.02	URP3	1	7.19
URP3	1	4.42	LLI2	1	4.46
LRI1	1	4.31	LRI1	1	2.63
LRI2	1	5.43	LRI2	1	4.14

Clavicle MNI Form

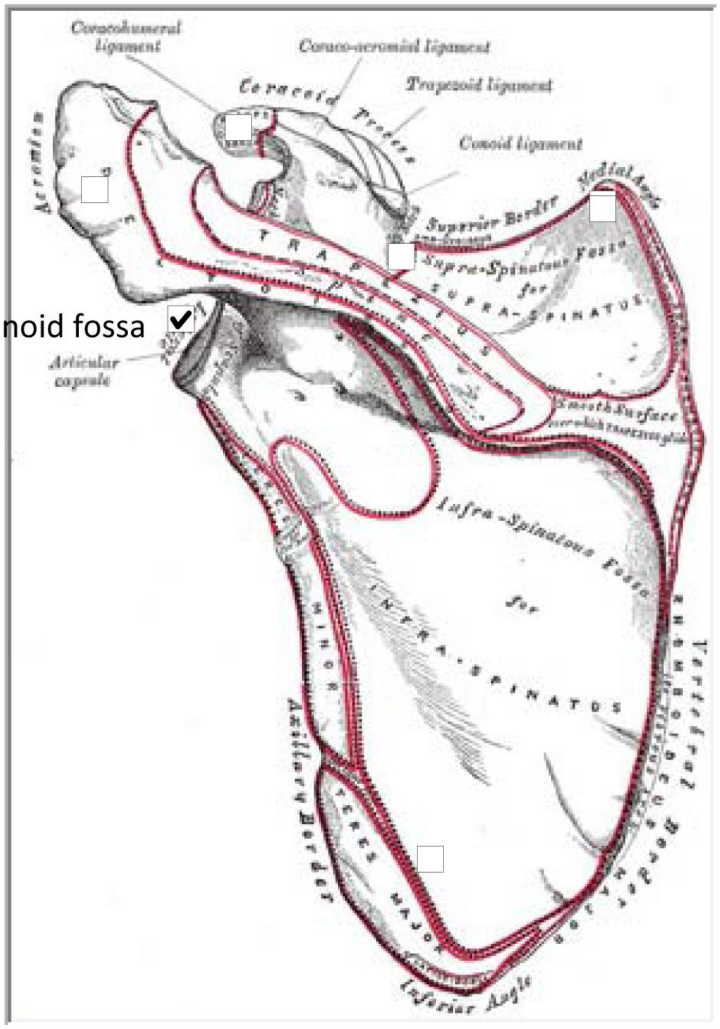
Site	KVT	ID Number	T.59.28	Conjoin ID	
Label Info	KALAVASOS T.	Side	Left		
Estimated Ag	Adult	Estimated Sex	Indeterminate		

- [ ] Medial Epiphysi
- [ ] Costoclavicular Impression/Tubercl
- [x] Middle 1/3 Shaf
- [x] Conoid Tubercle — Max Length:
- [x] Deltoid Rugosity — Midshaft Circumfere:
- [ ] Acroial End

Scapula MNI Form

Site Name		Estimated Age	Adolescent
Label Info		Refined Age	
ID Number	T.53.26	Estimated Sex	Indeterminate
Conjoin ID			
Side	Midline		

glenoid fossa ✔



Humerus MNI Form

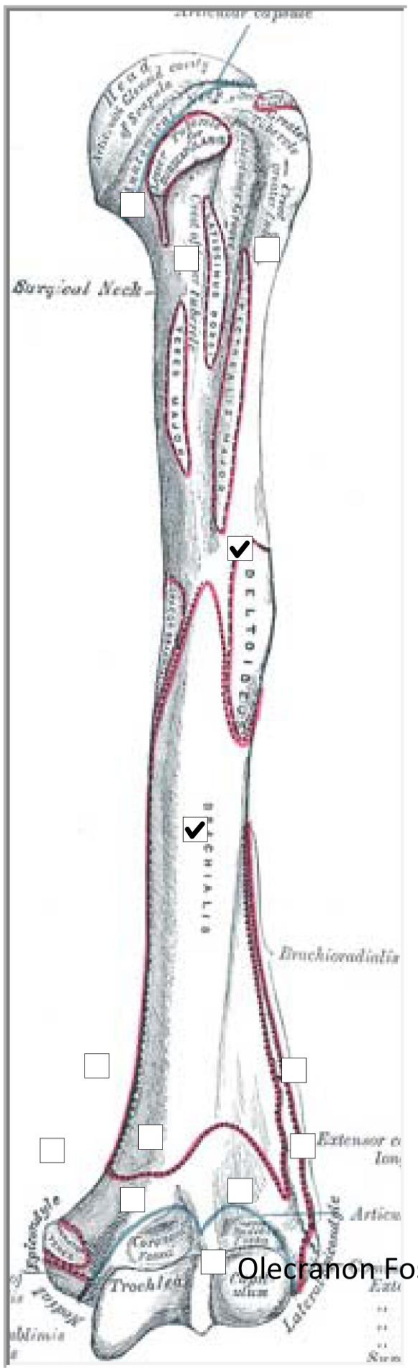
Site Name:	KAD	Estimated Age:	Adolescent+
Label Info:	KAD T.17 SK1 R	Refined Age:	
ID Number:	T.17.1	Estimated Sex:	Indeterminate
Conjoin ID:			

Side: Right

Vert. Diameter of Head

Biepicondylar Breadth:

☐ Shaft Fragment (not contributing to

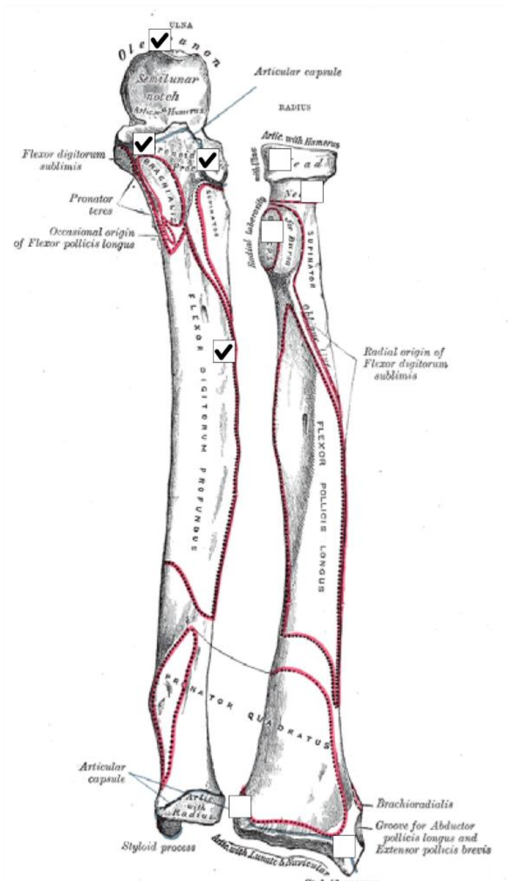


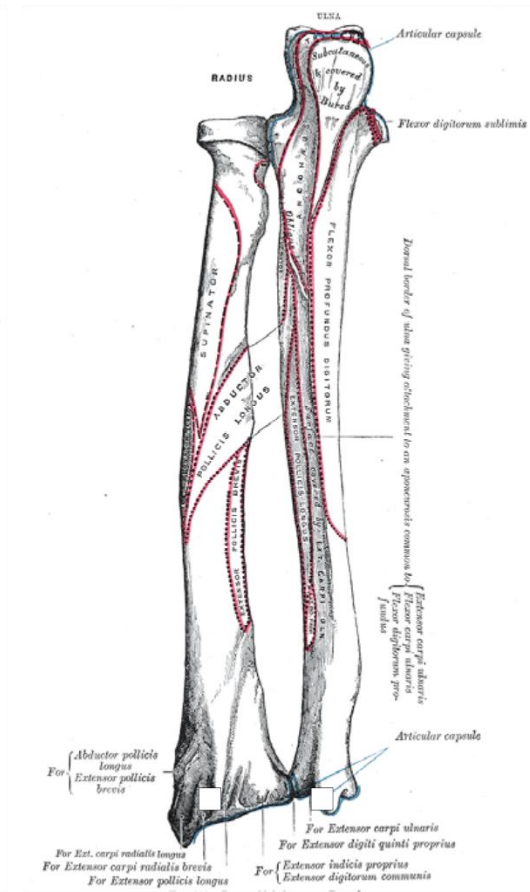
Forearm MNI Form

Site Name:	KAD	ID Number:	T.12.3
Label Info:		Conjoin ID:	
Estimated Age:	Infant	Refined Age:	
Estimated Sex:	Not Applicable		
Diameter of radial head:			
Side:			

☐ Ulna-shaft (not contributing to MNI)

☐ Radius-shaft (not contributing to MNI)





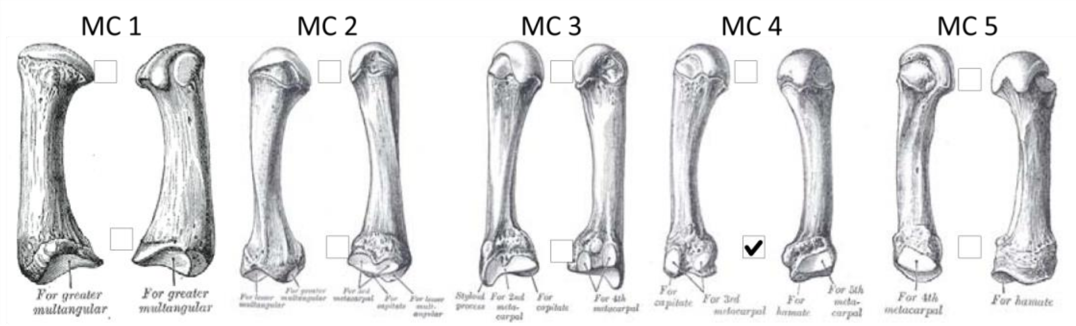
Hand MNI Form

Site Name: KAD ID Number: T.14.11

Label Info: Conjoin ID:

Element: MC4 Side: Left

☐ Whole Bone (for use with all except metacarpals)



Upper Limb Pathology, Trauma, and Robusticity Form

Site Name KAD
ID Number A.50W.3
Element Humerus
Label Info
Conjoin ID
Side Indeterminate

Humerus Max Length
Humerus Vert Diam Head
Humerus minimum circumference
Humerus Epicondylar Brdth
Radius Diam radial head

Estimated Sex Not Applicable

Estimated Age Infant

☑ Path not scorable ☐ No pathology ☐ Pathology

☐ Pathology1-Periosteal Reaction
Location of Reaction
Location within bone
Extent
Active vs Chronic
stage of healing

☐ Pathology2-Periosteal Reaction
Location of Reaction
Location within bone
Extent
Active vs Chronic
stage of healing

☐ Trauma?

☐ Fracture?

Fracture1 Completion
Fracture1 Type
Fracture1 Clinical Type
Healing

Fracture2 Completion
Fracture2 Type
Fracture2 Clinical Type
Healing

MSMs-Hum Bracioradiali
MSMs-Humerus Deltoid
MSMs-Hum Pectoralis
MSMs-Ulna Brachialis
MSMs-Ulna Triceps Bracchii
MSMs-Radius Biceps brachi

Os Coxa MNI Form

Site Name: KAD   ID Number: T.12.5

Label Info: T.12 COMPLET   Conjoin ID:

Estimated Age: Infant   Refined Age: B+- 2 MO

Estimated Sex: Not Applicable

GSN Score:

Ventral Arc

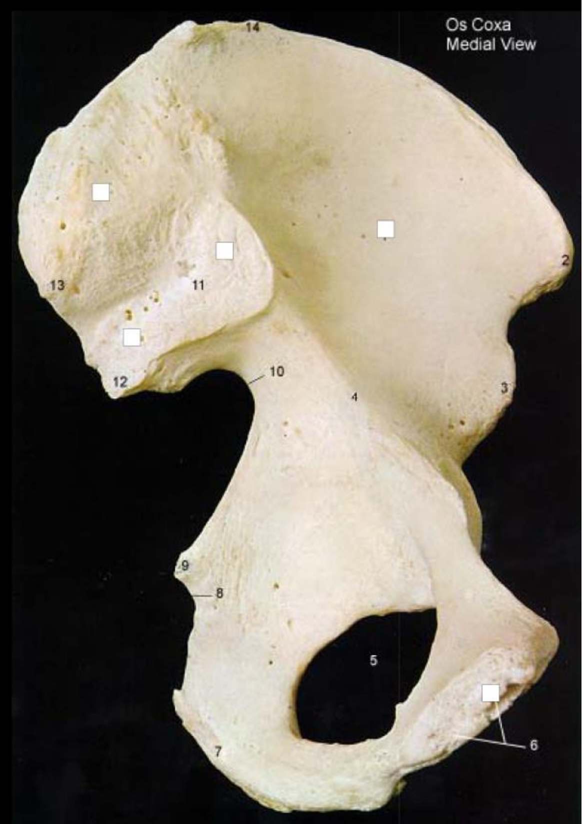
Subpubic Concavity

Ischiopubic Ramus

Side: Left

For Fragments not contributing to the MNI

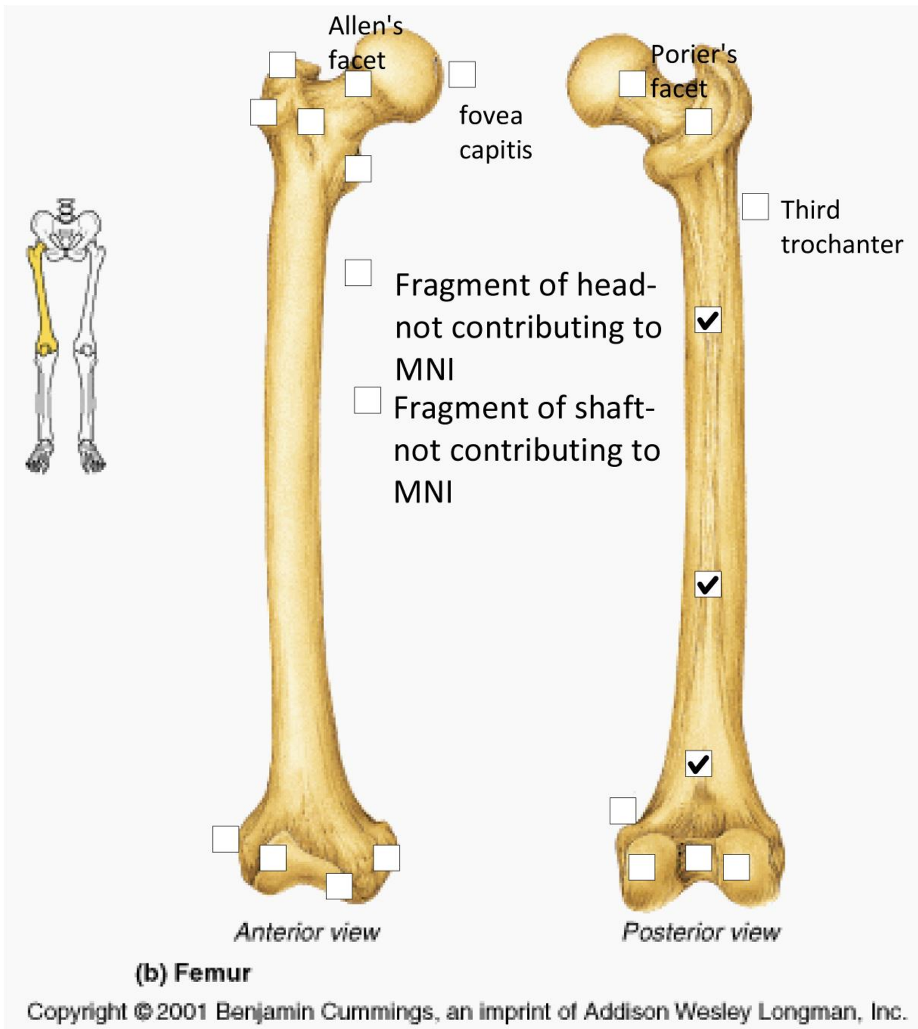
- [ ] Acetabulum
- [ ] Ilium
- [ ] Ischium
- [ ] Pubis



Femur MNI Form

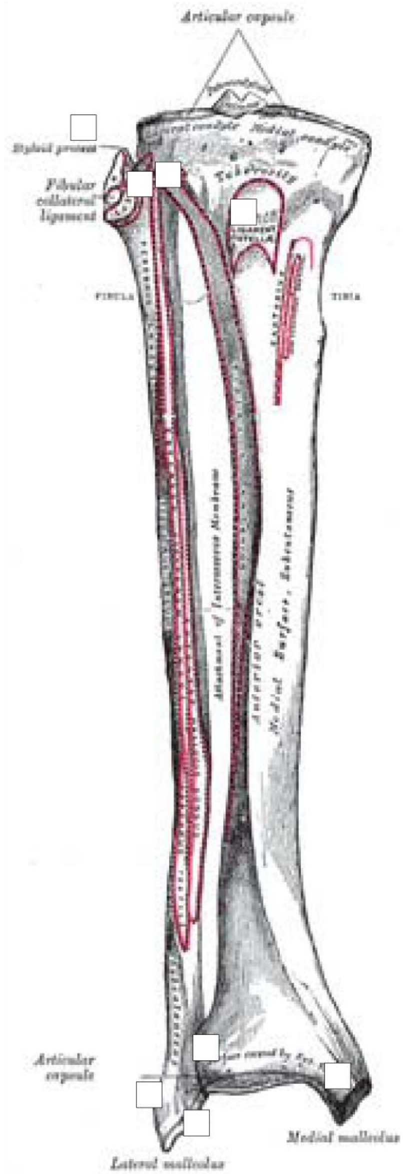
Site Name:	KAD	ID Number:	A.50W.1
Label Info:	KAD 82 A.50 W	Conjoin ID:	
Estimated Age:	Infant	Refined Age:	
Estimated Sex:	Not Applicable		
element:	Femur		
Side:			

Diameter of femoral head:

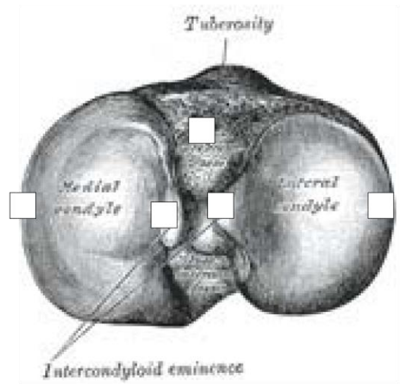


Lower Limb MNI Form

Site Name:	KAD	ID Number:	T.12.24
Label Info:		Conjoin ID:	
Estimated Age:	Infant	Refined Age:	
Estimated Sex:	Not Applicable		
element:			
Side:			



☐ Tibia-squatting facet?
☑ Tibia-nutrient foramen



☐ Tibia-shaft (not contributing to MNI)
☐ Fibula-shaft (not contributing to MNI)

Patella MNI Form

Site Name	KVT	ID Number	T.36.2
Label Info	KALAVASOS T.	Conjoin ID	
Estimated Age	Adult	Side	Left
Refined Age			
Estimated Sex	Indeterminate		

Max Width	41.99
Max Height	41.59
Max Brdth	20.23

☑ quadriceps attachment

Foot MNI Form

Site Name:	KAD	ID Number:	T.13.33
Label Info:	KAD 92 T.13 7.	Conjoin ID:	
Estimated Age:	Adult	Refined Age:	
Estimated Sex:	Indeterminate		
Element:	Talus	Side:	Right

☐ Whole Bone-For use with all tarsals except Talus and Calcaneus

☑ Talus-Head	☐ Calcaneus-Sustantaculum Tali
☑ Talus-Superior Articular Surface	☐ Calcaneus-Calc Tuberosity
☐ Talus-Flexor Hal Long groove	☐ Calcaneus-Facet for Cuboid
☐ Talus-Lateral Process	☐ Calcaneus-Posterior Talar Facet
	☐ Calcaneus-Fibular Tubercle

☐ MT1-Head	☐ MT2-Head	☐ MT3-Head	☐ MT4-Head	☐ MT5-Head
☐ MT1-Base	☐ MT2-Base	☐ MT3-Base	☐ MT4-Base	☐ MT5-Base

Lower Limb Pathology, Trauma, and Robusticity Form

Site Name KVT ID Number T.45.1
Label Info KALAVASOS T. Conjoin ID

Femur Max Length
Femur Bicondylar Length
Femur Diam Head
Femur AP Midshaft Diam
Femur ML Midshaft Diameter
Metrics-Femur Robusticity Index 0
Femur AP Subtrochanteric Diameter
Femur ML Subtrochanteric Diameter
Metrics-Tibia-AP diam at nut for
Metrics-Tibia-ML diam at nut for
Metrics-Tibia-circum at nut for

Sex Notes Estimated Sex Indeterminate

Age Notes Estimated Age Adult

☐ Path not recordabl ☐ No Pathology ☐ Pathology

☐ Pathology1-Periosteal Reaction?
Location of Reaction
Location within bone
Extent
Active vs Chronic
stage of healing

☐ Pathology2-Periosteal Reaction
Location of Reaction
Location within bone
Extent
Active vs Chronic
stage of healing

☐ Trauma? Trauma Notes

☐ Fracture?

Fracture1 Completion
Fracture1 Type
Fracture1 Clinical Type
Fracture1 Healing
Notes

Fracture2 Completion
Fracture2 Type
Fracture2 Clinical Type
Fracture2 Healing
Notes

MSMs-Femur Gluteus Maximus
MSMs-Femur Iliopsoas
☐ MSMs-Femur Porier's Facet
☐ MSMs-Femur Posterior Cervical Imprint
☐ MSMs-Femur Peritrochlear Groove

MSMs-Tibia Quadriceps Tendon
☐ MSMs-Tibia Squatting Facets

Curriculum Vitae

Anna J. Osterholtz

Contact Information

Address	Department of Anthropology University of Nevada Las Vegas 4505 S. Maryland Parkway, Mailstop 455003 Las Vegas, NV 89154-5003
Email	annao@unlv.nevada.edu

Education

Current	Ph.D. Candidate (ABD-5/12)	University of Nevada, Las Vegas, Bioarchaeology (GPA 3.96)
2003	M.S.	University of New Mexico, Biological Anthropology/Bioarchaeology
1999	B.A.	New Mexico State University, Anthropology

Academic Employment

2014-Present	University of Nevada, Las Vegas	Instructor, Introduction to Cultural Anthropology (Anth 101), Introduction to Biological Anthropology (Anth 102)
2013-2014	University of Nevada, Las Vegas	UNLV Foundation President's Graduate Research Fellow
2013	Archaeotek-Canada	Project Assistant to Intensive Bioarcheology Workshop in Transylvania, Romania
2012	University of Nevada, Las Vegas	Instructor, Introduction to Biological Anthropology (Anth 102)
2012	University of Nevada, Las Vegas	Co-Instructor, Osteology (Anth 440/660)
2011	University of Nevada, Las Vegas	Instructor, Anatomy and Physiology II (Biol 224)
2011	University of Nevada, Las Vegas	Co-instructor, Osteology (Anth 440/660)
2010-2013	University of Nevada, Las Vegas	Lab Director, Bioarchaeology Labs
2010-2013	University of Nevada, Las Vegas	Osteological Collections Manager
2010-2011	University of Nevada, Las Vegas	Instructor, Introduction to Physical Anthropology Lab (Anth 110L)

2010	University of Nevada, Las Vegas	Teaching Assistant, Osteology (Anth 440/660)
2002-2003	University of New Mexico	Instructor, Anatomy and Physiology Cadaver Labs
2003	University of New Mexico	Research Assistant to Dr. Jane Buikstra
2001-2002	University of New Mexico/ Center for American Archeology	Teaching Assistant and Osteology Lab Director, University Field School-Bioarchaeology

Guest Lectures and Roundtables

2014	Archaeo-Nevada	Lecture: "Performative Violence at Sacred Ridge." *Invited Lecture*
2013	Boston University, Forensic Anthropology Program	Lecture: "Sacred Ridge: Performative Violence in the Prehistoric Southwest." *Invited Lecture*
2013	University of Nevada, Las Vegas	Lecture: "The Role of Performance in Massacre: Who tells the story" *Anthropology of Violence, Summer*
2013	University of Nevada, Las Vegas	Lecture: "Functional Anatomy of the hand and Foot" *Osteology, Fall*
2013	Cyprus American Archaeological Research Center	Roundtable: "Commingled Remains on Cyprus: Possibilities and Analytical Challenges"
2012	University of Nevada, Las Vegas	Lecture: "Sacred Ridge: Methodology and Social meaning of massacre" *Osteology, Summer*
2011	University of Nevada, Las Vegas	Lecture: "Violence in the Prehistoric Southwest" *Southwestern Archaeology, Spring*

Mentoring and Supervisory Positions

2013	Archaeotek-Canada	Supervision and mentoring of 20+ undergraduates during intensive Bioarchaeology workshop including excavations and skeletal analysis.
2013 (spring semester)	University of Nevada, Las Vegas	Supervision of 5 Undergraduate Independent Studies involving bioarchaeological research into the Tell Abraq assemblage.
2012 (summer)	University of Nevada, Las Vegas	Mentoring 20 Undergraduates in their osteological studies as part of instruction of Osteology

2012 (spring and fall semesters)	University of Nevada, Las Vegas	Supervision of 2 Undergraduate Independent Studies involving bioarchaeological research into the Tell Abraq assemblage.
2011 (summer)	University of Nevada, Las Vegas	Mentoring 20 Undergraduates in their osteological studies as part of instruction of Osteology
2011 (spring and fall semesters)	University of Nevada, Las Vegas	Supervision of 2 Undergraduate Independent Studies involving bioarchaeological research into the Tell Abraq assemblage.
2010	University of Nevada, Las Vegas	Mentoring 20 Undergraduates in their osteological studies as part of instruction of Osteology
2009	SWCA Environmental Consultants	Lead bioarchaeologists for the Guam office of SWCA supervising 2 technicians in the running of a lab dedicated to both human and archaeological materials.
2006-2009	SWCA Environmental Consultants	Bioarchaeologist for the Durango office of SWCA supervising and developing research design for the Animas-La Plata project, a large commingled assemblage.
2005	SWCA Environmental Consultants	Site Supervisor, Entrega Pipeline Project. Supervised excavation and survey at multiple sites in Wyoming.
2005	SWCA Environmental Consultants	Lead bioarchaeologist for the Albuquerque office supervising 2-3 technicians in the running of a lab concerning the analysis of human remains from numerous archaeological sites. Duties included excavation and analysis of remains, report writing.
2001-2002 (summers)	University of New Mexico/Center for American Archaeology	Lab director and Osteology Teaching Assistant. Assisted in undergraduate coursework and research project and acted as lab director for both osteology and archaeology labs.

Research and Projects

2014	**Petra North Ridge Project**, Jordan. Analysis of commingled burials from multiple tombs dating to the first century, A.D.
2013	**Telekfalva,** Romania. Analysis of large assemblage of neonates from a late Medieval church in Transylvania.
2011-Present	**Early-Late Bronze Age Sites,** Cyprus. Examination of human remains from Sotira-*Kaminouhdia*, Episkopi-*Phaneromeni*, Hala Sultan Tekke, Kalavasos Village Tombs, Kalavasos-*Ayios Dhimitrios*, Kalavasos-*Ayious*, and Kalavasos-*Mangia* for dissertation work regarding the embodiment of social change
2011-Present	**Grasshopper Pueblo**, Arizona. Current projects include examination of antemortem trauma and paleopathology.
2010-Present	**Tell Abraq**, United Arab Emirates. Bronze Age ossuary. Current projects include tabulation of Minimum Number of Individuals present, mortuary patterns and behavior, analysis of patellar trauma, hypercementosis, and cranial depression fractures.
2006-Present	**Sacred Ridge site**, Durango, CO. Pueblo I period habitation site. Projects center on interpretation of commingled human remains from pit structure.
2005-2008	**San Felippe de Neri Church**, Albuquerque, NM. Excavations and analysis of historic cemetery population from the oldest colonial church in Albuquerque.
2003	**El Palmillo Project**, Valle de Oaxaca, Mexico. Excavations and analysis of Zapotec human remains.
1999-2002	**University Field School**, Kampsville, IL. Analysis of human remains from numerous Middle and Late Woodland sites in the Central Illinois River Valley.
1998	**Valley of Peace Archaeological Project**, Belize. Excavation and survey of Classic Period Maya mounds, underwater survey.
1997	**Jackrabbit Pueblo Field School**, Winslow, AZ. Excavation of Ancestral Puebloan pueblo.

Awards and Grants

2014	*University of Nevada, Las Vegas.* College of Liberal Arts, Dean's Stipend ($3000)
2014	*University of Nevada, Las Vegas*. Patricia Sastaunik Scholarship ($2500)
2014	*University of Nevada, Las Vegas.* Graduate and Professional Student Grant for Spring 2014 ($350)
2013	*University of Nevada, Las Vegas.* UNLV Foundation President's Graduate Research Fellowship ($25,000)
2013	*University of Nevada, Las Vegas.* Graduate and Professional Student Grant for Fall 2013 ($950)
2013	*University of Nevada, Las Vegas.* College of Liberal Arts Dean's Graduate Student Stipend ($2000-declined)
2013	*Cyprus American Archaeological Research Institute*. Anita Cecil O'Donovan Fellowship ($1000)

2012 *University of Nevada, Las Vegas*. Graduate and Professional Student Grant for Spring 2013 ($450)

2012 *University of Nevada, Las Vegas.* Patricia Rocchio Scholarship *($500)*

2012 *University of Nevada, Las Vegas.* International Programs Research Grant ($1000–declined due to death in the family)

2012 *University of Nevada, Las Vegas*. Graduate and Professional Student Grant for Summer 2012 ($850–declined due to death in the family)

2012 *University of Nevada, Las Vegas*. Graduate and Professional Student Grant for Spring 2012 ($450)

2011 *University of Nevada, Las Vegas*. Patricia Rocchio Scholarship ($2100)

2011 *University of Nevada, Las Vegas*. Graduate and Professional Student Association Grant for Summer 2011 ($635)

2011 *Arizona Archaeological and Historical Society/Kiva*. Winner of the Julian Hayden student paper competition for a paper titled "Hobbling and Torture as Performative Violence: An Example from the Prehistoric Southwest." (Publication and $750 prize)

2011 *University of Nevada, Las Vegas*. International Programs Graduate Research Grant ($600)

2011 *University of Nevada, Las Vegas*. Graduate and Professional Student Association Grant for Spring 2011 ($550)

2003 *Field Museum, Chicago*. CCC Internship

Conference Participation

2014 "Pathologies by the Bone: Making Meaning from Commingled Remains at Tell Abraq, UAE (2200-2000 BC)." A.J. Osterholtz and D.L. Martin. Paper Presented accepted for presentation at the 2014 American Schools of Oriental Research Meeting, San Diego, CA.

2014 "Cranial Depression Fractures as Indicators of Interpersonal Violence in Bronze Age Cyprus." Poster accepted for presentation at the 2014 Western Bioarchaeology Group Conference, Las Vegas, NV.

2014 Society for American Archaeology. Session organizer and chair. "Theoretical Approaches to Analysis and Interpretation of Commingled Human Remains." Podium session at the 79th Annual meeting of the Society for American Archaeology, Austin, TX.

2014 Patterned Processing as Performative Violence at Sacred Ridge." Paper presented at the 79th Annual meeting of the Society for American Archaeology, Austin, TX.

2014 "The Tomb at Tell Abraq (2200-2000 BC): Demographic Structure and Mortuary Complexity". D.L. Martin, A.J. Osterholtz, K. Baustian, and D. Potts. Paper presented at the 79th Annual meeting of the Society for American Archaeology, Austin, TX.

2014 "Of infants and elderly: a bioarchaeological analysis of a 17th century mortuary context from Transylvania, Romania" J. Bethard, A.J. Osterholtz, A. Gonciar, and Z. Nyaradi. Paper presented at the 79th Annual Meeting of the Society for American Archaeology, Austin, TX.

2014 “Possible Prenatal and Perinatal Scurvy at Telekfalva, Romania.” A.J. Osterholtz, J.Bethard, A. Gonciar, Z. Nyaradi. Poster presented at the 2014 Annual Meeting of the American Association of Physical Anthropologists.

2014 “Of infants and elderly: a bioarchaeological analysis of a 17th century mortuary context from Transylvania, Romania” J. Bethard, A.J. Osterholtz, A. Gonciar, and Z. Nyaradi. Poster presented at the 2014 Annual Meeting of the American Association of Physical Anthropologists.

2013 "Mortuary Patterns in the Tell Abraq Tomb Assemblage, UAE (2200-2000 BCE)."A.J. Osterholtz, K. Baustian, D. Martin, and D. Potts. Paper presented at the at the 2013 Annual Meeting of the American Schools of Oriental Research, Baltimore, MD.

2013 Society for American Archaeology. Session co-organizer (with Kathryn Baustian and Aaron Woods). “Negotiating Identities: Defining and Compartmentalizing the Self and Group in Multi-Cultural Settings.” Honolulu, Hawaii.

2013 “Warrior, Soldier, Big Man: Warrior Ethos, Identity Formation and the Negotiation of Social Roles in Multicultural Settings.” A.J. Osterholtz and R.P. Harrod. Paper presented at the 78th Annual meeting of the Society for American Archaeology, Honolulu, HI.

2013 American Association of Physical Anthropologists. Session co-organizer (with Sherry Fox and Megan Perry) of poster session titled “Current Bioarchaeological Research in the Near East and Circum-Mediterranean.” Knoxville, TN.

2013 “A Feature-based Method for the Determination of the Minimum Number of Individual from the Tell Abraq Tomb, UAE.” A.J. Osterholtz, D.L. Martin. Poster presented at the 2013 Annual Meeting of the 2013 meetings of the American Association of Physical Anthropologists, Knoxville, TN.

2013 “Cranial Depression Fractures of the Frontal Bones from a Bronze Age Arabian Commingled Tomb.” R. P. Harrod, A.J. Osterholtz, and D.M. Martin. Poster presented at the 2013 Annual Meeting of the 2013 meetings of the American Association of Physical Anthropologists, Knoxville, TN.

2012 “Tell Abraq: New Research on the Skeletal Remains.” A. Osterholtz and D. Martin. Poster presented at the 2012 Annual Meeting of the American Schools of Oriental Research, Chicago IL.

2012 Society for American Archaeology. Session co-organizer (with Kathryn Baustian and Debra Martin) and co-chair (with Kathryn Baustian and Debra Martin). “Commingled and Disarticulated Human Remains: Working Towards Improved Theory, Method, and Data.”

2012 “Determining the Minimum Number of Individuals (MNI) for Tell Abraq, UAE.” A. Osterholtz, K. Baustian, and Debra Martin. Paper presented at the 77th Annual meeting of the Society for American Archaeology, Memphis, TN.

2012 “Interpreting Sacred Ridge: Behavioral Taphonomy, Quantitative Taphonomy and Regional Context.” A.L. Stodder and A. Osterholtz. Paper presented at the 77th Annual meeting of the Society for American Archaeology, Memphis, TN.

2012 “Injury Recidivism, Trauma, and Pathology in the Multi-Ethnic Community of Grasshopper Pueblo (AD 1275-1400).” K. Baustian, D. Martin, R. Harrod, and A. Osterholtz. Poster presented at the 2012 meetings of the American Association of Physical Anthropologists, Portland, OR.

2012 Society for Cross-cultural Research. Session co-organizer (with John Crandall) and co-chair (with John Crandall). "Cross-Cultural Approaches to Violence, Social Control and Health in Pre-State Societies."

2012 "Hobbling and Torture at Sacred Ridge, Colorado: A View of Performative Violence from the Prehistoric Southwest", paper presented at the 2012 Meeting of the Society for Cross-cultural Research, Las Vegas, NV.

2011 "Hobbling and Torment as Performative Violence: An Example from the Prehistoric Southwest." A. Osterholtz. Paper presented at the National Meeting of the American Anthropological Association, Montreal, Quebec, Canada November 16-20, 2011.

2011 "Battered and Abused: Analysis of Increased Violence at a Large, Multi-Ethnic Mogollon Site." K.M. Baustian, R.P. Harrod, A.J. Osterholtz, and D.L. Martin. Paper presented at the National Meeting of the American Anthropological Association, Montreal, Quebec, Canada November 16-20, 2011.

2011 Society for American Archaeology. Session co-organizer (with Ryan Harrod and Debra Martin) and co-chair (with Ryan Harrod). "The Dead Don't Bury Themselves: Taphonomy as a Tool to Understand Sex and Violence in the Past."

2011 "Personal Taphonomy at Sacred Ridge: Burial 196" A. Osterholtz and A.L. Stodder, poster presented at the 76th Annual Meeting of the Society of American Archaeologists, Sacramento, CA.

2011 "Differential Diagnosis of Patellar Pathology: Use-Wear Patterns and Pathology from Tell Abraq (2200-2000 BC)." A. Osterholtz, R. Harrod, and D. Martin. Poster presented at the 80th Annual Meeting of the American Association of Physical Anthropologists, Minneapolis, MN.

2010 "Sacred Ridge: The Bioarchaeology of Genocide." A.L. Stodder, A. Osterholtz, and K. Mowrer. Paper presented at the 79th Annual Meeting of the American Association of Physical Anthropologists, Albuquerque, NM.

2010 "Conjoining a Neighborhood: The Taphonomy of Processed Human Remains from Sacred Ridge." A. Osterholtz and A.L. Stodder. Poster presented at the 79th Annual Meeting of the American Association of Physical Anthropologists, Albuquerque, NM.

2010 "Social and Physical Control of Massacre Victims: Hobbling at Sacred Ridge." A. Osterholtz. Poster presented at the 37th Annual Meeting of the Paleopathology Association, Albuquerque, NM.

2008 "The Long and the Short of It: A Case of Diminutive Stature in Prehistoric Ridges Basin." A. Osterholtz. Poster presented at the 77th Annual Meeting of the American Association of Physical Anthropologists, Columbus, OH.

2007 "Bioarchaeological Investigations at the Church of San Felipe de Neri, Albuqueruqe, New Mexico." A. Osterholtz. Poster presented at the 76th Annual Meeting of the American Association of Physical Anthropologists, Philadelphia, PA.

2005 “Analysis of Skeletal Remains Found at LA 457 near Alamogordo, May-August of 2005.” A. Osterholtz. Paper Presented at the 14th Biennial Jornada Mogollon Conference, El Paso, TX.

2001 “Achondroplasia in the Middle Woodland Period, Elizabeth Site, IL.” A. Osterholtz, S. Burgess, J.E. Buikstra. Poster Presented at the 70th Annual Meeting of the American Association of Physical Anthropologists, Kansas City, MO.

Publications

2014 Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin (eds.) *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data*. Springer.

2014 Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin. “Introduction.” In Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin (eds.) *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data*. Springer.

2014 Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin. “Commingled Human Skeletal Assemblages: Integrative Techniques in Determination of the MNI/MNE.” In Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin (eds.) *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data*. Springer.

2014 Anna J. Osterholtz. “Extreme Processing at Mancos and Sacred Ridge: The Value of Comparative Studies.” In Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin (eds.) *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data*. Springer.

2014 Kathryn M. Baustian, Anna J. Osterholtz, and Della Collins Cook. “Taking Analyses of Commingled Remains into the Future: Challenges and Prospects.” In Anna J. Osterholtz, Kathryn M. Baustian, and Debra Martin (eds.) *Commingled and Disarticulated Human Remains: Working Toward Improved Theory, Method, and Data*. Springer.

2013 Anna J. Osterholtz “Hobbling and Torture as Performative Violence: An Example from the Prehistoric Southwest.” *Kiva*. 78(2): 123-144.

2012 Anna J. Osterholtz “The Social Role of Hobbling and Torture: Violence in the Prehistoric Southwest.” International Journal of Paleopathology 2(2-3): 148-155.

2012 Kathryn M. Baustian, Ryan P. Harrod, Anna J. Osterholtz, and Debra L. Martin “Battered and Abused: Analysis of Trauma at Grasshopper Pueblo (AD 1275-1400).” International Journal of Paleopathology 2(2-3): 102-111.

2012 Debra Martin and Anna Osterholtz. “A Bioarchaeology of Captivity, Slavery, Bondage, and Torture.” *The SAA Archaeological Record* 12(3): 32-34.

2012 Anna Osterholtz. “Review of *Living with the Dead: Mortuary Ritual in Mesoamerica* by James L. Fitzsimmons and Izumi Shimada (eds.).” *Ethnoarchaeology* 4(1): 105-107.

2012 Anna Osterholtz and Ann L.W. Stodder. “Personal Taphonomy at Sacred Ridge: Burial 196.” *Landscapes of Violence* 2(2): Article 9.

2005 Anna Osterholtz. “Analysis of Skeletal Remains Found at LA 457 near Alamogordo, May-August of 2005.” In J. Jurgena, L. Jackson, and M. Thompson (eds) *Viva la Jornada*, Papers from the 14th Biennial Jornada

Mogollon Conference. El Paso: El Paso Museum of Archaeology, pp. 15-22.

Selected CRM Experience-SWCA Environmental Consultants

2009	Okura Hotel Mitigation, Hagatna, Guam. Role: Bioarchaeologist
2006-2009	Animas-La Plata Cultural Resources Mitigation, Durango, CO. Role: Bioarchaeologist
2006	Miller Mesa Osteological Project, Task 2, La Plata County, CO. Role: Bioarchaeologist
2006	Legacy Parkway Project Quality Assurance, Davis County, UT. Role: Bioarchaeologist
2005	Alamogordo Water Line Cultural Resource Services, Otero County, NM. Role: Bioarchaeologist
2005	San Felipe de Neri Archaeological Mitigation, Albuquerque, NM. Role: Bioarchaeologist

Technical Reports

2010	"Skeletal Pathologies and Anomalies" A.L.W. Stodder, K. Mowrer, A.J. Osterholtz, E. Salisbury. 2010. In E. Perry, A.Stodder, C. Bollong (eds.) *Animas-La Plata Project*. Vo. XV-Bioarchaeology. SWCA Anthropological Research Paper Number 10, pp. 89-155.
2010	"Analysis of the Processed Human Remains from the Sacred Ridge Site: Methods and Data Collection Protocol." A.L.W. Stodder and A.J. Osterholtz. 2010. In E. Perry, A.Stodder, C. Bollong (eds.) *Animas-La Plata Project*. Vo. XV-Bioarchaeology. SWCA Anthropological Research Paper Number 10, pp. 243-278.
2010	"Processed Human Remains from the Sacred Ridge Site: Context, Taphonomy, Interpretation." A.L.W. Stodder, A.J. Osterholtz, K. Mowrer, J.P. Chuipka. 2010 In E. Perry, A. Stodder, C. Bollong (eds.) *Animas-La Plata Project*. Vo. XV-Bioarchaeology. SWCA Anthropological Research Paper Number 10, pp. 279-416.
2008	"Human Remains" in C. Carlson, *Data Recovery at LA 457 for the La Luz Filtration Plant to Green Reservoir Waterline, Otero County, New Mexico*. SWCA Report No. 2008-580/SWCA Project No. 8673/NMCRIS No. 94965. SWCA Environmental Consultants, Albuquerque, New Mexico.
2007	"Final Report on the Results of Data Recovery at La 119407 for the Evans Gravel Pit near Carlsbad, Eddy County, New Mexico." A. Osterholtz and C. Carlson. SWCA Report No. 2006-40/ SWCA Project No. 10574/NMCRIS No. 97205. SWCA Environmental Consultants, Albuquerque, New Mexico.
2006	"Excavation of LA 121047, an Early Twentieth Century Gravesite near Oscura, Lincoln County, New Mexico." A. Osterholtz SWCA Report No. 2005-575/SWCA Project No. 7571-0008/NMCRIS No. 96609. SWCA Environmental Consultants, Albuquerque, New Mexico.

2006 "Monitoring and Excavations for a Proposed Remodeling of the Sister Blandina Convento Courtyard, San Felipe de Neri Church (LA 8872), Bernalillo County, New Mexico." A. Osterholtz, J. Railey, and J. Ballagh. SWCA Report No. 2005-594/SWCA Project No. 9266-175/NMCRIS No. 96848. SWCA Environmental Consultants, Albuquerque, New Mexico.

2005 "A 107-Acre Cultural Resources Survey for a Proposed Realignment and County Road Expansion Along Portions of NM 128, NM 31, and Adjoining Road Segments in Eddy County, New Mexico." P. Pflepsen and A. Osterholtz. SWCA Report No. 2005-375/SWCA Project No. 7571-0009/NMCRIS No. 93644. SWCA Environmental Consultants, Albuquerque, New Mexico.

2001 "Report of Investigation: OMI Cases Nos. 5160-1101-AZ and 5161-1101-AZ." T. Petersen, J. King, and A. Osterholtz. Osteology Laboratory, Maxwell Museum of Anthropology, University of New Mexico. Report submitted to the Office of the Medical Investigator.

Professional Affiliations

American Anthropological Association
American Association of Physical Anthropologists
Society for American Archaeology
Paleopathology Association
Cyprus American Archaeological Research Institute
American Schools of Oriental Research
Register of Professional Archaeologists